Vision and Challenges of Edge Computing

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ABSTRACT: The expansion of Internet of Things (IoT) and the performance of rich cloud service has expanded the boundaries for the latest computing model of edge computing. Edge computing is capable of solving the problems of response time, battery life constraints, bandwidth saving, privacy security and safety. For some IoT applications, the response time could be incredibly small, some might be private, and others might generate a huge volume of data for the networks, which might create a large load. Cloud computing cannot accommodate these programs enough. Researcher expect the edge of a network to switch from the data provider to both the data manufacturer as well as the data user by incorporating cloud storage as an IoT drive. Within this paper, a concepts of cutting edge computing and multiple case studies covering the principle of cutting end computing from cloud offloading to smart home and community is presented. Finally, they pose many problems and opportunities in the edge computing sector and hope that this paper will draw global interest and encourage more work in this area.

KEYWORDS: Edge computing, Internet of Things (IoT), Intelligent home, Smart city, Cloud service.

INTRODUCTION

Since it was introduced around 2005, cloud Computers have profoundly influenced the way we live, operate and learn. Software as a service (SaaS), for example, was commonly used in our everyday lives as instances of Twitter, Facebook, goggle apps and Flickr. In addition, modular infrastructures and computing engines built to support cloud-based applications have major impacts on the way businesses work, such as the Google File System and Map Reduce [1], [2]. The Internet of Things (IoT) was first implemented in 1999 to the Society for supply chain management and was later quickly applied to other areas, including health care, home, climate and transportation, to' making computer-sensitive data without human interference [3], [4].' Now with the IoT program, people are in the post-cloud era, where a lot of data is created by objects which are embedded in our everyday lives and many applications are often used to absorb this data[5], [6]. By 2019, the data generated by people, computers and things are expected to exceed 500 zettabytes, however, the worldwide IP data center traffic would not attain more than 10.4 zettabytes at that time. By 2019, 45 percent of IoT-created data is processed in near proximity to or along the edge of the network. By 2020, as estimated by Cisco Internet business Solutions Company, there will be 50 billion items connecting to internet [7], [8].

Some IoT implementations may require very fast response times, some may include private information, and some may produce a huge volume of data that may be a high network loads. Cloud computing cannot serve these programs easily enough. People expect that the network will move from the data provider to both the data producer and the data user by moving pull from IoT and cloud services. Researcher seeks to contribute the idea of edge computing in this paper [9], [10]. They continue with the study of why people need edge computing, so researcher describe and see edge computing. Several cases, like Cloud Offloading, smart home, and the city, are presented to discuss the advanced computing in details, followed by a number of programming challenges, naming, service management, data abstraction, privacy and security, as well as improvement methods worth researching and studying.

1. Edge Computing

The data is generated progressively on the edge of the network, so the processing of data at the edge of the network will be more effective. Ever since cloud computing is not always effective to process data when the data is generated at network level, prior research has been implemented in this society such as micro data center, cloudlet, and fog computing. In this section, some explanations is given that why edge computing is more efficient than cloud computing for other computing resources, and then the definition of edge computing.

2. Need of Edge Computing

2.1. Push From Cloud Services:

It has been shown that the convergence of all programming functions in the cloud is an optimal way to manage data because the processing capacity of the cloud overrides items ability. Nevertheless, the bandwidth of the network has come to a standstill due to the rapidly evolving data processing capacity. Data storage is the bottleneck in the cloud-based computing model, despite the increasing amount of data produced by the edge. For e.g., every second a Boeing 787 generated data on Gigabyte, but the bandwidth between the aircraft and the ground satellite or base station is inadequate to transmit data. Another example is an autonomous car. The car will produce one gigabyte of data per second and the device will have to be analyzed in real time to take the right decisions. The response time would be unacceptable if any of the data were to be transferred to the cloud to process. Not to mention the fact that the capacity to support multiple vehicles in a single region would threaten the overall networking capability and reliability. Data must be stored at the edge in this situation for shorter response time, improved performance and a decreased network pressures.

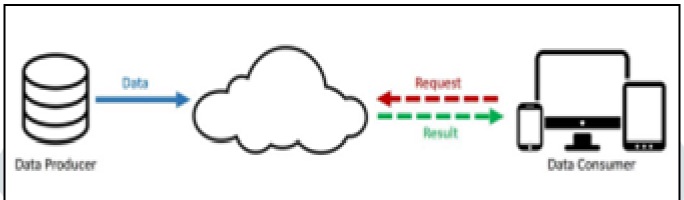

Figure 1: Cloud computing paradigm

2.2. Pull From IoT:

Almost all electrical devices will be part of IoT, and device suppliers and users such as air quality detectors, LED bars, streetlights and even an internet connected microwave will play a role. It can be estimated that in a couple of years, the amount of items on the network's edge will rise to over billions. Therefore, their raw data would be immense and modern cloud computing would not be adequately powerful to cope with all those data. This ensures that most IoT data are never migrated to the cloud, but are used on the network edge. Figure 1, shows the standard structure for cloud computing. As shown by the Blue Solid line, device manufacturers generate raw data to the cloud and forward it to the server. The red dotted line represents the order for data use from data users to the cloud. The cloud effect is represented by the green dotted line. This arrangement is however not enough for IoT. The first aspect that results in an immense excessive bandwidth and computer resource consumption is the data volume at the edge. Furthermore, the need for privacy protection presents a challenge for IoT cloud computing. Finally, most of the final nodes in IoT are energy limited objects and the Wi-Fi module is typically very energy-hungry, so it could be more energy efficient to discharge certain computing functions on the edge.

3. Change from Customer Data to Producer

The end users on the edge typically act as data consumers in the Cloud computing model, for example while streaming a YouTube video on a mobile. Yet people still produce data from their mobile devices today. The transition from data consumer to data producer / user needs an improved location at the edge. For example, people take pictures or capture video and share data through a cloud service like YouTube, Facebook, Twitter or Instagram nowadays. It's very popular. In comparison, every minute, the users of YouTube upload 72 hours of new video material; almost 2.5 million content from Facebook; almost three hundred thousand times for Twitter users; and almost 220 000 new images for Instagram users. The picture or video clip may still be relatively wide and would take up a lot of bandwidth. In such a scenario, before uploading to the cloud, users can delete the video clip and change it to the correct resolution at the edge. Wearable health devices would also be an example. As the actual data obtained at network edges are typically confidential, data analysis at the edge could better protect user privacy than raw data deposited into the cloud.

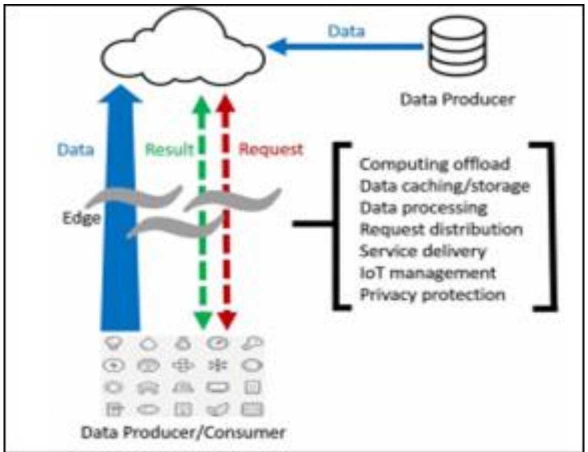

Figure 2:- Edge computing paradigm

4. Edge Computing

Edge computing is the infrastructure allowed for the processing of downstream data on behalf of cloud services and upstream data on behalf of IoT services on the edge of a network. There we describe "edge" as the route between cloud data sources and cloud data centers, as any device and network infrastructure. For e.g., a cell phone is the edge between bodily items and the cloud, the edge between home and the cloud is the portal into a smart home, the edge between a mobile computer and a cloud is a micro data-center. The explanation for cutting edge computation is that processing will take place near the data sources. In some point of view, edge computing can be interchanged with fog, but edge computing concentrates more on the side of things, whereas fog computing focuses more on the side of networks. They assume that edge computing will affect the culture as well as cloud computing. Fig. 2 shows the edge computing directional flow. In the edge computing model, not only data users, but also data producers are concerned. At the edge of the web, stuff can not only call for service and information but also execute cloud computing activities. Cloud offloads networking, data collection, routing and application retrieval, and distributes cloud configuration and distribution services. The edge must be carefully built to satisfy the demands efficiently, for example, in operation stability, health and security of privacy.

5. Benefits of Edge Computing

Researcher wants to position computing near the data sources in edge computing. Compared to conventional cloud-based computing paradigms, this has many advantages. They include some early group tests here to illustrate the possible advantages. Researchers have developed a proof-of-concept infrastructure to run the face recognition program, and by moving the device from cloud to border, response times are reduced from 900 to 169 ms. Cloudlets were used by researchers to offload wearable cognitive support computing functions and this indicates an increased reaction time from 80 to 200 m. In fact, cloud storage could also eliminate electricity usage by 30%–40%. Clone cloud may become the runtime and resources to 20 digits for checked applications by integrating partitioning, replication with mixing, and on-partitioning instantiation between the device and the cloud.

6. Opportunities and Challenges

In the last segment, five possible edge computing applications have been identified. They suggest that the applications and the network ecosystem have to work together to understand the meaning of edge computing. This section will include a comprehensive overview of these problems, and discuss possible approaches and opportunities worth pursuing, including programming, naming, data abstraction, database management, security, privacy and optimization.

7. Programmability

Users configure and execute their technology on the cloud of cloud computing. The service operator is responsible for deciding where processing takes place in a system. Users are aware of zero or incomplete whether the code is going. It is one of the advantages of cloud computing, which is a user transparent platform. In addition, the software, since the program only runs in the cloud, is compiled in one programming language for a single target platform. Nevertheless, the computations are imported from the cloud in the edge computing process, and the edge nodes are most possibly heterogeneous. The runtime of those nodes in this situation varies and the programmer faces immense difficulties in creating an application which can be used in the edge calculation paradigm. They suggest the concept of computer stream, defined as a set of functions / computing used on data along the data flow process, to discuss the programming features of edge computing. The functions / computing can be complete or partial, and the computation can happen anywhere on the way as long as the device determines where the computation is to be carried out. The processing stream is the computerized flow of information such that data can be managed on data servers, edge nodes, and the cloud system transmitted and effectively. A lot of computation can be made on the edge instead of the center cloud, as described in edge computing. In this case, the information stream will assist others in evaluating the functions and the retrieval of the data after the calculation has occurred at the bottom. The latency metrics of the functions / computing delivery, energy costs, TCOs and hardware / software limitations listed. The comprehensive cost model is discussed in Section IV-F. They expect data to be measured as near as possible to the source and data processing costs to be minimized by using a database stream. The function should be reassigned to a computer stream, and the information and status can be reallocated along with the function. However, problems of integration (e.g. scheduling, transfer of data / state etc.) will be discussed in the framework of edge computing through several layers.

8. Naming

One essential concept of edge computing is that there are a large amount of things to do. There are several programs at the top of the edge nodes and every device has its own framework as to how it is distributed. As all the computer systems for scripting, addressing, recognition and data transmission, in edge computing, the naming scheme is very important. However, a successful naming system has not yet been developed and standardized for the edge computing model. Edge practitioners typically involve learning various protocols of communicating and networking in order to communicate with heterogeneous objects in their program. The edge computing system must manage the mobility of the objects, highly complex network topology, protection and health, and the scalability of the unfaithful things.

Most modern networks are effectively supported by standard naming frameworks including DNS and standardized resource recognition. They are not, though, versatile enough to support the complex edge network, because most of the stuff at the edge might be extremely mobile and with minimal resources. In comparison, IP-based naming may be too noisy to accommodate the sophistication and generality of certain items at the edge of the network that are resource limited. New naming structures may be implemented for edge computing, such as NDN and Mobility First. For content / data centric network, NDN offers a hierarchically organized name which is human for service management. In order to work with other networking protocols like Bluetooth or ZigBee, it will require additional proxy, though. Another issue related to NDN is protection, as hardware knowledge is very difficult to separate from service providers. In order to have increased connectivity support Mobile First would distinguish name from network address and it would be very useful if it were extended for specialized networks where things are extremely mobile. Sadly Mobile First has to be able to label a global unique identifier (GUID) and this is not available at the edge of the network, such as the home area, for the corresponding fixed information processing function. The challenge in service administration as GUID is not human-friendly is another downside of Mobile First for edge.

9. Data Abstraction

Different applications may run on edge OS, which collect data or provides a service through the air position indicators from the service layer. In the wireless sensor network and the cloud computing model data abstraction has been extensively debated and researched. Nevertheless, this problem is more complex in edge computing. There will be a large amount of data generators in the network with IoT, so we take an example of an intelligent home environment. Different applications may run on edge OS, which collect data or provides a service through the air position indicators from the service layer. In the wireless sensor network and the cloud computing model data abstraction has been extensively debated and researched. Nevertheless, this problem is more complex in edge computing. There will be a large amount of data generators in the network with IoT, so we take an example of an intelligent home environment. On the basis of this finding, it is our goal to eliminate human involvement in edge computing and to consume / process all data and engage pro-actively with users in the edge node. In this scenario, data at gateway level will be preprocessed, for example, noise / low-quality elimination, incident identification, and confidentiality protection, etc. For possible service provisioning, collected data should be sent to the upper layer. During this phase, there will be multiple challenges.

CONCLUSION

More and more resources are now being moved from the cloud to the edge of the network as the transmission of data on the edge will provide reduced reaction time and better reliability. In fact, bandwidth can be reduced if a significant volume of data may be stored on the edge instead of uploading to the cloud. In the computing paradigm from a data collector to a data producer / user, the development of IoT and universalized mobile apps changed the position of edge. Processing or relaxation data at the edge of the network will be more effective. Within this paper they have established the own interpretation of edge computing, based on the idea that data sources can be standardized. Then we list a variety of situations in which edge computing will succeed in a smart world, like the home and the urban core. They are now implementing distributed edge, because edge can physically and technically link end user and cloud so that the conventional cloud computing model is not only enabled, but also as data is nearby it can bring long-networks together for data exchange and collaboration. In the end, they have raised problems and incentives to work on such issues as scripting, naming, aggregation of data, management of resources, privacy and security, and optimization steps. Edge computing is here, and this paper will carry this to the community's attention.

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