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A Glimpse: Comparison of Fog Computing and Cloud Computing

Mr. Rakesh Kumar PGT (IT)
Kasauli International Public School
Sanwara, Distt. Solan
Himachal Pradesh-173209

Abstract **- The term fog computing was coined by Cisco in 2014, so it is new platform and environment for the public. Nowadays, Fog and cloud computing are interconnected. Fog computing is also known as fogging. In nature, fog is closer to the earth than clouds; in the era of technology, it is just the similar, fog is closer to end-users, bringing cloud capabilities down to the ground. Fog Computing is an extension of cloud computing which is used broadly. This paper is generally consists of comparison of fog computing and cloud computing.**

Keywords **—**Edge computing, Edge networking, Cloud Computing and IoT.

I. INTRODUCTION

The "pay-as-you-go" Cloud Computing model is an efficient alternative to owning and managing private data centers (DCs) for customers facing Web applications and batch processing. Several factors contribute to the economy of scale of mega DCs:higher predictability of massive aggregation, which allows higher utilization with-out degrading performance; convenient location that takes advantage of inexpensive power; and lower OPEX achieved through the deployment of homogeneous compute, storage, and networking components[2].I have already got used to the technical term cloud, which is a network of multiple devices, computers and servers connected to each other over the Internet.

Such a computing system can be divided into two parts:

- **The frontend** — It consists of client devices (computers, tablets, mobile phones).
- **The backend** — It consists of data storage and processing systems (servers) that can be located far away from the client devices and make up the cloud itself.

These two layers communicate with each other directly by means of wireless connections. Cloud computing technology provides various types of services that are categorized into three groups:

1. **IaaS (Infrastructure as a Service)** — It provides remote data centre (collection of server) with resources
   such as data storage capacity, processing power and networking.
2. **PaaS (Platform as a Service) —** It provides a development platform with tools and components for creating, testing and launching applications.
3. **SaaS (Software as a Service) —**It provides ready-made software tailored to a variety of business needs.

Fig. 1 Structure of cloud computing.

Connecting your company to the cloud, you get access to the above-mentioned services from any location and via different devices. Hence, availability is the greatest advantage. Moreover, there is no need to maintain local servers and worry about downtimes — the vendor supports everything for you, saving you money. The integration of the Internet of Things with the cloud is a cost-effective way to do business. Off-premise services provide the necessary scalability and flexibility to manage and analyze data gathered by connected devices, while specialized platforms (e.g. Azure IoT Suite, IBM Watson, AWS and Google Cloud IoT) give developers the power to create IoT apps without big investments into hardware and software.

Advantages of Cloud for IoT

Since connected devices have limited storage capacity and processing power, the integration with cloud computing comes to assistance:

- Improved performance (the communication between IoT sensors and data processing systems is faster).
- Storage capacities (highly scalable and unlimited storage space are able to integrate, aggregate and share the enormous amount of data).
- Processing capabilities (remote data centres provide unlimited virtual processing capabilities on-demand).
- Reduced costs (license fees are lower than the cost of the on-premise equipment and its continuous maintenance).

Disadvantages of Cloud for IoT

Unfortunately, there is nothing immaculate, and cloud technology has some downsides, especially for the Internet of Things services.

- High latency (more and more IoT apps require very low latency, but cloud can't guarantee it because of the distance between client devices and data processing centres).
- Downtime (technical issues and interruptions in networks may occur for any reason in any Internet-based system and make customers suffer from an outage; many companies use multiple connection channels with automated failover to avoid problems).
- Security and privacy (your private data is transferred through globally connected channels alongside thousands of gigabytes of other users' information; no surprise that the system is vulnerable to cyber attacks or data loss; the problem can be partially solved with the help of hybrid or private clouds).

II. FOG COMPUTING

Fog computing is a distributed computing paradigm that acts as an intermediate layer in between Cloud datacenters and IoT devices/sensors[1].The fog is the extension of cloud computing that consists of multiple edge nodes directly connected to physical devices.

Such nodes are physically much closer to devices if compared to centralized data centers, which is why they are able to provide instant connections. The considerable processing power of edge nodes allows them to perform the computation of a great amount of data on their own, without sending it to distant servers. Fog can also include cloudlets — small-scale and rather powerful data centers located at the edge of the network. Their purpose is to support resource-intensive IoT apps that require low latency. The main difference between fog computing and cloud computing is that cloud is a centralized system, while the fog is a distributed decentralized infrastructure. Fog computing is a mediator between hardware and remote servers. It regulates which information should be sent to the server and which can be processed locally. In this way, fog is an intelligent gateway that offloads clouds enabling more efficient data storage, processing and analysis. One should note that fog networking is not a separate architecture and it doesn't replace cloud computing but rather complements it, getting as close to the source of information as possible. The new technology is likely to have the greatest impact on the development of IoT, embedded Artificial Intelligence and 5G solutions, as they, like never before, demand agility and seamless connections. Fog-as-a-Service (FaaS) will enable new business models to deliver services to customers. Unlike the clouds that are mostly operated by large companies who can afford to build and operate huge data centers, FaaS will enable companies, big and small, to deploy and operate private or public computing, storage, and control services at different scales to meet the needs of a wide variety of customers[3].

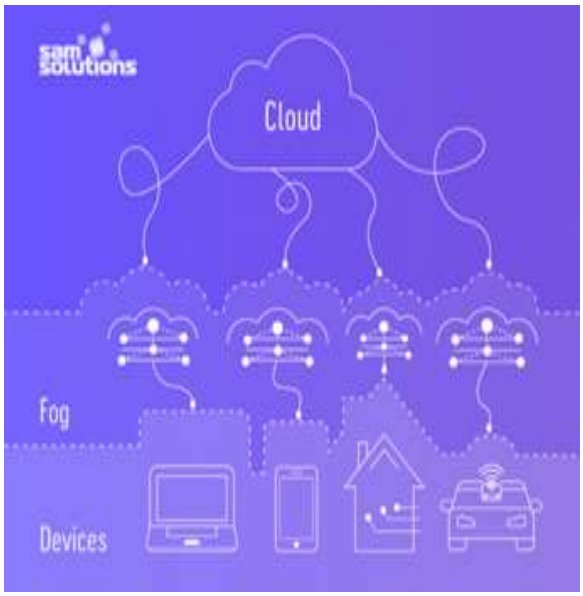

Fig. 2 Fog computing structure.

Advantages of Fog Computing

- The fogging approach has many benefits for the Internet of Things, Big Data and real-time analytics. Here are the main advantages of fog computing over cloud computing:
- Low latency (fog is geographically closer to users and is able to provide instant responses).
- No problems with bandwidth (pieces of information are aggregated at different points instead of sending them together to one centres via one channel).
- Loss of connection is impossible (due to multiple interconnected channels).
- High security (because data is processed by a huge number of nodes in a complex distributed system)

- Improved user experience (instant responses and no downtimes satisfy users).
- Power-efficiency (edge nodes run power-efficient protocols such as Bluetooth, Zig bee or Z-Wave).

Disadvantages of Fog Computing

- The technology doesn't have any apparent disadvantages, but some shortcomings can be named:
- A more complicated system (fog is an additional layer in the data processing and storage system)
- Additional expenses (companies should buy edge devices: routers, hubs, gateways)
- Limited scalability (fog is not as scalable as cloud)

Fog Computing vs. Cloud Computing:

Clouds vs. fog technology are very similar to each other. But still, there is a difference between cloud and fog computing on some parameters. Here is a point-by-point comparison of fog computing and cloud computing:

- Cloud architecture is centralized and consists of large data canters that can be located around the globe, a thousand miles away from client devices. Fog architecture is distributed and consists of millions of small nodes located as close to client devices as possible.
- Fog acts as a mediator between data centres and hardware, and hence it is closer to end-users. If there is no fog layer, the cloud communicates with devices directly, which is time-consuming.
- In cloud computing, data processing takes place in remote data canters. Fog processing and storage are done on the edge of the network close to the source of information, which is crucial for real-time control.
- Cloud is more powerful than fog regarding computing capabilities and storage capacity.
- The cloud consists of a few large server nodes. Fog includes millions of small nodes.
- Fog performs short-term edge analysis due to instant responsiveness, while the cloud aims for long-term deep analysis due to slower responsiveness.
- Fog provides low latency; cloud — high latency.
- A cloud system collapses without an Internet connection. Fog computing uses various protocols and standards, so the risk of failure is much lower.
- Fog is a more secure system than the cloud due to its distributed architecture.

The table following assist better understand the difference between fog and cloud, summarizing their most important features.

Table 1 Cloud and Fog Computing: a Comparison Chart.

	Cloud	**Fog+**
Architecture	Centralized system	Distributed system
Communication with devices	From a distance	Directly from the edge
Data processing	Far from the source of information	Close to the source of information
Computing capabilities	Higher	Lower
Number of nodes	Few	Very large
Analysis	Long-term	Short-term
Latency	High	Low
Connectivity	Internet	Various protocols and standards
Security	Lower	Higher

III. CONCLUSION

In the era of IT, the requirements of the emerging technologies are the driving force behind IT evolution. The Internet of Things is a constantly enhancing industry that requires more efficient ways to manage data transmission and processing. One of the approaches that can satisfy the demands of an ever-increasing number of connected devices is fog computing. It utilizes the local host rather than remote host resources, making performance more efficient, powerful and reducing bandwidth issues.

REFERENCES

[1]. Fog Computing: A Taxonomy, Survey and Future Directions Redowan Mahmud, RamamohanaraoKotagiri and RajkumarBuyya
[2]. Flavio Bonomi, Rodolfo Milito, Preethi Natarajan and Jiang Zhu., Fog Computing: A Platform for Internetof Things and Analytics.
[3]. Fog and IoT: An Overview ofResearch OpportunitiesMung Chiang,Fellow, IEEE, and Tao Zhang,Fellow, IEEE.
[4]. https://www.sam-solutions.com/blog/fog-computing-vs-cloud-computing-for-iot-projects/