Edge Applications In Cloud

Shaik Jafer Ali
School of Computer Science And Engineering
The Research And Development Cell
Phagwara,India.
skjaferali8@gmail.com

- ***Abstract:*** Edge Applications in Cloud it refers to services that are deployed closer to the customers or End-users instead of using centralized server, Using Edge Greengrass Core, Device Shadow to make secured connections to get control over the resources and operations in offline and make use of Sensors for Real world communication. It also uses Band-Width Efficiency, Scalability for avoiding the data loss and making scalable for more users. It also takes the Security measures like Attenuation, Authorization, End-End Encryption to make the server and the data safe. It also contains Database in it to store the information and for backing up data in case of any failure. It operates on Distributed Processing to make server independent. It also balances the issues like Low Latency, Load Balancing, Fault Tolerance to avoid failures in the process of communication.

Keywords: Greengrass Core, Device Shadow, Scalability, Band-Width Efficiency, Security, Cloud Computing, De Centralized cloud computing, Latency, Load Balancing, Fault Tolerance

- ***Introduction***:

With the development of intelligent society and the continuous improvement of people's needs, intelligence has involved various industries and people's daily lives in society. Edge devices have spread to all aspects of society, such as smart homes and autonomous vehicles in the field of transportation, camera, intelligent production robot in intelligent manufacturing, etc. As a result, the number of devices connected to the Internet has increased significantly. Cisco pointed out in the Global Cloud Index [1].

Global IoT spending has hit $1.2 trillion in 2022, reports IDC. According to Cisco, 500 billion devices are expected to be connected to the internet by 2030.), 45% of the data will be stored, processed and analysed on the edge of the network, and by 2030, the number of wireless devices connected to the network will exceed 50 billion. The amount of data generated by devices worldwide has also increased from 218ZB in 2016 to 847 ZB in 2021. International data company Internet Data Center (IDC) statistics show that by 2020, the number of terminals and devices connected to the network will exceed 50 billion, and the total global data in 2020 will also exceed 40 ZB [2].

In this new environment, there is a need to manage, process and store the huge amount of data generated at the network edges. Cloud computing frees the enterprise and the end users from many details. As an effect, computational and network overhead at central cloud increases.

1. Edge Computing :

Edge computing directs computational data, applications, and services away from Cloud servers
to the edge of a network. The content providers and application developers can use the Edge

computing systems by offering the users services closer to them. Edge computing is characterized in terms of high bandwidth, ultra-low latency, and real-time access to the network information that can be used by several applications [6],[7].

The service provider can make available the radio access network (RAN) to the Edge users by opening access to new applications and services. Edge computing enables several new services for enterprises and consumers [7].

III. KEY TECHNOLOGIES OF EC-CC SYSTEM There are many technologies of EC-CC system functions to be applied to the smart grid. Most of these technologies are widely used and illustrated in distributed computing such as data collection and transmission technologies. Therefore, only essential technologies are discussed in this section, which is also the basis for the following section of application scenarios. A. Data Processing Technology in EC-CC System For the EC-CC system in the smart grid, the data processing not only determines the efficiency of daily operations but also seriously affects the user privacy. This section re- views the existing research on data fusion, storage, and security to reveal the core technologies of data processing.

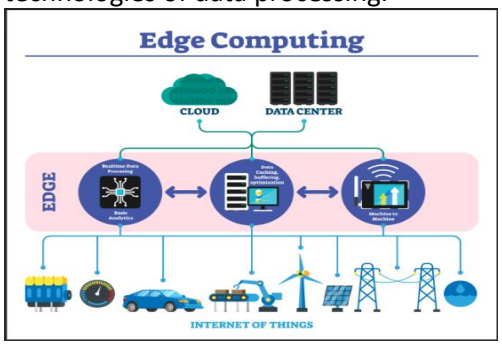


Figure (1)

Uses of Edge Computing

The use cases of Edge computing are location services, augmented reality, video analytics, and data caching. Thus, these new Edge computing standards and deploy- ment of Edge platforms become key enablers for new revenue streams to vendors, third-parties, and operators. which made the processing and storage far from user devices possible by leveraging high bandwidth and reasonably low latency connection to infrastructure. This had resulted in high capabilities of processing power and storage possibilities.

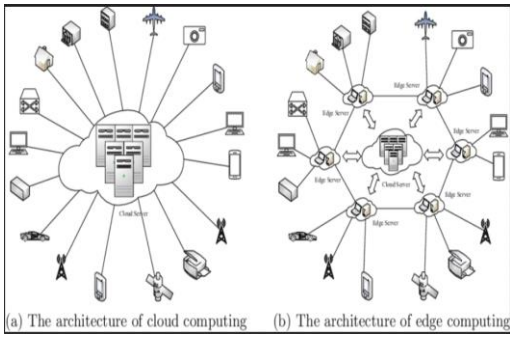
2. Cloud Computing :

The idea behind cloud computing is to separate the application, operating system, and hardware from each other. That means everything is virtual. When one underlying hardware component or cloud infrastructure fails, it does not matter because the infrastructure is separated from platform and that last is separated from software. Thus, the basic development models of cloud computing are the following [3],[4],[5],[6]:

Cloud Computing Service Models

- Software as a Service (SaaS); google docs, Gmail, office 365 features are all software applications resides in cloud presented to us as a service. In other words, if we want just a software to use it then we choose SaaS development model.
- Platform as a Service (PaaS); almost adapted to programmers to write and run their codes in the cloud. Microsoft Azure is a platform as a service model that make use of cloud services along with codes that we wrote to develop web-based applications. In other words, if we have software but need a platform to deploy and run it then we choose PaaS development model.
- Infrastructure as a Service (IaaS); instead of having telephone systems in our buildings or user-configured security system on our own, we simply

buy this hardware as a service from providers and cut cost and time of provisioning and maintenance. In other words, if we have a software and platform and we need a hardware to run those then we use IaaS development model.



Cloud Computing represents a computing technology providing services of storage, sharing and processing of data through visualized and scalable resources over the networks [4].
[Bhandari, G. P. & Gupta]

With the advantage of flexibility, storage, sharing and easy accessibility, Cloud Computing has a big role in Data Analytics process with the accent on Big Data, namely Big Data Analytics (BDA), as it offers access-based

- *LR Survey :*

Industry 4.0 unites various new advanced technologies to discover a more efficient way for improving manufacturing processes in every aspect of management. With the implementation of new advanced technologies in manufacturing processes, the amount of data approximately increasing at a rate of 10 times every five years, which results in a large quantity of raw data [1]. [Saif, S. & Wazir]

Using the appropriate methods, algorithms and software tools, different types of data can be collected and extracted from different layers in the production environment, named Big Data [2].[Pan, J. & McElhannon]

Cloud Computing, as a mixture of centralized, distributed and parallel system, includes virtualized and organized computers that are dynamically supplied and set or a large number of existing computing resources creates a service at the level of the connected device.[3]
[Nabeel Khan & Adil Al-Yasiri]

computing infrastructure oriented to subscription, data, and application services [5].
[Naeem, M. M.; Mahar]

The Edge Computing, unlike Cloud Computing, represents the decentralized computing service for storage, processing and applications. It takes place on the network edge and acting as a middle layer between end user and cloud data centres. In that way introduces distance that data must travel on the network while producing minimal delays [6]. [Khan, S.; Parkinson]

The Edge Computing is prescribed as a method of optimizing the Cloud Computing by performing Data Analytics as close to the data sources as possible . Many researches find that Edge Computing is synonym for Fog Computing [7],[8]. [Shi, W.; Cao, J.; Zhang] [Hussain, F. & Al-Karki]

Edge Computing can be interchangeable with Fog Computing, with the minor

difference that Edge Computing is focused more toward the things side, while Fog Computing is focused more on the infrastructure side, while both of these technologies are the same regarding the Data Analytics perspective [8]. [Hussain, F. & Al-Karki]

Edge Computing offer myriad benefits to large enterprises that are bound to experience an influx of data in the coming years. One size doesn't fit all and similarly, one technology may not serve every enterprise's needs especially as we head towards a future where data will become the lifeblood of business [9]. [Bilal, K.; Khalid]

In the future, when more and more businesses realize the value of big data and the power of analytics, there will be an increased demand for data processing solutions [10].[Bhandari, G. P. & Gupta]

Edge applications handles Large enterprises can stay a step ahead of the competition by utilizing high-tech resources and technological capabilities offered in order to maintain big amount of data we require both edge computing and cloud computing to handle big data and improve scalability and performance [9],[10],[11].

[Bilal, K.; Khalid], [Bhandari, G. P. & Gupta], [Hu, P.; Dhelim, S.; Ning]

Edge computing can be combined with other technologies such as 5G to bring extremely powerful wireless connectivity with low latency and high cellular speed . Microsoft Azure provides a solution for intelligent cloud-to-edge computing that addresses IoT use cases [12].

[Beri, R. & Behal, V]

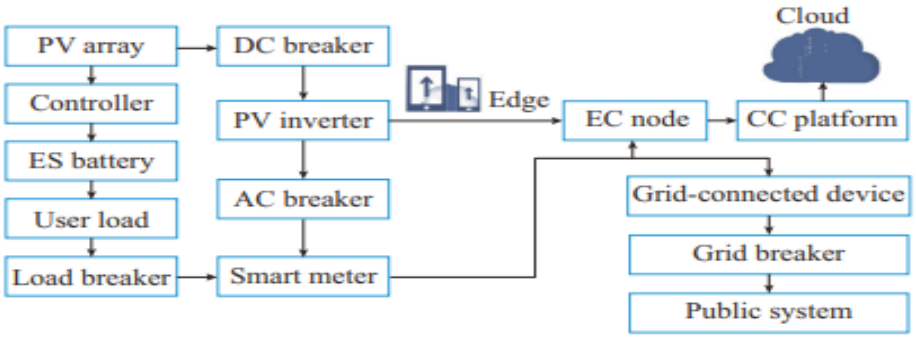


Figure 3 : How The Edge Computing Interact with the Cloud Computing

Table 1 : Comparison Between Edge Computing and Cloud Computing.

S no	factors	Edge Computing	Cloud computing
1)	Computing Architecture	Distributed	Centralized
2)	Server Mode Location	Data Centre	Edge Network
3)	Transmission Bandwidth Load	Low	High
4)	Energy Consumption	Low	High
5)	Data Processing	Fast	Slow
6)	Latency	Low	High
7)	User Experience	Strong	Weak
8)	Security	High	Low
9)	Reliability	Low	High
10)	Computing Resources	Limited	Unlimited
11)	Computing Costs	Low	High

Table 2 : Comparison Between Various Research Paper and Techniques.

Sno	Title and name of the Author	Algorithm Technique Used	Importance	Research Gap
1	Title : Analysis of Big Data and Cloud Computing Author: Saif, S. & Wazir	Stream processing algorithms	Used to analyse the data in real time application processing	5 Years
2	Title : Future edge cloud and edge computing Author: Pan, J. & McElhannon	Edge Machine Learning and AI	AI task is locally to reduce latency and bandwidth	4 Years
3	Title : Cloud Security and Threats Author: Nabeel Khan & Adil Al-Yasiri.	AES (Advanced Encryption Standard)	Provides Encryption for large data applications with various lengths	7 Years
4	Title : An Overview of Edge Computing/Cloud Computing Author: Bhandari, G. P. & Gupta, R.	Load Balancing algorithm	Manages load/traffic on multiple servers	5 Years
5	Title : Edge Computing vs Cloud Computing Author: Naeem, M. M.; Mahar, H.; Memon, F. & Siddique, M.	Edge to Edge Communication algorithm & Distributed computing and scaling algorithm	For efficient communication among devices and handling varying work-loads through horizontal and vertical scaling.	7 Years

6	Title : Big Data and Fog Computing. in the Internet of Things. Author: Hussain, F. & Al-Karki, A.	Edge and Fog computing algorithms	Designed to optimize the processing and storage of data network's edge in IOT devices.	7 Years

Conclusion :

Edge Applications are the Essential components in cloud computing in order to transfer or transmit the data it can handles various kinds of data. It helps in managing the data provides security with out the edge server we cannot be able to transfer the data which is of high cost . It works on distributed processing makes the server independent on the other servers this mainly helps in recovery of the data in this the data is transmitted fast. The resources are allocated and used accordingly on request basis of cloud computing .It provides higher the security.

Both Cloud Computing and Edge Computing offer various benefits to large enterprises that are bound to experience an influx of data in the coming years. Both computing technologies are important to process, organize, and store big data. One technology may not serve every needs especially as we head towards a future where data will become the heart for business. In the future, when more and more businesses realize the value of big data and the power of analytics, there will be an increased demand for data processing solutions.

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