Fundamental Perception of EDGE Computing

Khaja Mannanuddin¹, M.Ranjith Kumar², Srinivas Aluvala³, Y.Nagender⁴, S.Vishali⁵

¹,²,⁵Sumathi Reddy Institute of Technology for Women, Warangal, India.
³,⁴SR Engineering College; Warangal, India.

¹k_mannanuddin@sritw.org

Abstract. Edge computing is considered as a scattered computing process module where the end user data can be executed at the end corner or at the last node of the network which is indirectly represented as “Edge”. It creates an sensory impact where the end user data is executed very closely to the original data center Alex Reznik has defined edge computing as “anything that’s not a traditional data center” will be an edge to the client who is the end user. Edge computing is closely connected to equipments of IoT devices that are mostly operated by mobile user which helps in the reaching to the expected constraints based on the response time for the real world applications. Edge computing can be implemented on any hardware IoT equipment using any type of software tools. The major aim of Edge computing is to reduce the latency levels and perform the task from the nearest possible data source. Edge computing performs on instant data which is real time data processed by the sensors or end user clients whereas the cloud computing works on BIG DATA generated from different sources and locations. In this paper, We try to represent few basics of edge computing along with its pros and cons and how it is related to machine learning and IoT.

Keywords: Edge nodes, edge devices, latency, infrastructure, scalability, reliability.

1. Introduction:
Now, the Information Technology industry considers EDGE computing as the rapidly growing fourth wave of computing. It is mostly useful in executing the process at the bottom corner of cloud data center where the bottom is very close to the end user client. By 2020, there will be approximately about 20 billion IoT devices used by end client users for the real time applications. Mostly the IoT devices will process the data that helps in implementing few tasks of the social committee engineering such as health care, agriculture, and transportation and government functionaries. Due to excessive implementation, there is an assumption that 35 -45 ZettaByte data will be created and processed. And which might rise to 200 ZettaByte by the year 2026[1].

Edge computing basically provides solutions by extracting and processing the basic information at a point of workstation with very minimum capacity of data center. And later it is forwarded to the central cloud data center; this brings profits to the organization at different levels such as cost reduction, minimum time taken in cloud connection and also in analysis of instant data queries and most accurate and fastest response to end user client [2].

2. Different Waves of Computing:
2.1 First wave: Monolithic Systems
During the period of mainframes, there was a presence of very large size system which was acquired by a highly beneficial organization to produce/ create and maintain the information data for ease of work and future use [3]. All the information data was maintained and connected by means of physical data cables making a system interrelated in a form of network. Development of computing can into existence due to high pitch demand for accessibility of information data.

2.2 Second wave: Technology of web
During this period of time, the system was built up with larger scale of speed and storage capacity to process the required data within a short of time and to store the data of larger amount. During this wave of web technology, the data was controlled by a central system for maintenance and accuracy. The required data was requested from different position and location by the end user client. The major portion of the information data was stored centrally at remote location and it was accessed by the end user client by means of its domain name or an internet protocol address. The mode of data transfer between the data center and the end user client was implemented using hypertext modules. Even the data was back up at other location due to excessive security threats to the central data centres.

2.3 Third wave: Cloud computing
Earlier, the companies use to bourne the total expenses of procurement and maintenance of infrastructure and data center along with its accessible tools but now there is a new concept of saving and maintaining and executing of the information data at remote severs using wireless network hosted on the internet instead of using the local server. Such concept is called as cloud computing and the main services provided by cloud computing are infrastructure as a service, software as service, platform as a service and last but not the least pay as service. Cloud computing provides various services with a time constraint but the information data is stored remotely and the data is centralized.

2.4 Fourth wave: Edge computing
Since the cloud computing holds the data centrally at only one location, there is a lot of back, forth moment during the message operations which lead to rise in network bandwidth computation. Since all the devices doesn’t require cloud computing for each and every transaction/query, “EDGE COMPUTING” fits itself perfectly to overcome difficulties of the network bandwidth by providing information data execution at its nearest end corner reducing the back and forth operation of client and cloud in transactions[4] as shown in fig.4. It can help to balance network traffic, prolongs the life of IoT devices and ultimately decreases the “response times for real-time IoT applications.

Figure 1: Cloud and Edge computing

3. Rise of Edge computing:
“Within a span of time, the real time associated devices produces a huge amount of information data that need to process and executed in a very short minute time.” Usually every process is done at cloud
level but due to rise of The real time associated devices in large number. Cloud computing has shown some of the its inabilities to perform better due to the following constraints [5-7].

User device: The performance for the flow of data back and forth from the cloud to the real time device is based on the configuration of user device and its connectivity with the internet protocol.

Latency: there is a direct proportion between cloud and user device in other words, if the distance between cloud and user device is more, then the time taken for transmission of data also increase. So it is represented as latency increases as distance increase [8].

Surplus data: Since the complete data is stored at a central location, the cloud needs to process a huge amount of information data.

To overcome these inabilities of the cloud computing, A Concept was generated where a small portion of information data will be processed and executed. The points where the small portion is executed is considered as end corner points of cloud which are also called as “edge servers” which act as catalyst between the cloud and the end user. These end corner points are very nearer to the end user. Due to this computing concept, there is a bit of relaxation for the cloud and the end user in terms of response time, transmission of data which leads to better performance.

4. Basic Architecture of Edge Computing:
This is basically a small idea behind the architecture of an edge computing. This illusion diagram is based on the concept of latency and the computing capability of the system in a hierarchical order of increasing at the top and decreases to its minimal at the end corner points. The diagram is presented as different levels, as it shown in fig.2.

The topmost level is that of cloud where the complete data is stored in form of huge information without any limitation on storage. It is central part of data and app for storage and maintenance but the edge computing implements this level as long term storage system but not every intermediate processing.

The last level is the physical devices which least computing capability and very much limited resource availability. These devices are built is a single target based computation. The most common example for such end user level devices is traffic signal and atmosphere temperature measurement instrument.

There are two intermediate levels between the first and last levels of edge computing architecture.

The first intermediate level is considered as nodes which are located just in front of the last position in the hierarchical networks of cloud. They are also defined as lower stream nodes. The devices of such nodes have capability of performing high computation and create itself a path which generates a network mapping for transfer of information data. The best examples of edge node devices are base stations, small scale data centers, work stations and routers.

The second intermediate level is a point of accession or gateway. It doesn’t have higher unit of graphic presentation and its computing capability is bit smaller when compared to the edge nodes. It’s a level just above the end user level which includes smart phones, sensors in four wheelers and movement detectors.

4.1 The other major principles of the edge computing architecture are as follows:
4.1.1 Peer-peer communication is possible within the application of edge. The advantage is that there is partial decrease in the network traffic since the two edge nodes are transferring the data within themselves without the involvement of the cloud data center [9].

4.1.2 If the data is transferred between the edge nodes then there is no need of making a communication request with cloud data center which leads to skip the internet protocol for making a connection between cloud and nodes.

4.1.3 There is possibility of security threats in peer-peer data transfer between edge nodes hence it is mandatory for both nodes to acquire required permission before data transfer takes place.

4.1.4 The most important principle is that there is no limitations on devices to be connected to a single edge node located at various positions and internally connected to the cloud

![Edge computing architecture](image)

Figure 2: Edge computing architecture

5. Advantages of implementing the edge computing:

5.1 Enhance the performance intensity of an application:
To improve the performance of the application, the information data has to be present very close to the end user which results in highest response time without any delay in transmission of information data. For a given particular time slice, if the data transmission is very slow then it will be considered as irrelevant. Latency plays an important during the transmission of information data between the edge nodes and devices which help the enterprise to improve its performance on service based application.

5.2 Zero limitation on expansion in form of scalability:
Since the edge computing node is connected with the end user devices such as sensors and adhoc wireless networks, there's no limitation on the storage capacities of the devices. And more over, the edge computing devices process and executes time bound tasks. The data processing and data management tool are located at the edge node so it can implement the request initiated by the devices rather than delaying its response time in coordination of datacenter located at remotely.

5.3 Better alternative for the safety of information data.
Since the complete data is stored at a central remote location in cloud computing, with a single attack, there is a threat of complete data loss but in edge computing, the data is forwarded as per the requirement and request made by the device, so there is very less possibility of security threat as the information data stored and shared is a very small in size when compared to the original data present at central data center. If the data is distributed among different edge computing nodes, there is also
possibility of lesser security threats in distribution of information data. If the data transmitted is less, then the threat is also low. Edge computing helps in maintaining the sovereignty of information data with local compliance and privacy regulations [10].

5.4 Infrastructure overhead reduction:
[6] The redundancy cost can be minimized if the information data is stored at edge computing devices in form of cookies if there is a frequent request for the transmission of the same information data. Hence there will be no need of high storage required at the cloud data datacenter. Even though the data is not similar and the request/response of information data is not accurate, the edge computing nodes uses some significant data and some expandable data which is extracted from the cloud data center in one operation. Classification of the information data is done by edge computing based on the credentials given by the owner and management. Indirectly, edge computing reduces the bandwidth connectivity by storing the data at its edge node. Edge computing optimizes the flow of data in order to reduce the operational cost on cloud [11-14].

5.5 Efficiency and reliability in business
The edge computing nodes and devices are assembles as per the requirements to be operated in the feasible environment. This results in no data loss if there are interrupt in bandwidth and transmission of data through data center. The efficiency of business is achieved by means of low latency and minimum data storage at the cloud.

6. Few important concept of edge computing:
1. The edge computing devices on its own principles and speed, so there are no concerns with regard to the internet connections.

2. The reliability of the data center gets increases as the edge nodes and its devices save the information data for execution and maintenance.

3. Micro data center are assembled as per the requirement of devices to access the data center without any interruption during the transmission of information data.

4. The data storage capacity will be constrained to a limit at the edge computing nodes as the whole data is centralized at remotely located data center.

7. Few Drawbacks of edge computing:
Every computing technique has their own hassle during its development. With few years of Continuous research will be helpful in overcoming such hassle. Edge computing is also have few pit falls in its implementation. An overview of the drawbacks is discussed below:

7.1 Edge has longer outage time:
The time taken by the edge computing nodes to perform its basic functionality with regard to response time for execution of certain application or its unavailability for the updation of central data center.

7.2 Loss of data:
Edge computing nodes just access only those information data which is required by the edge devices which is considered as sub set of data. Due to this process, the central data center cannot track the flow of data and unable to trace the loss of information data.

7.3 Rise of malicious threats:
The edge computing devices process and implement the application through edge nodes irrespective of geographical limitation due to which there is a possibility of malicious attack on the central data center.
by masking themselves as edge devices and generating a reliable connection to the data center and retrieving the most sensitive data of the business which is located at central data center.

7.4 Edge doesn’t support tier III/IV security:
Edge computing should provide a very small basic infrastructure and maintenance procedure for updation of the information data present at cloud data center. The expected uptime levels of an edge computing device and its node should be approximately 99.85%.

7.5 Potential loss or corruption of data:
Edge computing nodes along with its devices should avoid errors and exception during writing reading, saving and transfer of data which leads to updation of original data

8. Future challenges:
In this new era of computing, every electronic equipment is IoT enabled and all the social communities are heading towards IoT solutions with more advancement in artificial intelligence. In such prevailing conditions, the applications and information data cannot be located at central data center with remote accessibility, hence edge computing is such needed at device level so that the data can be processed and maintained in very short span of time with real time results for execution of application. Secondly, the rise of 5G networks that provides huge bandwidth with built in application and interrelation between similar devices. Such devices are dependent upon edge computing nodes as these devices cannot afford longer time for transmission of data over the network protocol.

Last but not the least, Edge computing require a stable and unique security module with high configuration for authentication and identification of edge computing devices along with algorithms that provide a better firewall solutions from malicious attacks in real time application.

9. Conclusion:
Edge computing will be growing much faster in the world of computing with its full potential to expand due to the presence of IoT devices with integration of artificial intelligence Edge computing will be implemented into smart form of living with implementation of various application that are needed in daily life and social committee development..

10. References
[1] Edge computing technologies for Internet of Things: a primer
[2] Edge Computing: Vision and Challenges.. Weisong Shi.
[3] https://moorinsightsstrategy.com/research-paper-edge-computing-the-fourth-wave-rises/
[4] https://link.springer.com/chapter/10.1007/978-3-030-34957-8_8
[5] https://www.usenix.org/sites/default/files/conference/protected
les/hotcloud_hotstorage_slides_keynote.pdf
[6] https://medium.com/velotio-perspectives/a-beginners-guide-to-edge-computing-6cfea853aa11
[7] https://www.zdnet.com/article/where-the-edge-is-in-edge-computing-why-it-matters-and-how-we-use-it/
[8] https://www.cloudflare.com/learning/serverless/glossary/what-is-edge-computing/
[9] https://arxiv.org/pdf/1609.01967.pdf
[10] https://cacm.acm.org/magazines/2019/4/235622-research-for-practice-edge-computing/fulltext
[11] Mahender K, Ramesh KS and Kumar TA 2017 An efficient ofdm system with reduced papr for combating multipath fading Journal of Advanced Research in Dynamical and Control Systems 9(Special issue 14) 1939-1948
[12] Rajasri I, Guptha AVSSKS and Rao YVD 2011 Influence of Structural Aspects on the Generation Process in Planetary Gear Trains Engineering 3(10) 1018-1021 DOI: 10.4236/eng.2011.310126
[13] Seena Naik K and Sudarshan E 2019 Smart healthcare monitoring system using raspberry Pi on IoT platform ARPN Journal of Engineering and Applied Sciences 14(4) 872-876.

[14] Sudarshan E, Naik K.S, Kumar P.P 2020 Parallel approach for backward coding of wavelet trees with CUDA. ARPN Journal of Engineering and Applied Sciences 15(9), pp.1094-1100