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EDGE COMPUTING

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ABSTRACT

With the rapid development of the Internet of Everything (IoE), the number of smart devices connected to the Internet is increasing, resulting in large-scale data, which has caused problems such as bandwidth load, slow response speed, poor security, and poor privacy in traditional cloud computing models.

Traditional cloud computing is no longer sufficient to support the diverse needs of today's intelligent society for data processing, so edge computing technologies have emerged. It is a new computing paradigm for performing calculations at the edge of the network. Unlike cloud computing, it emphasizes closer to the user and closer to the source of the data. At the edge of the network, it is lightweight for local, small-scale data-storage and processing.

INTRODUCTION

Internet of Things (IoT) is conquering the world by storm, as it has become one of the most influential buzzwords not only in the tech sector, but also many other businesses. From farms to factories and smart cities to homes, IoT technology is all over the place with a continually expanding set of connected systems and devices. According to Statista, the installed base of IoT devices is forecast to grow to almost 31 billion worldwide. As a result, cloud computing will emerge as an increasingly dominant trend as the enormous amount of data generated by billions of connected IoT devices need to be stored for processing and retrieval. Both the technologies - IoT and cloud computing are interconnected, with one providing the other a platform for success.

Low latency and faster real-time analysis of edge computing have a number of applications across various sectors such as automotive, consumer electronics, energy, health care and more. Autonomous vehicles are a strong use case in point, where data needs to be collected from the surrounding environment and cloud to make decisions quickly and safely. Patterns in sensor data should be detected, stored and transferred quickly to aid real-time decisions at local nodes. Decentralized architecture of edge computing negates the latency in communication of critical data thereby ensuring safety.

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.

Fig 1: Edge computing [1]

Edge computing is shown in figure 1.Based on the continuous and massive growth of data volume and various data processing requirements, cloud-based big data processing has shown many shortcomings:

1. Real-time
2. Security and privacy
3. Energy consumption

Edge computing is close to the source of the data, such as smart terminals. It stores and processes data at the edge transportation of the network. It has proximity and location awareness, and provides users with near-end services. In terms of data processing, it is faster, real-time, and secure. It can also solve the problem of excessive energy consumption in cloud computing, reduce costs, and reduce the pressure of network bandwidth. Patterns in sensor data should be detected, stored and transferredquickly to aid real-time decisions at local nodes.

Edge computing is applied in various fields such as production, energy, smart home, and with the development of the Internet of Things (IoT), edge computing models are urgently needed and have become hot research issues.

Edge computing consists of following topics:

1. Internet of Things.
2. Software Defined Networking.
3. Cloud Computing.
4. Network Function Virtualization.
5. Internet of Things Device.
6. Unmanned Aerial Vehicle.

WORKING

Edge computing is all a matter of location. In traditional enterprise computing, data is produced at a client endpoint, such as a user's computer. That data is moved across a WAN such as the internet, through the corporate LAN, where the data is stored and worked upon by an enterprise application. Results of that work are then conveyed back to the client endpoint. This remains a proven and time-tested approach to client-server computing for most typical business applications.

The principle is straight forward: If you can't get the data closer to the data centre, get the data centre closer to the data. The concept of edge computing isn't new, and it is rooted in decades-old ideas of remote computing such as remote offices and branch offices where it was more reliable and efficient to place computing rsesources at the desired location rather than rely on asingle central location.

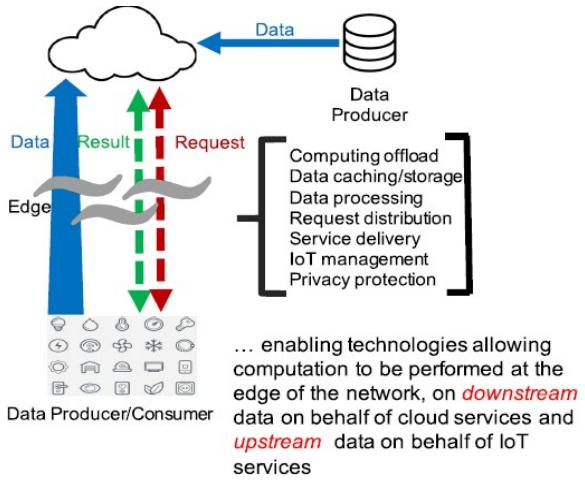

Fig 2: Edge computing in nutshell [2]

Figure 2 shows the edge computing in nutshell. By deploying servers and storage where the data is generated, edge computing can operate many devices over a much smaller and more efficient LAN where ample bandwidth is used exclusively by local data- generating devices, making latency and congestion virtually nonexistent.

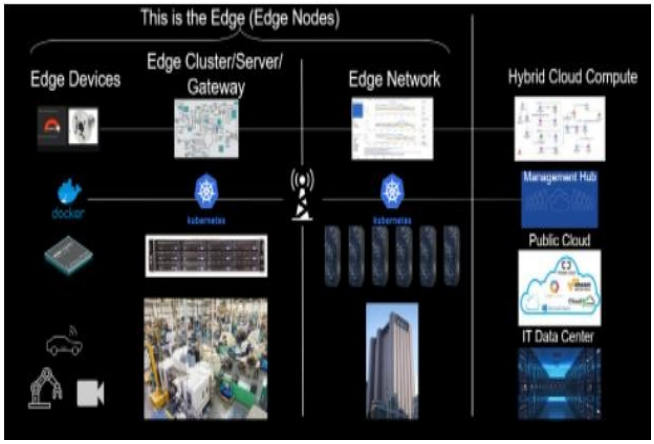

Fig 3 : Examples of edge nodes [2]

Examples of edge nodes are shown in figure 3. The keycomponents of edge computing are:

1. Cloud
2. Edge device
3. Edge node
4. Edge cluster/server
5. Edge gateway

Cloud: This can be a public or private cloud, which can be a repository for the container-based workloads like applications and machine learning models.

Edge device: An edge device is a special-purpose piece of equipment that also has compute capacity that is integrated into that device. Interesting work can be performed on edge devices,such as an assembly machine on a factory floor, an ATM, an intelligent camera, or an automobile.

Edge node: An edge node is a generic way of referring to any edge device, edge server, or edge gateway on which edge computing can be performed.

Edge cluster/server: An edge cluster/server is a general-purpose IT computer that is located in a remote operations facility such as a factory, retail store, hotel, distribution centre, or bank.

Edge gateway: An edge gateway is typically an edge cluster/server which, in addition to being able to host enterprise application workloads and shared services, also has services that perform network functions such as protocol translation, network termination, tunnelling, firewall protection, or wireless connection.

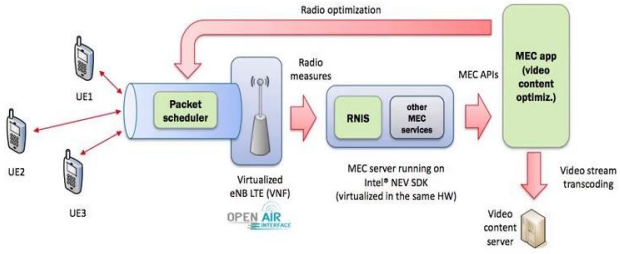

Fig 4: Edge computing use cases [4]

Edge computing use cases is shown in fig 4. In principle, edge computing techniques are used to collect, filter, process and analyze data "in-place" at or near the network edge.

DECENTRALIZATION:

In decentralized applications, on the other hand, the clients are not fully dependent on a single node or an endpoint. Decentralization is “a shift from concentrated to distributed modes of production and consumption of goods and services.” Decentralized applications make it possible to spread control, access, or ownership across several nodes within a network. Clients can connect to any of thesenodes.

The cloud is thus dispersed into multiple small-scale computing devices called “computation spots”. Because the data is distributed across multiple nodes, it is less likely that any of the individual endpoints can impact the entire system.

The centralized and decentralized data centres are shown in fig 5. In centralised system, every device is connected and dependent on central data-centre.

Whereas in decentralised system, each device isconnected to every other device. Decentralisation plays animportant role in case of edge computing.

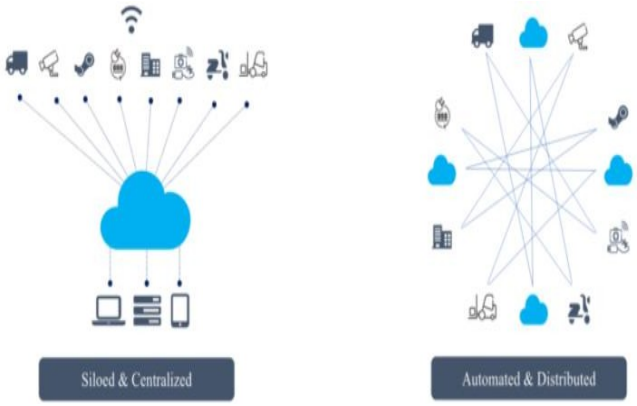

Fig 5 : Centralized and decentralized data centers [4]

In the IoT example, may have individual devices, i.e. things with sensors, connecting to gateway nodes. Typically, these individual devices are not connected to the internet. They are limited in their field of interaction and are part of constrained networks.

Gateway nodes, have transmission control protocols/internet protocols and can speak to backend services. In this scenario, we have multiple local devices talking to their edge gateways. And then, we have a number of decentralized gateways talking to the cloud.

This is called "edge computing" because you have a multitude of such IoT gateways dispersed at the edge of the IoT network. The individual gateways do not communicate with each other. They serve as gathering points for the content coming from their local IoT devices. This content is collected, pre-processed, and selectively handed over to the cloud for in-depth analyses. In the cloud, the locally produced and pre-aggregated data is combined with data from other gateways, allowing for various Big Data operations.

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APPLICATIONS

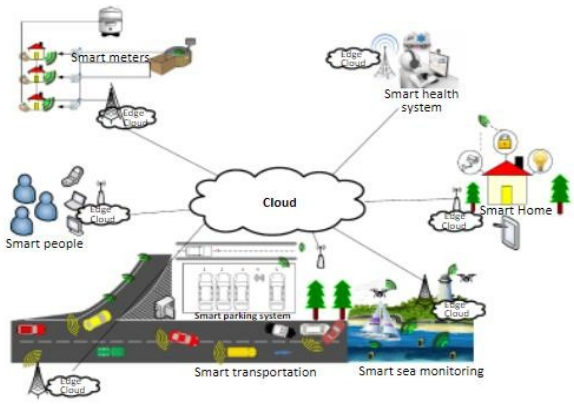

Fig 6 : Applications of Edge computing [5]

Fig 6 shows the applications of edge computing. Some otherapplications of edge computing are as follows:

1. Video Surveillance
2. Smart Cities
3. Connected Cars
4. Manufacturing

ADVANTAGES

1. Edge computing model stores and processes data on edge devices without uploading to cloud computing platform.
2. Fast data processing and analysis
3. Real-time: Improves data transmission performance,ensuring real-time processing and reduces delay time.
4. It provides Security and Privacy.
5. Low cost and low bandwidth cost.
6. Low energy consumption.

CONCLUSION

With edge computing, things have become even more efficient. As a result, the quality of business operations has become higher. Edge computing is a viable solution for data-driven operations that require lightning-fast results and a high level of flexibility, depending on the current state of things.
IoT devices are gaining momentum from wearables to vehicles to robots. As we are moving to a world with lots and lots of data, and data processing the need of a faster connection is becoming crucial. While a centralized data centre or cloud for data management, processing and storage has its limitations. Edge computing can provide an alternative solution for this. But since the technology is still in its immaturity, it is difficult to predict its success in future. Even though, there will be more opportunities for companies to test and set up this technology.

REFERENCES

1. Weisong Shi, George Pallis, Zhiwei Xu: A paper on Edgecomputing, Proceedings of the IEEE | vol. 107, No. 8, Issue August 2019, pp 1474-1481.
2. Keyan Cao, Yefan Liu, Gongjie Meng, and Qimeng Sun: A review paper on An Overview on Edge Computing Research, IEEE transactions on Edge computing, vol. 8, Issue may 19, 2020, pp 85714- 85728.
3. https://www.techtarget.com/searchdatacenter/definition/e dge-computing, accessed on 15/05/2022.
4. https://developer.ibm.com/articles/edge-computing- architecture-and-use-cases/, accessed on 02/06/2022.
5. https://inform.tmforum.org/wp- content/uploads/2019/11/X1-330x186@2x.png, accessedon 02/06/2022.
6. R. Wang, M. Li, L. Peng, Y. Hu, M. M. Hassan, and A. Alelaiwi, "Cognitive multi-agent empowering mobile edge computing for resource caching and collaboration", Future Gener. Comput. Syst., vol. 102, Issue Jan 2020, pp66-74.
7. https://www.researchgate.net/publication/340401570, accessed on 04/06/2022.
8. https://www.researchgate.net/figure/Edge-computing- applications_fig1_331362529, accessed on 04/06/2022.
9. C. T. Ding, J. N. Cao, L. Yang, and S. G. Wang, "Edge computing: Applications, state-of-the-art and challenges", Zte Technol., vol. 25, no. 3, Issue 2019, pp. 2-7.
10. Z. M. Xu andY. F. Tian, "The history and applicationof cloud computing", Inf. Recording Mater., vol. 19, no. 8, Issue 2018, pp. 66-67.
11. M. Chen, T. Wang, K. Ota, M. Dong, M. Zhao, and A. Liu, "Intelligent resource allocation management for vehicles network: An A3C learning approach", Computer Communication, vol. 151, Issue Feb 2020, pp. 485-494.
12. F. Lu, J. Hu, L. T. Yang, Z. Tang, P. Li, Z. Shi, and H. Jin, "Energy efficient traffic offloading for mobile users in two-tier heterogeneous wireless networks", Future Generation Computer System, vol. 105, Issue Apr 2020, pp. 855-863.
13. T. Wang, G. Zhang, A. Liu, M. Z. A. Bhuiyan, and Q. Jin, "A secure IoT service architecture with an efficient balance dynamics based on cloud and edge computing", IEEE Internet Things J., vol. 6, no. 3, Issue Jun. 2019, pp. 4831-4843.
14. C. K. M. Lee, Y. Z. Huo, S. Z. Zhang, and K. K. H. Ng, "Design of a smart manufacturing system with the application of multi-access edge computing and blockchain technology", IEEE Access, vol. 8, Issue 2020, pp. 28659-28667.
15. M. Symeonides, D. Trihinas, Z. Georgiou, G. Pallis, and M. Dikaiakos, "Query-driven descriptive analytics for IoT and edge computing," in Proc. IEEEInt. Conf. Cloud Eng. (IC2E), Jun. 2019, pp. 1–11