Methods and Results Section

Group:NO.6

Why

- Influence
- Academic status
- Technical innovation

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Application of Cloud Edge Collaboration Architecture in Power IoT

TAO Jing[1,2,3], JIN shen[4], TANG Jia[5], JI Yutong[4], ZHANG Ning[5]
1.Global Energy Interconnection Research Institute
2.State Grid Laboratory of Electric Power Communication Network Technology
3. Southeast University
Nanjing China
4. State Grid Jibei Electric Power Company Limited
5.State Grid Information & Telecommunication Branch

***Abstract*—In order to solve the problem of network resource redundancy and overload caused by the widespread use of chimney-type independent service access in the current power IoT architecture, this paper proposes a model of cloud edge collaborative architecture applied to the power IoT. In this mode, edge computing devices or networks are set up around the perception layer devices of the power IoT to process massive power / non-power data locally. This model combines the centralized nature of cloud computing and the decentralized nature of edge computing to meet the requirements of big data computing and real-time analysis of local data, and fits the complex network and data access and management requirements of the power IoT.**

Keywords—cloud computing; edge computing; power internet of things(power IoT)

I Introduction

With the rapid development of network communication technology and the increasing number of user services, traditional cloud computing has been unable to meet the requirements of rapid network service response, data protection, and network flexibility in some areas. Edge computing makes up for some shortcomings of cloud computing by providing computing services on the device or data side, but cloud computing is superior to edge computing in terms of construction costs and functional scalability. Therefore, the coordinated work of edge computing and cloud computing can better meet the needs of various application scenarios. With the advent of the Internet of Everything, the number of sensing terminals and the total amount of power / non-power data of the power system connected to the Internet of things will also increase exponentially. A large number of terminal devices in the sensing layer transmit information to the application server in the platform layer through the power communication network and power data network, which brings high risk of concurrent data upload to the network layer and easily leads to network congestion. The platform layer handles a large amount of redundant data, which also greatly wastes storage and computing resources. In order to solve these problems, it needs to study the application mode of cloud edge collaborative architecture in the power internet of things.

II Cloud Edge Collaboration Architecture

The development of cloud computing and edge computing

Cloud computing is a type of distributed computing, the huge data calculation processing program is decomposed into countless small programs through the network "cloud". Then, these small programs are processed and analyzed by a system composed of multiple servers to obtain the results and return to user. Cloud computing is divided into two layers: terminal and cloud computing center. The terminal just sends a request to the cloud and receives and displays the processing results. All computing and storage operations are carried out in the cloud computing data center.

Since IBM proposed cloud computing in 2007, cloud computing and its services have been widely used. However, with the rapid development of network communication technology and user services, especially the emergence and development of ubiquitous communication networks, the inherent problems and defects of cloud computing have begun to emerge, making cloud computing no longer the best computing model.

- The rapid development of Internet of things. With the appearance of perception, interconnection, intelligence and other characteristics of the Internet of things, the huge number of intelligent sensing terminals at the bottom of the Internet of Things generate massive amounts of sensing data, all of which need to be uploaded to the cloud computing data center, which will occupy a large amount of network bandwidth and computing resources.
- Bandwidth and real-time problems brought by the popularity of intelligent terminals. As the utilization rate of smart phones, appliances, portable computers, and wearable devices has greatly increased, multimedia services have increasingly higher requirements on network bandwidth and real-time performance. In the whole year of 2019 alone, the total global smart phone shipments are 1.486 billion, and the total global tablet Market shipments are 144 million.

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3-1 The Struction of the Method Section

Importance: This section is considered the most important section in a research study, because it provides the information by which the validity and credibility of a study can ultimately be judged.

Different titles of the method section

- Materials and Methods
- Theory and Methods
- Theoretical Framework and Methods

3-1 The Struction of the Method Section

Fig. 3. Power Internet of things architecture based on cloud edge collaboration

the perception layer of the power Internet of things includes environmental monitoring, multimedia services, comprehensive energy, power distribution services, power consumption services, etc. Environmental monitoring business is connected with temperature sensor, humidity sensor, pressure sensor, voltage sensor and other sensing equipment; multimedia business is connected with audio recording equipment, video recording equipment, camera and other sensing equipment; integrated energy is connected with intelligent sensing module of photovoltaic equipment, charging post, wind turbine, nuclear power device and other equipment; distribution business is connected with total meter and reactive power compensation of the station area Intelligent sensing module of compensation, fantasy switch and other equipment; intelligent electricity meter, intelligent home appliance, electric vehicle and other sensing equipment are connected under the power business.

According to the specific calculation requirements, installation environment and cost considerations, different domains can be divided according to different devices, networks, data or applications, and edge calculation nodes can be set nearby in each domain. The sensing equipment under the jurisdiction is connected to the edge computing node equipment through the local communication network. The

widespread installation of edge computing equipment also increases the cost of system construction and operation and maintenance. At the same time, there are also problems in the coordination of computing tasks, resource scheduling, and management collaboration between the platform layer, application layer, and edge computing network. How to solve and solve these problems and realize the global view management and flexible scheduling of cloud computing, edge computing and sensing devices are the directions of the next research.

Acknowledgment

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References

[1] XU Enqing, DONG Enran. Exploration and practice of collaborative development of cloud computing and edge computing[J]. Communications World, 2019(09):46-47.

communication technology to realize the interconnection of everything in the power system , Human-computer interaction, intelligent service system with comprehensive status perception, efficient information processing, convenient and flexible application features. Internet of Everything refers to the connection between power users and their equipment, power grid companies and their equipment, power generation companies and their equipment, suppliers and their equipment, and the generation of shared data.

The hierarchy of the power Internet of things architecture system is consistent with the traditional Internet of things system, including four levels: perception layer, network layer, platform layer and application layer, as shown in Figure 2.

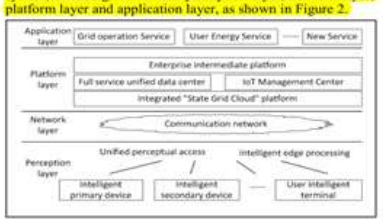


Fig. 2. Power IoT architecture

The composition and functions of each layer are as follows:

1) Perception layer

The perception layer is the foundation of the power Internet of Things, which realizes the perception, monitoring, collection and reporting of basic data. The perception layer devices includes intelligent primary devices (such as

characteristics of massive information interaction and high openness of ubiquitous power Internet of things in heterogeneous networks in the perception layer, the network layer has established authentication and key agreement mechanisms between the nodes of the access network and the end-to-end of the core network.

3) Platform layer

The platform layer completes the storage and management of the primary system, secondary system, and user-side data uploaded by the perception layer. Solve the problem of information fragmentation by using big data, artificial intelligence and other technologies to fuse, analyze, and store massive sense data. Through unified management and update of data, information islands are avoided, and upper-layer applications provide unified shared data, realize unified management of ultra-large-scale terminals, and lay the foundation for hub, platform, and shared data management.

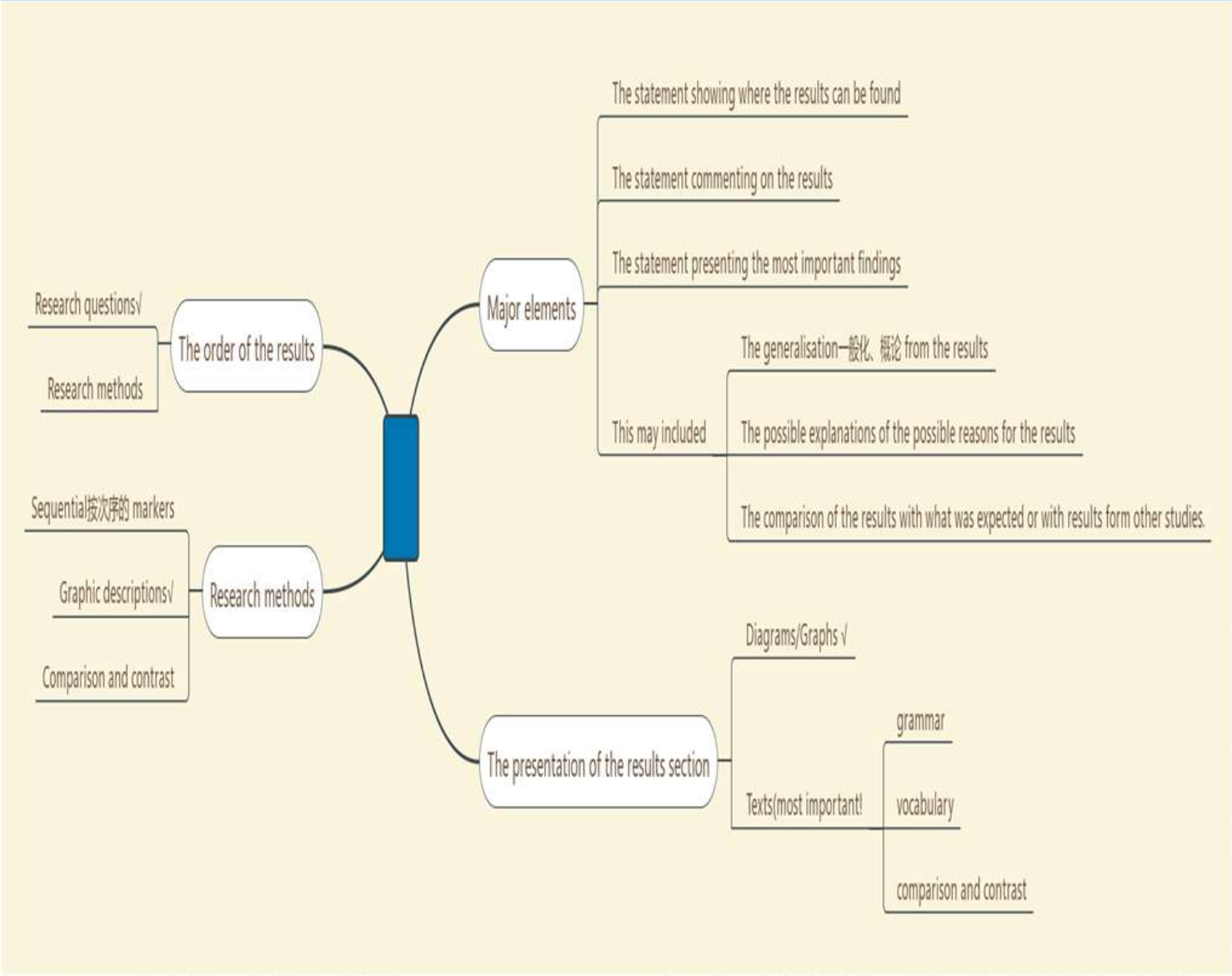
4) Application layer

The application layer is the business application platform for grid data information. The application layer enables entities such as power generation, transmission, transformation, distribution, and use enterprises and users to access the unified ubiquitous power IoT cloud platform, providing end users with more intelligence for grid operation business, user energy consumption business, and integrated energy system operation business Power application services to realize the perception and interaction of the entire network system, users and other energy systems.

IVPOWER INTERNET OF THINGS ARCHITECTURE BASED ON CLOUD EDGE COLLABORATION

The ubiquitous nature of the power Internet of Things has made the Internet of Things sensing equipment widely distributed in the power generation, transmission,

3-2 The Structure of the Results Section



3-2 The Structure of the Results Section

- CLOUD EDGE COLLABORATION ARCHITECTURE
  - The development of cloud computing and edge computing
    - The inherent problems and defects of cloud computing have begun to emerge.
    - （The statement showing where the results can be found）

In order to solve the above problems, the Pacific Northwest National Laboratory in the United States proposed the concept of edge computing in 2013, and Carnegie Mellon University in the United States proposed the edge computing model in 2015. This is a new network function that provides interconnected computing and storage resources. This network function is located near the users. The main features of edge computing are to improve user experience through extremely low latency and reduce data traffic through edge services.

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3-2 The Structure of the Results Section

- Cloud Edge Collaborative Architecture
  - （Comparison and contrast）Compared with traditional cloud computing

Edge computing is a mesh network that can process or store critical data locally and push all received data to a central data center or cloud storage repository. Compared with traditional cloud computing, edge computing has the following obvious advantages:

- Massive data is preprocessed nearby, and a large amount of redundant information and temporary information are properly processed, and are no longer fully uploaded to the cloud data center, which saves network bandwidth and storage computing resources.
- Processing information from similar devices nearby reduces the difficulty of heterogeneous device information collection and processing, improves data preprocessing and local service capabilities, and reduces the cost of edge computing and cloud computing.

3-2 The Structure of the Results Section

- （The generalization from the results）

Edge computing is an effective supplement to cloud computing. They need to work together to meet the requirements of each scenario. In the cloud edge collaborative work, edge computing is responsible for the processing tasks of real-time and short period data as well as the real-time processing and execution of local businesses, providing high-value data for the cloud; cloud computing is responsible for the computing tasks that edge nodes are not competent for, at the same time, through big data analysis, it is responsible for the processing of non real-time and long period data, optimizing the output business rules or models.

3-2 The Structure of the Results Section

- （The possible explanations of the possible reasons for the results）

Figure 1 is the basic architecture of cloud-side collaboration. This paper proposes two ways of cloud computing and edge computing collaboration.

- The first is a three-layer network structure, which is divided into intelligent terminals, edge clouds, and central cloud. The edge cloud is similar to the central cloud structure, including computing resources, storage resources, and cloud applications. This kind of structure is suitable for large-scale network networking. The edge cloud can independently undertake part of the cloud computing tasks connected to the intelligent terminal, and at the same time, it can be connected to the central cloud. Application scenarios include prefecture-provincial-central data centers, enterprise private cloud-public network cloud services, etc.

- The second type is a two-layer network structure, including intelligent terminals, edge access nodes, edge computing nodes, and a central cloud. The intelligent terminal accesses the edge access node, and the edge computing module preprocesses the data and uploads it to the central cloud. After completing operations such as data redundancy processing, effective data screening, and heterogeneous data conversion, edge computing nodes upload data to the central cloud, and the central cloud completes data storage and calculation.

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3-2 The Structure of the Results Section

- BASIC STRUCTURE OF POWER INTERNET OF THINGS
  - （Graphic descriptions）

The hierarchy of the power Internet of things architecture system is consistent with the traditional Internet of things system, including four levels: perception layer, network layer, platform layer and application layer, as shown in Figure 2.

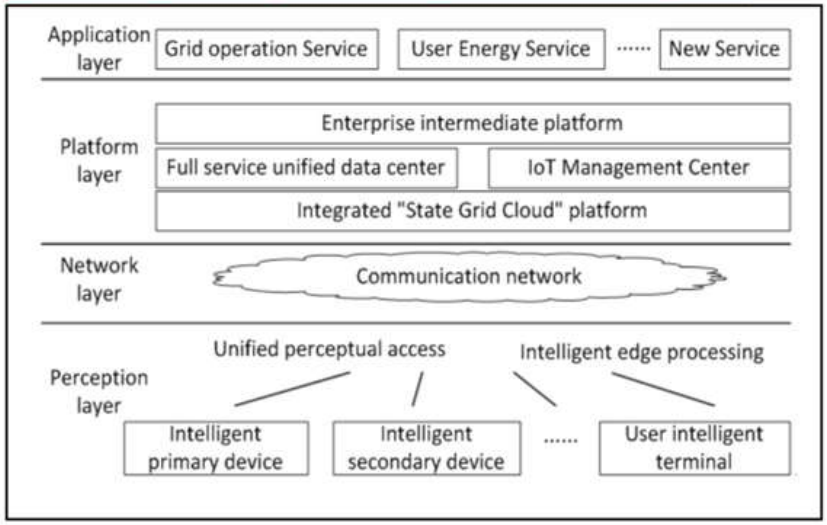

Fig. 2. Power IoT architecture

The composition and functions of each layer are as follows:

3-3 Sequential markers

Cloud computing is a type of distributed computing, the huge data calculation processing program is decomposed into countless small programs through the network "cloud". Then, these small programs are processed and analyzed by a system composed of multiple servers to obtain the results and return to user.

This paragraph describes the detailed process of cloud computing, and the conjunction "then" indicates the sequential relationship, which strengthens the connection between sentences and makes the whole process concise and clear.

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3-3 Sequential markers

Cloud computing is responsible for the computing tasks that edge nodes are not competent for, at the same time, through big data analysis, it is responsible for the processing of non real-time and long period data, optimizing the output business rules or models.

The conjunction "at the same time" indicates a juxtaposition.This means that the two events occurred at the same period, ensuring a degree of logic and connectivity between sentences

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3-3 Sequential markers

The first is a three-layer network structure, which is divided into intelligent terminals, edge clouds, and central cloud. The edge cloud is similar to the central cloud structure, including computing resources, storage resources, and cloud applications. This kind of structure is suitable for large-scale network networking. The edge cloud can independently undertake part of the cloud computing tasks connected to the intelligent terminal, and at the same time, it can be connected to the central cloud. Application scenarios include prefecture-provincial-central d3ata centers, enterprise private cloud-public network cloud services, etc.

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The "first" and "second" at the beginning of the paragraph indicate a specific time frame, proposing two approaches to cloud and edge computing collaboration, and detailing the network structure and role of each approach.

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3-4 Graphic description

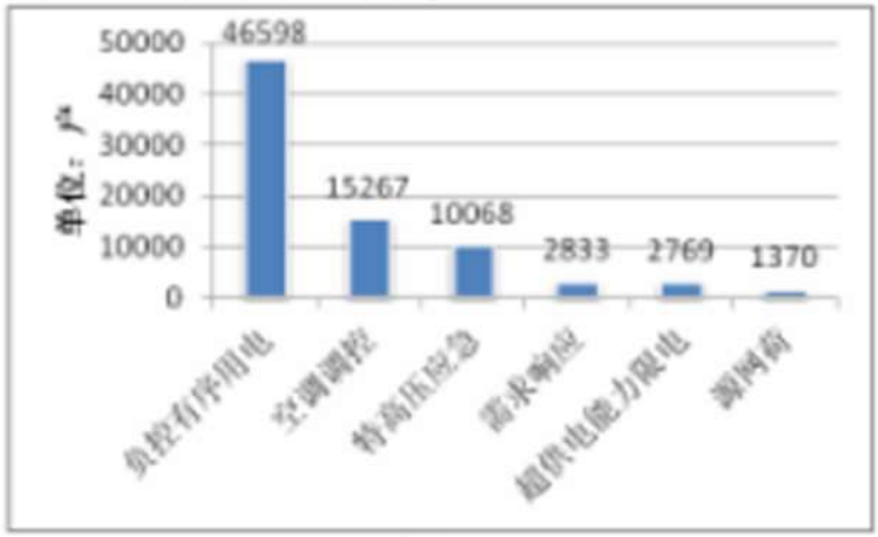
A. Introduction of graphs

The definition

A graph is a diagram, usually a line or a curve , which shows how two or more and sets of numbers measurements are related.

The types

Graphs usually include bar/column charts /graphs, pie charts and line graphs



Number of users involved in various control methods

3-4 Graphic description

B. Use of graphs in the results section

Prepare the graphs as soon as all the data are analyzed and arrange them in the sequence that best presents your results in a logical way
Describe the graphs well because good descriptions can help the readers understand your research better.

C. Description of Graphs

Step 1 Introduce the graphic information briefly and indicate the main trend . Normally it includes the place, time ,content and purpose of the graph;
Step 2 Describe the relevant and most important or significant data and make some comparison if necessary
Step 3 Summarize the data /trends

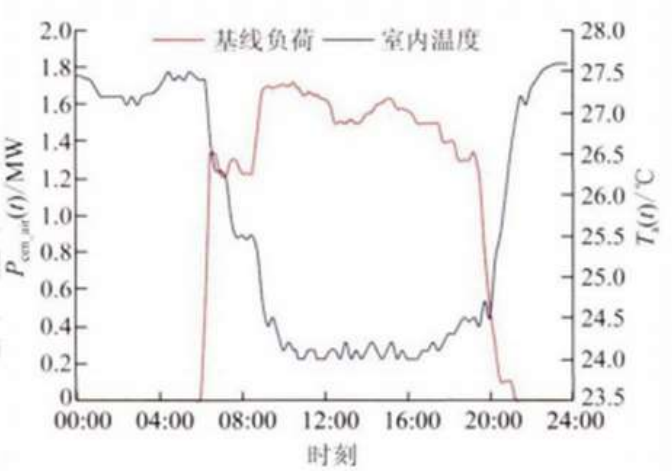


图 4　南京市某公共楼宇中央空调运行特性

3-4 Graphic description

D. Useful words, phrases or sentence patterns in different situations of graphic description.

Graphical description of hierarchical association of things.

Expressions for

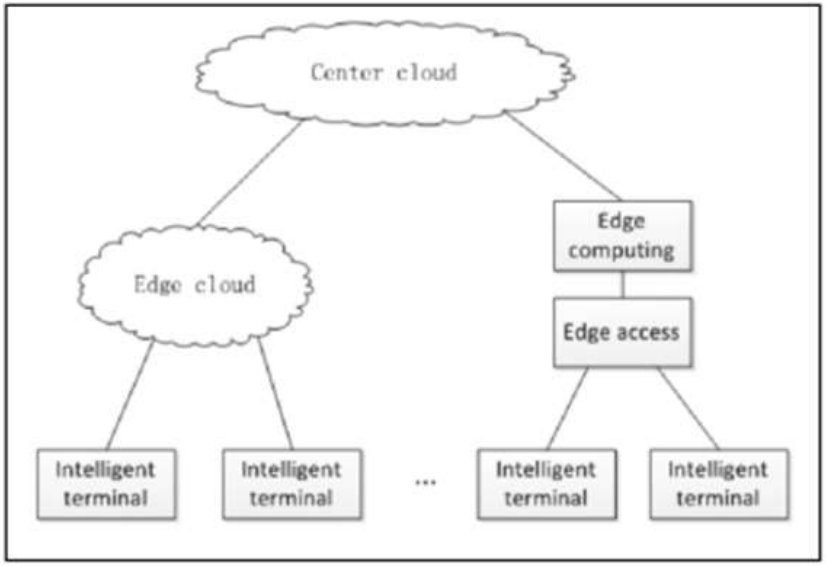


Fig.1 Basic architecture of cloud edge collaboration

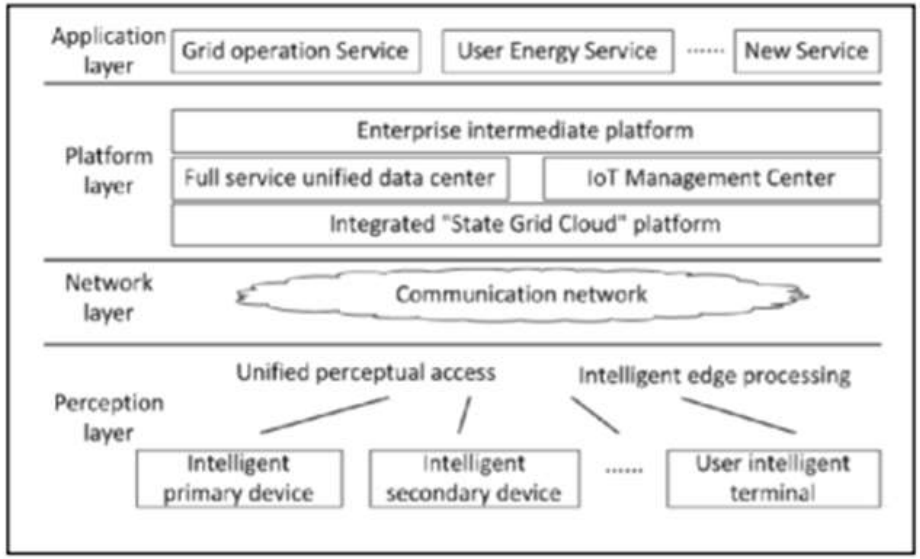


Fig.2 The composition and functions of each layer are as follows

3.5 Comparison and Contrast

A. The definition and commonly used expressions
Comparison: To show the similarities

For example:

> The hierarchy of the power Internet of things architecture system is consistent with the traditional Internet of things system, including four levels: perception layer, network layer, platform layer and application layer, as shown in Figure 2.

Contrast: To show the differences

For example:

- The development of emerging network technologies. With the development of SDN and NFV technologies, users prefer to realize more flexible network networking and network resource management through software to relieve their dependence on manufacturers. This is contrary to the centralized management model of cloud computing.

3.5 Comparison and Contrast

B. Two major ways of organization

Organization of block comparison/contrast	Organization of alternating comparison/contrast
Subject A: Point # 1 Point # 2 Point # 3 Subject B: Point # 1 Point # 2 Point # 3	Point # 1: Subject A VS Subject B Point # 2: Subject A VS Subject B Point # 3: Subject A VS Subject B

Organization of block comparison/contrast	Organization of alternating comparison/contrast
Subject A: Point # 1 Point # 2 Point # 3 Subject B: Point # 1 Point # 2 Point # 3	Point # 1: Subject A VS Subject B Point # 2: Subject A VS Subject B Point # 3: Subject A VS Subject B

3.5 Comparison and Contrast

Block comparison/contrast: To examine one thing thoroughly and then examine the other

Since IBM proposed cloud computing in 2007, cloud computing and its services have been widely used. However, with the rapid development of network communication technology and user services, especially the emergence and development of ubiquitous communication networks, the inherent problems and defects of cloud computing have begun to emerge, making cloud computing no longer the best computing model.

- The rapid development of Internet of things. With the appearance of perception, interconnection, intelligence and other characteristics of the Internet of things, the huge number of intelligent sensing terminals at the bottom of the Internet of Things generate massive amounts of sensing data, all of which need to be uploaded to the cloud computing data center, which will occupy a large amount of network bandwidth and computing resources.
- Bandwidth and real-time problems brought by the popularity of intelligent terminals. As the utilization rate of smart phones, appliances, portable computers, and wearable devices has greatly increased, multimedia services have increasingly higher requirements on network bandwidth and real-time performance. In the whole year of 2019 alone, the total global smart phone shipments are 1.486 billion, and the total global tablet Market shipments are 144 million.
- Heterogeneity of intelligent terminals. Intelligent terminal usually adopt different data protocol and network system according to the consideration of geographical location, business type and cost. When accessing cloud computing data center upward, heterogeneous integration of each terminal should be considered.
- The development of emerging network technologies. With the development of SDN and NFV technologies, users prefer to realize more flexible network networking and network resource management through software to relieve their dependence on manufacturers. This is contrary to the centralized management model of cloud computing.

3.5 Comparison and Contrast

Alternating comparison/contrast: To examine two things at the same time, discussing them point by point

Edge computing is a mesh network that can process or store critical data locally and push all received data to a central data center or cloud storage repository. Compared with traditional cloud computing, edge computing has the following obvious advantages:

- Massive data is preprocessed nearby, and a large amount of redundant information and temporary information are properly processed, and are no longer fully uploaded to the cloud data center, which saves network bandwidth and storage computing resources.
- Processing information from similar devices nearby reduces the difficulty of heterogeneous device information collection and processing, improves data preprocessing and local service capabilities, and reduces the cost of edge computing and cloud computing.
- The privacy data is preprocessed locally, without uploading all data to the public cloud, which can solve the problems of data privacy protection and security protection to a certain extent.

C.Tips for making comparison or contrast

1. Not all the information has to be compared or contrasted with each other.
Choose the most significant or important information:Cloud computing and Edge computing; The traditional Internet of things System and The power Internet of things architecture system

2. It is not necessary to lay equal emphasis on every change.
Just give stress to those dramatic changes or those that are of special interest to you or those that you want your readers pay more attention to.

3. The comparison/contrast should be supported by concrete and relevant facts or data.

3.6 Reference

[1]T. Jing, J. shen, T. Jia, J. Yutong and Z. Ning, "Application of Cloud Edge Collaboration Architecture in Power IoT," 2020 IEEE International Conference on Information Technology,Big Data and Artificial Intelligence (ICIBA), Chongqing, China, 2020, pp. 18-22, doi: 10.1109/ICIBA50161.2020.9277488.

Thanks for listening