|| Volume 6 || Issue 1 || January 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH AND ENGINEERING TRENDS

EDGE COMPUTING FOR INTERNET OF THINGS

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Abstract:- The success of Internet of Things (IoT) and rich cloud services has introduced new computing paradigm edge computing, which processes the data at the edge of the network . Edge computing has the potential to address the concerns of response time requirement, battery life constraint, bandwidth cost saving, as well as data safety and privacy. The paper evaluates the definition of Edge computing, Internet of Things. Due to enormous growth in Internet of Things (IoT) devices , there is need for real time computation which is fulfilled by Edge Computing. The paper covers the survey on edge computing and performance management towards IoT devices, characteristics and architecture of Edge computing over IoT devices. Finally it covers challenges and opportunities in the field of edge computing in IoT.

Keywords: - *Edge computing, IoT, Data Processing, performance computing*

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I INTRODUCTION

Edge computing refers to the enabling technologies that allowing computation to be performed at the edge of the network, on behalf of cloud services on downstream data and upstream data on behalf of IoT services. In these 'edge' is any computing and work resource along the path between data source and cloud data centers. Simply edge computing is that computing should happen with the contiguity of data sources. Edge computing can be interchangeable with fog computing [1], but edge computing focuses more towards the things side, while fog computing focus more on the infrastructure side. Fig. illustrates the two-way streams of computing in edge computing. In the edge computing pattern, the things not only a data consumers, but also play as data producers. At the Edge, the things can request services and content from the cloud as well as performs the computing tasks from the cloud. As the number of smart devices increases, day by day, the consumptions of power in data centers are also increases rapidly. In this case, the cloud cannot improve computing efficiency [2] to meet the increasing demand for the source of power. Where as edge can perform computing, data storage, caching and processing, as well as distributes the request and delivery service from cloud to user. For the jobs in the network, edge itself needs to be well designed to meet the requirements in the service such as reliability, security, and privacy protection.

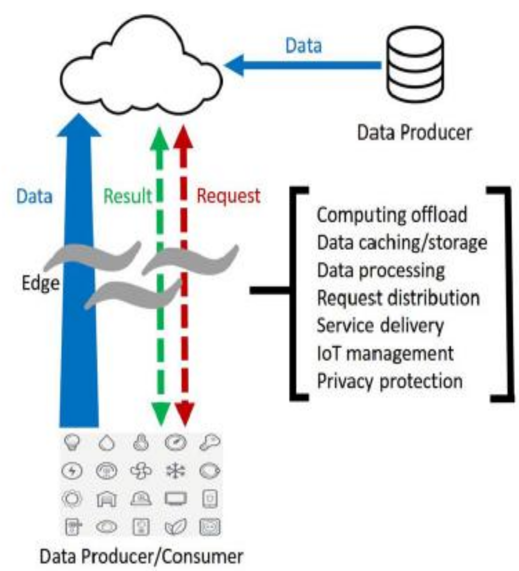

Figure1: Edge computing paradigm

Next coming to the Internet of Things (IoT) applications, These IoT devices requires a large scale of the network, heterogeneity in network level and devices, considerable number of operating system events and applications. Recent research stated that only Edge nodes can support these IoT devices and its requirements [3].

IoT is, a global infrastructure for information society, enabling advanced services by interconnecting that may be physical or virtual things based on existing and evolving interoperable information and communication technologies [4] here, a thing is considered as an object of the world (physical things) or the information world (virtual things), which are capable of being identified and integrated into communication networks, device is a piece of equipment with capabilities of communication and optional capabilities of sensing, data capture, data storage and data processing. In simple Internet of Things is collection of computing devices interconnected through internet and offers services to all type of applications and provided security requirements.

IoT is merging into daily life rapidly in the devices such as smart mobile phones, vehicles, sensors, and many other embedded devices will be connected and communicate with data centers and exchange information IoT also takes an important role In the business field. IoT was reported as one of the most important technologies that will impact in US interests [5].

IoT devices thus one of the most important data sources for big data in future[6].

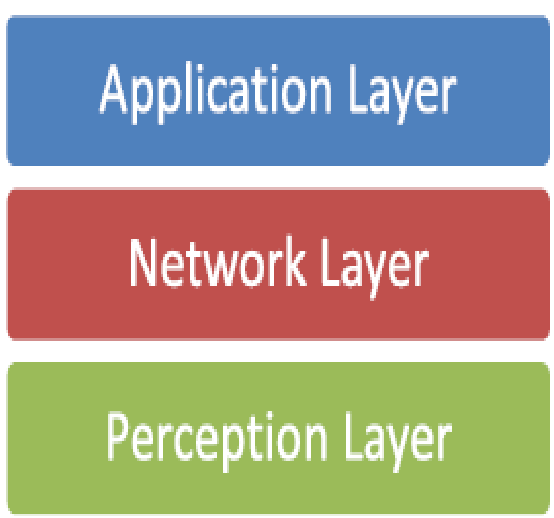

Figure 2 IoT layers

1.1 ADVANTAGES OF EDGE COMPUTING

As comparing to other cloud computing, Edge computing has many unique advantages.

Low latency :

As Edge devices are placed closer to end devices, which are both data sources and transmission target of processing results. Transmission latency can be largely reduced in these scenario. The emerging 5G technology further enhances the advances of edge computing from the perspective of low latency transmission [7].

Transmission:

In general, IoT devices create a voluminous amount of data, continuously, but have only limited computational requests. Indeed, large network latency will be unacceptable, and cannot satisfy the QoS requirements. Unlike the traditional cloud, edge computing can provide numerous distributed computational nodes, which are close to the end users to supporting real-time information collection and analysis services [8]. Meanwhile, the edge computationnodes also provide acceptable computational capacity to handle the demands of IoT.

Bandwidth:

As the IoT deploys large number of sensors the generated data is also extremely large. Using edge computing data is divided into multiple servers thus bandwidth is shared.

Energy Saving:

IoT requires power resources and battery capacity. IoT devices usually have quite limited energy supply, and are restricted by the size and usage scenarios, but it expects to perform very complex tasks that are usually power consuming. It is challenging to design a cost efficient solution to well power the numerous distributed IoT devices given that frequent battery charging or discharging is not possible practically. Edge computing enables the billions of IoT devices to perform most power-consuming computation tasks to the edge servers, which greatly reduce the power consumption and also improves the processing efficiency. Edge computing maximizes lifetime of end device, it can incorporate a flexible task offloading scheme which considers the power resources of each device. [9]

Storage:

Edge computing based storage is distributed at the edge of the network structure. It combines clusters of disk drivers and

|| Volume 6 || Issue 1 || January 2021 || ISSN (Online) 2456-0774
INTERNATIONAL JOURNAL OF ADVANCE SCIENTIFIC RESEARCH AND ENGINEERING TRENDS

also balances the storage demands to different edge nodes. Edge computing based storage can leverage load balancing and failure recovery techniques to realize the performance and availability. These load balancing techniques are capable of offloading the storage demands to different edge nodes, which mitigates the traffic in the network connection links. the failure recovery techniques in massive data flow from the multi data sources is the key importance of edge computing

Computation:

in edge computing each edge node has less computation power than what is available to cloud servers. Thus computation tasks assigned to several edge nodes. For satisfying the requirements of end users edge computing offloads the computing and storage to the edges of the networks, and uses task scheduling schemes. The objective of task scheduling is to fid optimal subset of servers under the given constraints to allocate

Context-aware service :

Context aware computing [10] is playing an important role in IoT and edge computing applications, since good modeling and reasoning of collected data can rely on the context of the data. With the advantage of the proximity nature, edge servers can collect more context information to support the data processing. For example, in the Amazon Go supermarket, video cameras can not only record the goods that customers select but also predicts customer's interest based on their location, duration and behaviors etc.

Privacy and security :

As compared to cloud computing, edge computing is more efficient and effective in protecting the data privacy and application security of users. On one hand, edge servers are usually geographically distributed clusters that can be managed and maintained by users themselves. Sensitive information can be monitored and protected more strictly. On the other hand, the small-scale nature makes it more concealed than large-scale data centers, further making it less likely to become a target of attacks [11].

II LITERATURE SURVEY

This section presents an expansive survey on the edge computing applications and potentialities embedded with IoT devices in various areas. The section also discusses edge computing technologies solving many real-time issues with IoT devices.

Shufen Wange [12] discusses in development of smart homes using IoT devices. These IoT devices monitor the internal status of the home and regulate the home environments providing home safety and proper security. As everything cannot be uploaded in the cloud especially some video data, edge computing monopolized for processing home data through the gateway reducing the overflow of household data, prevent the leakage of data improving he privacy of the edge node.

M. Chen et al. [13] devised Edge and cognitive computing (ECC) that endows smart health care systems when the patients are in emergency. The edge devices assigned according to the patient's health status. On assigned edge devices that process robustly with low latency, cognitive computation is carried out. The cognitive data engine collects the patient's data, and the cognitive resource engine collects the information relevant to edge, Cloud, and other network resources.

Zhang et al. [14] proposed video analysis in edge computing. This video analysis is named as Edge video Analysis for Public Safety framework (EVAPS). With this edge computing framework, the video analysis workload is distributed optimally on both the edge nodes and the cloud Centre. The edge node prevents unnecessary data transmissions to the cloud.

L.U. Khan et al. [15] Proposed a smart city scenario using edge computing. In this system, the data is taken from the environment. Vehicles run applications and transmit data to the edge computing servers via roadside units (RSU) for further analysis and processing. The RSUs and edge servers are interrelated and finally connected to the cloud. For seamless connectivity and security, RSUs are deployed. These work reduces the network deployment cost

B. R. Stojkoska and K. Trivodaliev [16] proposed an IoT and edge computing based smart home with a three-tier framework. The unit comprises smart homes tier, nano grid tier and microgrid tier. The first tier consists of a household item that enables wireless communication. The data is collected at the sink where it is locally processed and stored. In the second grid, sinks of smart home communicate with one another. This communication is enabled through mesh, cluster, or star. Sinks of various smart homes interact via IoT gateways enabled by the edge computing for reliable computation.

Richard Olaniyan et al. [17] define the Opportunistic Edge Computing (OEC) paradigm. It furnishes the management framework to construct, organize and monitor the infrastructure of the scalable edge that also involves the stakeholders. OEC utilizes the broker to launch pools of resources with the contributions of the end user at the edge.

Yunkon Kim and Eui-Nam Huh [18] explore data caching concepts in edge computing. The state-of-the-art relays on machine learning, reactive and proactive caching. A lightweight caching algorithm, namely EDCrammer (Efficient Data Crammer), is implemented to manage computing resources. EDCrammer helps in streaming data traffic, reduce the uplink load in the cloud by providing high quality video services. This model cache data efficiently, and the caching rate is controlled amidst the cloud and the edge nodes.

III INTEGRATION OF IoT in EDGE COMPUTING

1.1 System Integration :

In this section we will discuss the integration potential of IoT and edge computing. Based on the characteristics of both IoT and Edge computing, we can compare the characteristics of IoT, edge computing, and cloud computing. Furthermore, it focuses on to the transmission, storage, and computation characteristics to illustrate how edge computing improves the performance of IoT.

IoT and Edge computing are independently evolving, Despite their independence the edge computing platform can help IoT to solve some critical issues and improves the performance.

Thus, in recent years, it has become clear that these should be integrated. IoT has same layers as in edge computing structure and all IoT devices are end users for edge computing. In general IoT can benefit from both edge computing and cloud computing, because of the characteristics of the two structures i.e., high computational capacity and large storage. Nonetheless, edge computing has further advantages over cloud computing for IoT. Specially IoT requires fast response rather than high computational capacity and large storage. Edge computing offers a tolerable computational capacity, enough storage space and fast response time to satisfy IoT application requirements [19].

Edge computing can also benefit from IoT by extending the edge computing structure to deal with the edge computing nodes being distributed and dynamic. Either IoT devices or the devices that have residual computation power can be used as edge nodes to provide services. As IoT devices are increasing, IoT and edge computing are likely to become inseparable. Most IoT devices requires, transmission, storage and computation primarily.

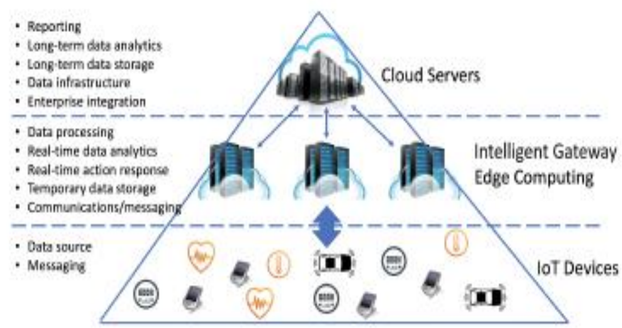

Figure 3 Layer Architecture Of Edge Computing-Based IOT

1.2 Implementation strategy :

Implementation strategy includes the various aspects to decide,

1. **To decide intelligence of IoT devices** :

For more intelligent device less intelligence edge server is required. This is due to data already being filtered at the source i.e IoT device

2. **Grouping of IoT devices :**

It is always beneficial to group intelligent IoT devices than dumb devices. It will be easy to manage as there is less filtering, analysis and reporting will have to be done on data streams. It is advisable that group devices which are creating data into manageable areas and capture the data as close to the group as possible to minimize cross platform data traffic. Therefore it is preferable to group devices by proximity, rather than capability. Proximity grouping will reduces latency and enables faster response to identifies events.

3. **Hub-and-spoke approach:**

To manage the flow of data there is edge infrastructure that consists of different edge servers placed across a network with a hierarchical manner of dealing with the data between them**.** The optimum way to deal with such system is to have the less cost , least intelligent edge servers. a relative use of terminology, these systems might be quite intelligent and costly in themselves as close to the IoT devices as possible. Such edge servers must be able to to send the relevant data to a more intelligent, more central server that is managing the group of all edge servers [20]. This central system can apply more intelligence to data analysis and better decide what decide what actions are required. It is also necessary for the edge servers to work in bilateral manner, : The outer edge servers must be able to identify events and send data to the center, while center also must be able to demand data in real time from the outer edge servers to bolster the data it's dealing with Where proximity grouping lowers direct data latency for all IoT devices under the control of the one edge server, a hub-and-spoke model lowers the time needed for analyzing data as the central server only needs to deal with known, high-priority data.

4. advanced data analytics and reporting

Although automation has come a long way, it is not 100% accurate. As such there may be cases which has lack of maturity of area currently where edge servers must be alert a human to an action to be taken. All possible routes to remediation must be shown to any human that gets involved. Reporting should be carried out in clear and meaningful manner.

IV CONCLUSION

We proposed enlighten the Edge computing, IoT and Integration of Edge computing into IoT devices. Paper describes the characteristics and features of Edge computing and demonstrated the benefits of the technology in IoT services. Paper presents the evaluation and progress of edge computing in different IoT services. Result shows that merging IoT in Edge computing is providing the growth in various aspects, as compare to traditional cloud services. IoT with edge provides transmission accuracy, increases computation speed , solves storage issues, provides security maintains the privacy and many more. As IoT is enlarges day by day, edge computing would be best available service in future to optimize the IoT problems

ACKNOWLEDGMENT

I would like It express our deep and sincere gratitude to my guide Prof. V. S. Karwande, Head of Computer Science Engineering for his support and continuous encouragement throughout the project and paper work. I am also thankful towards the department for providing me various resources and infrastructure facilities.

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|| Volume 6 || Issue 1 || January 2021 || ISSN (Online) 2456-0774
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