IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

EDGE COMPUTING LOT FROM HPE INTELIGENCE EDGE

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Abstract: The proliferation of Internet of Things (IoT) and the success of rich cloud services have put pressure on a new computer paradigm, edge computing, that requires internal data processing on the edge of the network. Edge computing has the ability to address the need for response time, battery life limit, saving bandwidth costs, and data protection and privacy. In this paper, we presents a computer definition at the end, followed by a few research examples, from the clouds loading on a smart home and city, with shared edges to create a seamless feel computer. Finally, we introduce a number of challenges and opportunities in the field of edge computing, tool hope this paper will draw public attention and encourage further research into this. With Digital Transformation and a growing technology in an effort to empower everything "smart" - cities, agriculture, automotive, health, etc. - within destiny calls for a large Internet of Things (IoT) sensor at the same time as facet computing will force launch. The proliferation of Internet of Things (IoT) and the acquisition of rich cloud offerings have furthered the idea of a brand new laptop, facet computing, which requires data processing in network rims. Edge computing has the potential to address issues such as call time, battery durability, store bandwidth costs, and information security and privacy. In this paper, we provide a definition of facet computing, which is seen in the form of examples of other studies, from cloud migration to a smart home and city environment, and the limit of collaboration to establish the concept of facet computing. Finally, we offer many challenging situations and opportunities within the facet computing industry, and we wish this paper to benefit the public interest and encourage more than just further studies in this regard.

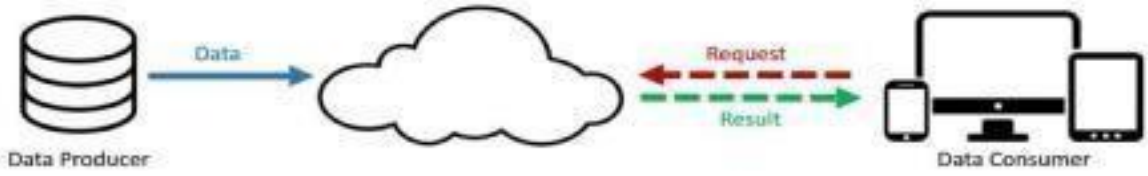
***Index Terms* - Edge computing, Cloud computing, loT**

I. Introduction

CLOUD computing has tremendously changed the way we live, work, and study since its inception around 2005. For example, software as a service (SaaS) instances, such as Google Apps, Twitter, Facebook, and Flickr, have been widely used in our daily life. Moreover, scalable infrastructures as well as processing engines developed to support cloud service are also significantly influencing the way of running business, for instance, Google File System, Map Reduce, Apache Hadoop, Apache Spark, and so on. Internet of Things (IoT) was first introduced to the community in 1999 for supply chain management, and then the concept of "making a computer sense information without the aid of human intervention" was widely adapted to other fields such as healthcare, home, environment, and transports. Now with IoT, we will arrive in the post-cloud era, where there will be a large quality of data generated by things that are immersed in our daily life, and a lot of applications will also be deployed at the edge to consume these data. By 2019, data produced by people, machines, and things will reach 500 zettabytes, as estimated by Cisco Global Cloud Index, however, the global data center IP traffic will only reach 10.4 zettabytes by that time. By 2019, 45% of IoT-created data will be stored, processed, analysed, and acted upon close to, or at the edge of, the network. There will be 50 billion things connected to the Internet by 2020, as predicted by Cisco Internet Business Solutions Group. Some IoT applications might require very short response time, some might involve private data, and some might produce a large quantity of data which could be a heavy load for networks. Cloud computing is not efficient enough to support these applications. With the push from cloud services and pull from IoT, we envision that the edge of the network is changing from data consumer to data producer as well as data consumer. In this paper, we attempt to contribute the concept of edge computing. We start from the analysis of why we need edge computing, then we give our definition and vision of edge computing.

WHAT IS EDGE COMPUTING?

Data is an increasing number of produced at the brink of the network, therefore, it'd be greater green to additionally method the facts at the brink of the network. Previous drawings as micro datacentres cloudlet, and fog computing have been introduced to the public because cloud computing now.



Cloud computingparadigm

WHY DO WE NEED EDGE COMPUTING?

Edge computing permits data-circulate acceleration, which include real-time data processing with out latency. It permits clever programs and gadgets to reply to data nearly instantaneously, as its being created, casting off lag time. This is important for technology including self-riding cars, and has similarly vital blessings for business.

Edge computing is expected to serve as a strategic brain behind IoT. Identifying the role of edge computing on IoT is a major research problem right now. Edge Computing is used for reduces the amount of data sent to the cloud and reduces service access delays. Picture demonstrates excellent role of edge and cloud computing in the IoT environment.

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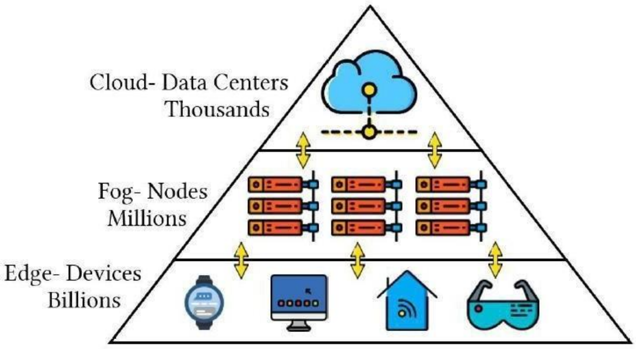


Typical edge computing architecture.

II. LITERATURE SURVEY

Edge Computing: Vision and challenges

The proliferation of Internet of Things (IoT) and the success of rich cloud services pushed the horizon of a new computer paradigm, edge computing, demanding processing data at the edge of the network. Edge computing has the power to deal with it concerns about the need for response time, battery life limit, saving bandwidth costs, e.g. and data security and privacy. In this paper, we introduce the definition of edge computing, followed by a few case studies, ranging from cloud loading to a smart home and city, e.g. and a seam of integration to create the concept of edge computing. Finally, we introduce several challenges and opportunities in the field of computing edge, and hopefully this paper will not gain public attention and encourage further research into this.

Edge Computing Protected on IoT Systems: Review and Case Studies

Designs of efficient and secure network system designs, such as Internet of Things (IoT) and big data analysis, is growing faster than ever before. Edge to make a computer in an IoT system a data processing done on or near data collectors in the IoT system. In this paper, we aim to briefly review concepts, features, safety, IoT applications that enable edge computing and its security features in our data-driven world. We focus on clarifying the various aspects to consider while building a computer system that is reliable, reliable, secure and distributed. We too summarize basic ideas on security risk reduction strategies. Then we check presented challenges and opportunities in the field of edge computing. Finally, we review two courses, intelligent packaging and content delivery network (CDN), and analysis different ways in which IoT systems can be used to perform daily tasks.

The Role of Edge Computing in the Internet of Things

Amazing progress in embedded on-a-chip systems has greatly increased a number of vending machines with sufficient resources to run the full operation programs. This change has expanded IoT capabilities. Most basic IoT devices can only collect and send data for analysis. However, the rise of modern computer power devices allow to perform complex calculations in space, leading to computer usage. Edge computing expands the capabilities of cloud computing by bringing resources closer to edge network and thus supports a variety of services and applications. In this work, we investigate, highlight, and report on the latest developments in nearby computer technologies respect for measuring their impact on IoT. We are developing the taxonomy of edge computing by to distinguish and classify existing books, and in so doing, we reveal the essentials as well supporting features of various IoT computer paradigms. In addition, we introduce I essential requirements for the successful deployment of edge computing to IoT and discuss a few key features of Edge computing on IoT. There are a number of open research challenges as well explained.

Internet of Things: Technology Enhancement Survey, Protocols, and Applications

Internet of Things (IoT) which emphasizes empowerment technology, agreements, and implementation news. IoT is powered by the latest developments in RFID, intelligent sensors, communication technologies, as well as online agreements. The basic premise is to be smart the senses work directly without human involvement to bring about a new phase of it applications. The current trend in Internet, mobile, and machine-to-machine (M2M) technology can be seen as the first phase of IoT. In years to come, IoT will be the same is expected to integrate various technologies to enable new applications through virtual connectivity things together to support intelligent decision-making. This paper begins by providing a horizontal view of the IoT. Then, we give her opinion other technical details related to technologies that allow IoT, agreements, and applications. Compared to other research papers in the field, our aim is to provide a a detailed summary of the most relevant agreements and app issues to enable researchers and app developers to quickly come up with how different they are protocols come together to deliver the desired functions without going through the RFCs and standardization. We also provide an overview of some of the key IoT challenges recently introduced books and provide a summary of the related research work. In addition, we examine relationships between IoT and other emerging technologies that combine big data and cloud computing as well fog computing. We also introduce the need for bet horizontal integration between IoT services. Finally, we introduce detailed service conditions to show how different protocols are presented in the paper comes together to deliver the desired IoT resources.

Next Generation Emergency Communications operates on the Multi-Entry Line Computer

This is even more evident in view of the upcoming 5G networks, available aims to support a combination of different applications and a wide variety of services operating requirements, which include critical IoT connectivity, large machine connection, and gigabit mobile connectivity. Emergency personnel are dealing with it a major challenge to adapt their performance model to the 5G paradigm. This article explores the challenges that next-generation emergency services need to overcome to meet the needs of rich content, real time, and location communication. The concept of the next generation of emergency communication as described in launched the EMYNOS project, with an idea of how this concept can reach 5G the most reliable and lowest emergency communication requirements.

Mobile Edge Computing Opportunities To Make Smart Cities

This article suggests how to improve user experience streaming video on the context of smart cities. The proposed approach relies on the Minister's vision as a key QoS development feature. Supports QoS by ensuring that applications / services follow the movement of users, recognizing the concept of "Follow Me Edge". The proposed plan sets out I automatic creation of MEC services to allow any data access at any time QoE and reduced delays. Considering its application in the context of a wise city, I The proposed system represents an important solution to reduce traffic network traffic as well to ensure very short delays with the construction of a smart MEC capable of achieving 1 ms latency dream for future 5G mobile apps.

Edge Analytics Online Features

Advanced data sensors are everywhere in the Internet of Things. GigaSight is an organization An online scale of video content full of sources forcing private preferences and access controls. Architecture is an integrated version of VM-based cloudlets do video statistics online.

III. SCOPE AND OBJECTIVE

Scope

Push from Cloud Services: Placing all computer activities in the cloud is proven become an effective way to process data from computer computing in the cloud exceeds the potential of peripheral objects. However, relatively fast developing data processing speed, network bandwidth has stopped. With The greater the amount of data built up the edge, the faster the data transfer becomes A bottleneck of cloud-based computer paradigm.

Pull To IoT: Almost all types of electrical devices will be part of the IoT, and will play the role of data producers and consumers, such as air quality sensors, LED bars, street lights and even an internet-connected microwave oven. It is safe to conclude that the number of items on the edge of the network will grow to more than a few billion years. Therefore, the raw data generated by them will be large, forming a common cloud using a computer does not work well enough to manage all this data. This means most of the data produced by IoT will not be transferred to the cloud, instead it will be burned to on the edge of the network.

Switch from Data Consumer to manufacturer: In the cloud computing paradigm, conclusion end-to-end devices often play as a data consumer, for example, watching YouTube video on your smart phone. However, people also produce data these days from them mobile devices. The transition from data buyer to producer / consumer requires more placement of work at the edges.

Objective

The various objectives of edge computing in the IoT context are as follows:

Reducing Delay: High latency has become a major problem for IoT-based smart applications. Another platform, such as edge computing, that can be verified in time service delivery is required to meet the quality of service (QoS) requirements for delays in critical IoT applications (e.g., smart transport and online games).

Network Management: A number of incidents, such as inadequate material performance support, lack of seamless communication, and control of inefficient congestion, degrade overall network performance. Therefore, the efficient use of network resources at the edges computer is important for IoT.

Cost Improvement: The use of an adequate edge-enabled computer platform requires extensive investment in infrastructure ahead of time investment and operating costs. Most of these costs are related to the network node placement, which requires deliberate planning and efficiency to reduce total costs. Posting the right number of nodes to the right locations can be greatly reduced big money, and well-organized edge node can reduce operating costs.

Power management: Power management is also an important goal of IoT-based edge computer. Subscribers need strict control over power management. Energy-efficient IoT machines and applications are desirable on the edge computer. According to a According to a study, one million IoT nodes require hearing aids that support a variety of applications using power harvesting to ensure growth, reduce costs, and avoid common battery instead.

Data Management: A large number of IoT devices are currently expected to produce large amounts of data need to be managed on time. It works well and it works data management methods are preferred on the computer edge. Transfer once the integration of IoT-generated data is an important concern in data management.

Resource Management: Proper management of accounting resources is essential to to find the purposes of service level. Proper resource management includes communication of resources, the balance of available resources, and the appropriate allocation of work.

IV. DESIGN AND IMPLEMENTATION

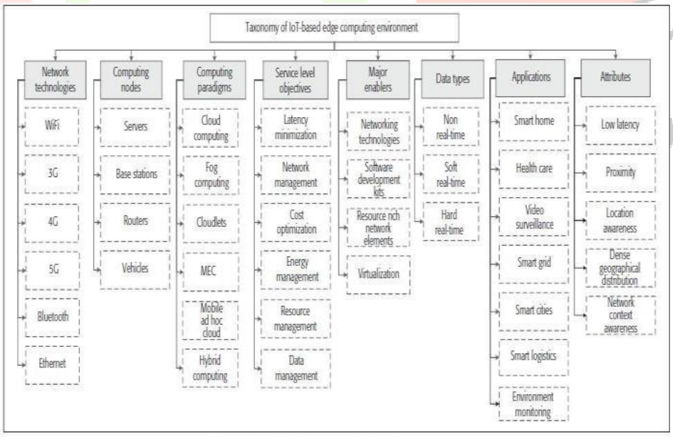
Taxonomy of IoT-Based Edge Computing

IoT-based edge computing Taxonomy that considers certain features, such as wireless network technology, computing nodes, computer paradigms, service level objectives, capabilities, data types, applications, and attributes.

Network Technologies IoT devices send data collected from a locally located server for consideration. These devices connect to the edges of the edges through it can be wireless communication technology, such as WiFi and mobile networks (e.g., 3G, 4G, and 5G), or wireless technology, such as Ethernet. These network technologies vary by terms of data rate, transmission range, and number of supported devices. Wireless networks provide flexibility and mobility for users who make their applications in edge server. However, wireless network technology is not as reliable as cables technology.

Computing Nodes IoT devices have limited processing capabilities, which they do not suitable for complex calculation tasks. However, resource-compressed IoT devices can expand their capabilities by using end-to-end server resources. Edge Computing The paradigm relies on various computer-enabled devices to provide services to IoT users. These computer devices are a key feature of IoT-based edge computing. Computing nodes include servers, base stations (BS), routers, and vehicles that can provide services and various services on IoT devices. The use of these devices is straightforward computing paradigm.

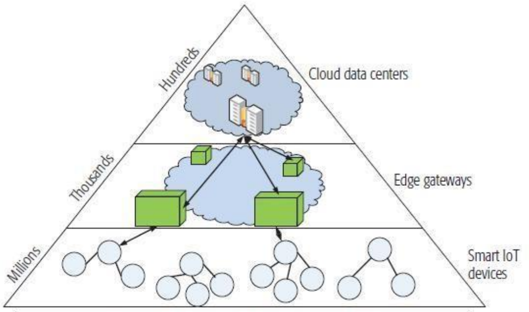
Computing Paradigms Various computer paradigms are used in IoT to provide distinction services depending on various application requirements. These paradigms can be divided by cloud computing, edge computing (i.e., MEC, fog, and cloudlet), mobile ad hoc cloud (MAC), and mixed platforms. Cloud computing is a central computer infrastructure that aims to provide seamless access to powerful cloud servers. These servers can quickly process large amounts of data when accessing remote IoT devices as well send back results. However, applications that are sensitive to real-time delays cannot pay off in the long run delays caused by the local area network. Continuous transfer of big green data using unreliable wireless links may also not work. In contrast, edge computing a a separate computer platform that delivers cloud computing power near IoT devices, that is, the edge of the network. An important type of computer peripheral platform is the MEC, bringing computer power to the edge of the mobile network [10]. Accounting and final services at the MEC are provided at BS. Unlike the MEC, the fog The computer uses local fog nodes (i.e., local network devices such as a router or switch) is located in a limited area to provide accounting services. Fog computing is regarded as advanced technology following the success of IoT. Cloudlet I another type of computer on the edge, where the functions are more sensitive and more calculated from IoT devices made to a server installed on a local network. In contrast cloud and edge computing platforms that rely on the use of infrastructure, MAC monetize shared resources for mobile devices available within your immediate area use computing- deep functions. Cloud and edge computing are used together in a hybrid computer. Such infrastructure is often accepted when we need a large computer cloud computing services but cannot tolerate cloud delays. Variety of hem computing can be used in such programs to overcome the problems of cloud delay computer.



Taxonomy of IoT-based edge environment.

EDGE COMPUTING ARCHITECTURE AND SECURITY

Edge Computing is a distributed format, which is simply defined as data processing thereis being collected. It has emerged to reduce both bandwidth and response time in IoT system. The use of an edge computer system is required where delays exist needed to be upgraded to avoid network overload and data processing the load is large in one place. An extended version of edge computing says fog computing, which is a structure that uses edge gadgets to achieve a large amount of calculation, storage, regional communication, which it undoubtedly has input and output from the real world called conversion. Fog nodes decide whether to process data locally from a few data sources or send it to data in the cloud.



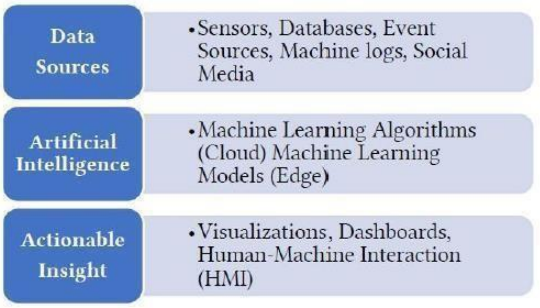
Layered model for cloud edge-based IoT service delivery

Edge computing jobs, people do it in a daily way. Three basic elements: inputs, processing, and output as abridged.

• **Data sources**: As input, any repository that records and collects data from customers or its locations are defined as a data source.

• **Performance intelligence:** As a processing function, it is a key element behind data collected to reveal realistic ideas, discover patterns and trends, produce independent recommendations, and improve machine-based performance data reading or analysis models.

• **Possible ideas**: The results of the previous section are only effective if I each person can do something and make any informed choice. So, in this section, the details appear visually in the form of control panels, visuals, alerts and more, which promotes communication between machines and humans, and thus produces a profitable response loop.



Major tasks of edge computing.

Privacy and Security

The organization must monitor and ensure the privacy and security of its IoT framework. Many of the terms used in privacy management are listed in the following:

• **Fake name:** where the pseudonym is used as an identifier to ensure that a person can use the source (e.g. pseudonym) without revealing the actual identity of the source. However, a the user can still be responsible for using it.

• **Invisibility:** to ensure that the person can use the service or service externally other third parties and the ability to see if a service or service exists used.

• **Disconnection**: ensuring that an external company (e.g., attacker) cannot identify the two things are connected to each other or not.

• **Anonymous:** a person can use the app without disclosing their identity.

• **Confidentiality:** to ensure only the owner of the data and the person who can access it personal information on the computer edge. Protects against access to unauthorized organizations data when individual data is transferred and collected on the edge or in the middle network coverage, and where data is stored or processed at peripherals or in cloudy locations.

• **Integrity:** ensuring effective and continuous information transfer authorized person without unauthorized modification of data. Privacy of individuals may be affected by a lack of integrity measures.

• **Availability:** to ensure that the accredited team has access to the limited resources at any regions based on individual needs. This also means that personal data is withheld edge or cloud nodes and cipher text format can be managed under a variety practical needs.

• **Access control and authentication:** access control mimics the location of your entire connection privacy and security requirements in the form of access control. Verification confirms that personal identification is authorized.

V. CASE STUDIES OF EDGE COMPUTING

Two case studies are presented in this section to illustrate the concept of computer edge fully. First, we analyze a smart parking system that reduces traffic congestion if each person wanders around the parking lot.

Smart Parking System

Consider a system that allows people to quickly find available parking one click of a key on a smart device. This program will greatly reduce time dedicated to finding parking space and preventing traffic violations.

Example of a smart parking system.

.The smart parking system is usually powered by RFID, ultrasonic detector, andinfrared sensor units.

Execution Flow: Normal kill flow works like this in a smart parking lotsystem.

- Log in to the smartphone parking app.
- Choose a parking area close to the customer's location.
- Browse through the available parking spaces from time to time, and select an option slot.
- Choose a set time to park the car.
- Pay the parking fee on time.
- When a customer parks a car roaming around and confirms his or her parking space, calculation time begins.
- On the move, the customer can pay any extra money if they skip time allowed.

Advantages: Smart parking can reduce traffic in the area, has been helpful to many people and has reduced car exhaust, making it even more so an environmentally friendly city. It can also improve access to businesses and wholesalers shops by improving available parking spaces.

Future scope:

- The system can be adjusted to integrate future self-driving vehicles and ensure real-time communication between the few vehicles that one does not have interactive load system.
- Highly efficient parking algorithms can be developed for full use resources, such as availability of spaces and parking times. For example, an in-depth learning model can be trained for real-time space allocation.

VI. CHALLENGES AND OPPORTUNITIES

We have outlined five potential edge computing applications in the last section. To note the concept of edge computing, we argue that systems and network society the need for cooperation. In this section, we will also summarize these challenges details and bring forward possible solutions and most important opportunities research, which includes ordering, naming, data withdrawal, service management, privacy and safety and efficiency metrics.

Programmability

On a cloud computer, users edit their codes and apply them to the cloud. Cloud the provider is responsible for determining whether the computer is cloud-based. Users have zero or partial information on how the app works. This is one of the benefits of cloud computing that the infrastructure is transparent to the user. Generally, the program is written in the same programming language and compiled in a specific destination, from the system only works in the cloud. However, on the edge computer, the countdown is loaded from the cloud, and the odge nodes are almost different platforms. In this case, the operating time of these nodes varies from one to another, and the editor faces a lot the difficulty of writing an application that can be used in the edge computing paradigm. To address edge computing system, we propose a computer concept streaming is defined as a series of operations / computer applications used in direct data how to distribute data. Tasks / computers can be all or part of operating system, and computer can be anywhere on the road as long as the application describes where a computer should be run. Computer streaming is software defined computer flow so that data can be processed by distribution and efficiency fashion on data-generating devices, edge locations, and cloud space. As described in edge computing, more computer use can be done on the edge instead of the middle cloud. Ku in this case, computer streaming can help the user decide which tasks / computer it should also be done how the data is distributed after the computer has occurred at the end. Work / computer distribution metrics may be driven by delays, energy costs, TCOs, and hardware / software restrictions. A detailed cost model is discussed in Section IV-F. By removing the computer stream, we expect the data to be computer-generated closely it is possible in a data source, and the cost of data transfer can be reduced.

Naming

In edge computing, one important thought is that the number of objects is very large great. On the edge of the nodes, there are many applications running, too each application has its own structure in terms of how the service is provided. Same for all computers, the edge computing system is very important in planning, address, object identification, and data communication. However, effective design The peripheral computer paradigm method has not been developed and is the same to date. Edge Doctors often need to learn different ways of communicating with the network in order to interacting with different objects in their system. Edge design scheme The computer needs to control the flow of traffic, a very powerful network topology, privacy and security protection, as well as the directed increase of the largest the number of unreliable items. Traditional design methods such as DNS and uniform resource identifier satisfies most current networks very well. However, they are not flexible enough to use the network on the changing edge as sometimes a lot of things in the edge can be very mobile and has heavy equipment. In addition, with certain resources mandatory features at the end of a network, an IP-based compiling system can be very complex support considering the complexity and highness of it. New ways of naming names like data networking (NDN) [27] and Mobility First [28] can also be used at the end computer. NDN provides a data-based content / network-based network, and allows people to manage the service and provides better edge measurement. However, it will require additional representative to access other such communication systems like Bluetooth or ZigBee, and so on. Another NDN-related problem is security, as it were It is very difficult to distinguish computer hardware information from service providers. MobileFirst can separate the name and network address to provide better mobility support, too will work best when used on peripheral services where things are going very well. Nervous, global unique identification (GUID) needs to be used for naming MobileFirst, and this is not required for a fixed data integration service edge of the network as a home. Another disadvantage of MobileFirst because the edge is a difficulty in service management as the GUID is not human.

Data Abstraction

Various applications can run on edgesOS using data or provide a service with communicating with air position indicators from the service management layer. Data abstraction was well discussed and researched in a wireless nerve network once cloud computing paradigm. However, with a computer on the edge, this problem gets worse challenge. With IoT, there will be a large number of data producers in the network, too here we take the smart home environment as an example. In a smart home, almost all of them items will report data to edgeOS, not to mention a large number of distributed items at home. However, most items are on the edge of the network, only occasionally report heard data at the gate. For example, a thermometer can report temperature every minute, but this data will probably be used by the real user several times a day. Another example would be a possible home security camera keep recording and posting video at the gate, but the data will be automatically saved in a temporary database that no one eats, and then deleted by the latest video.

Service Management

With regard to service management at the end of the network, we argue that the following four key features must be supported to ensure a reliable, inclusive system difference, expansion, separation, and reliability. Differences: With rapid growth for IoT distribution, we expected more resources to be distributed at the end network, such as Smart Home. These services will have some important features. For example, critical issues such as diagnostics and failure alarm should be considered in advance standard service. Health-related service, for example, the diagnosis of a fall or heart failure acquisition should also be of high value compared to other similar service entertainment.

Optimization Metrics

At the edge of the computer, we have many layers with different computing power. Job assignment becomes a major issue. We need to decide which layer to handle task load or how many tasks you will assign to each component. There are many strategies for sharing to complete the workload, in some cases, to distribute the workload evenly over each layer or complete as much as possible in each layer. Critical conditions are fully operational the last or most active point in the cloud. Choosing the right distribution strategy, we discuss a few development metrics in this category, including delays, bandwidth, power and cost.

Latency: Latency is one of the most important performance metrics, especially in collaborative applications / services

Bandwidth: From a latency perspective, high bandwidth can reduce transmission time, especially big data.

Power: The battery is a very valuable source of resources for network infrastructure. For the last point layer, the edge workload can be treated as a non-linear method.

Cost: From the perspective of service providers, e.g., YouTube, Amazon, etc., margin the computer provides them with minimal delay and power consumption, which is likely to increase improved performance and user experience.

VII. CONCLUSION

Nowadays, more resources are pushed from the cloud to the edges of the network because processing data at the end can ensure shorter response time and better reliability. In addition, bandwidth can also be saved if a large portion of the data can be processed on it edge rather than loading in the clouds. Increased IoT and universal availability mobile devices change the boundary role of a computer paradigm from a data client to data producer / consumer. It can be very effective to process or process data at the edges network.

In this paper, we have come up with our understanding of edge computing, and the reason that computer use should occur near data sources. In this article, investigate, highlight, and report on the latest developments of Edge Computing technologies (e.g., fog computing, MEC, and cloudlets) about measurement effect on IoT. After that, we split the computer books into a taxonomy, which was used to reveal potential premium edge computing features beneficial to the IoT paradigm. We have identified a few key requirements for the distribution of edge computing on IoT and discussed key aspects of Edge computing on IoT. In addition, there are many challenges to open research on the effective use of the edge computer in IoT is identified and discussed.

We conclude that although edge computing deployment to IoT provides many benefits, the integration of these two computer systems brings new ones problems to be solved in the future.

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