

# Research on the Deployment of MEC Edge Computing Platform Based on 5G Network in Power System

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## Abstract

With the rapid development of cloud computing, Internet of Things, AI and other technologies, edge computing technology has also developed rapidly. To be on the safe side, especially those mid-sized, larger utilities are more inclined to use edge computing. To this end, this paper conducts an in-depth discussion on the application of the MEC edge computing platform on 5G networks. A distributed power architecture based on distributed computing is proposed, and the distributed application of MEC is studied from two aspects: distributed application model and distributed service carrier. Experiments on the effect of deploying the live network pilot show that: the power system delay of the platform in the comparison case, the power system delay of the local forwarding platform is shortened by 50%, the deployment effect is faster, the delay is shorter, and the efficiency is higher.

## Keywords

5G network; MEC; edge computing; computing platform; power system; deployment research; power deployment;

## 1. Introduction

With the development of 5G network technology, the application scenarios of 5G continue to improve the user experience, and also provide new development methods for various vertical fields such as electricity, transportation, and medical care [1]. This technology can extend core services such as computing, storage, and offloading to the edge of the network, thus meeting the requirements for various vertical fields [2]. At the same time, because the communication between various services and base stations in the power grid also requires 5G technology to support, and as the requirements for bandwidth and delay become higher and higher, the boundary computing platform of MEC has also shifted from the operator side to the the power side [3]. However, in the power grid, there are many types of services, complex network layers, different master station locations, and high security requirements. Therefore, how to configure the MEC-based edge computing platform has become an urgent problem to be solved [4]. It can take advantage of specific network services and certain characteristics of the power system to extend some functions of its center to the edge of the network to save costs, reduce delay, optimize traffic and enhance security [5]. According to the industrial ecology and actual development, the edge computing of MEC can be divided into two parts: local offload and data service. Using MEC to achieve localized services can improve user experience and save transmission bandwidth and transmission costs [6]. On the MEC platform, through the open interface for users, the basic knowledge of the network can be fully utilized and massive data can be analyzed to realize high-value intelligent services for users [7]. In different types of MEC edge computing such as 4G and 5G, the high bandwidth and low latency of 5G make it further applied in the power system.

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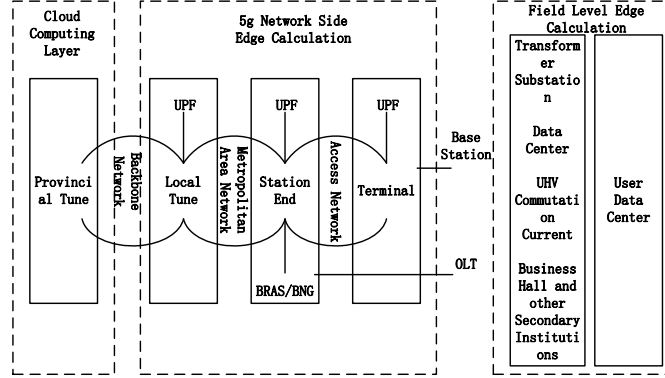
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## 2. Power system architecture of MEC edge computing platform based on 5G network

The MEC edge computing system is divided into three layers: cloud, edge, and on-site. Edge computing is between the cloud and on-site layers. The edge level provides access to various on-site devices downward, and the specific configuration is shown in Figure 1 below. Location [8].



**Figure 1** Deployment locations of edge computing

According to the MEC edge computing of 5G, its distribution distance is relatively close, and research shows that the deployment of edge computing is closely related to the actual situation. These influencing factors mainly include the quality requirements of the network and the delay required by the scene. According to the corresponding infrastructure and enterprise development characteristics of power system enterprise terminals and terminals, the boundary computing of China's power communication enterprises can be divided into two types in practical applications, namely networked and primitive. In the computer room between cities, there are a large number of clouds, which are small data centers. In order to retain better data, when selecting the source, this paper calculates the fitness of each data according to the following formula (1). probability.

$$p(i) = \frac{f(i)}{\sum_{i=0}^M f(i)} \quad (1)$$

in,  $p(i)$  represents the probability value of selecting data  $i$ , use  $f(i)$  For the calculation of the fitness

value of the fitness value of  $i$ ,  $\sum_{i=0}^M f(i)$  Refers to the sum of the compatibility of all data. On the operator's Internet, edge computing is usually deployed on computers owned by users, and most of them have no room, so it is the primary node for users to enter the network.

### (1) Field-level edge computing

The field layered network is close to the sensors, devices, controllers, etc. in the field. Devices such as field nodes and peripheral gateways are interconnected by a variety of local area networks and industrial buses, so as to achieve the interaction of data and control procedures at the local level and the boundary level.

### (2) 5G network side edge computing

The edge layer is a key part of the edge computing architecture. The system receives, processes, forwards, provides intelligent computing, process optimization and other services from the field level.

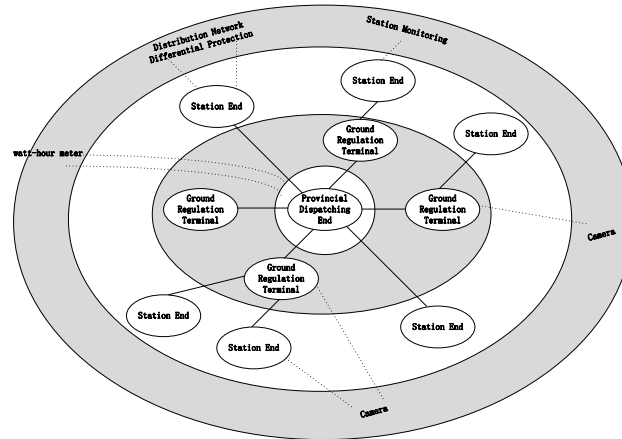
### (3) Cloud computing layer

Cloud computing provides an interface for enterprise decision support, intelligent production, networked collaboration, service extension and personalized customization.

### 3. Deployment of MEC edge computing platform in power system

#### 3.1. Platform Deployment Mode

The MEC edge computing platform can be deployed according to the network architecture of the power system.



**Figure 2** Architecture diagram of MEC edge computing deployment mode

In addition, according to the needs of business security protection, the peripheral computing system of the MEC is divided into two, one of which is responsible for the peripheral system, responsible for the network elements of the 5G core network and the boundary computing server, so as to ensure the isolation needs, and calculate the UPF network at the same edge. Meta redundancy.

#### 3.2. Service Bearing Solution

After the edge computing device is installed in the power system, the efficient communication of power and public network services can be carried out through the edge computing platform of MEC. Since the job is generated by the local terminal device, in this system, when the operation job does not need to be sent, only the time required for the operation of the task on the local terminal is performed. Its specific expression is shown in the following formula (2):

$$T_{m,l}^d = L_{m,l} / \int_{m,l} \quad (2)$$

In the formula,  $\int_{m,l}$  Represents the ratio of the clock frequency to the terminal device, and the computational workload set on the local terminal 1 is  $L_{m,l}$ , Therefore, in this machine, according to the direction of the service, its load mode is divided into local load and off-site load.

(1) Uninstall locally.

In these systems, site-side camera monitoring, 5G inspection, robot inspection, distributed monitoring, etc. all need to be locally unloaded at the site side, and edge computing MEC technology is used to perform local monitoring at each site according to the security isolation requirements of each partition. Data offload. Among them, the service sharing of industrial customers and management information partitions of the public Internet can realize the separation of services by utilizing the layering of the network.

(2) Offsite uninstillation.

Large-capacity power services, such as drone inspection, video surveillance, etc., through the edge computing platform at the MEC end of the terminal, through the preliminary analysis of the signal, the signal can be sent to the ground control end and the provincial control end for remote unloading, which not only saves money The bandwidth and cost of transmission can be reduced, and the security and stability of the service can be ensured. At the station end, the return channel between the ground and provincial tunes can be backhauled by an operator backhaul network, or a power-specific backhaul

network can be used for backhauling, so as to provide the Network segments provide end-to-end offload separation.

## 4. Deploying the pilot effect of the existing network

### 4.1. Experiment preparation

In order to test the local cache capacity of the MEC edge computing power system platform, this paper has conducted relevant tests on the existing network. The test objects are 5 stations and 10 units. The data source of this paper is the provincial grid company. The dispatching network structure of the grid is divided into provincial dispatching, provincial transmission, local dispatching, prefecture and municipal transmission network, station and terminal. The service bandwidth is required to be between Kbps and Mbps, and the delay is required to be between milliseconds and seconds, mainly distributed in local, local and provincial dispatching. The power system is supported by three applications with low delay (mmtc access, embB enhancement, mobile broadband embB enhancement, ultra-low delay and high reliability urllc) such as wide coverage (power consumption information collection and distribution automation), large bandwidth (video monitoring and robot patrol inspection), low delay (distributed feeder automation and precise load control). The experiments compare the cache of wireless core network and browsing service delay.

### 4.2. Experimental results

The test results of the local caching of the MEC edge computing platform in the power system are shown in Table 1.

**Table 1:** MEC local cache implementation effect

	Web page download		video visit	
	Throughput/MB.-s-1	Throughput improvement	first buffer time/ms	Latency reduction
Not cached	3.35	-	350.5	-
Core network cache	3.85	16.5%	285.5	20.5%
local cache	5.5	65.5%	265.5	25.5%

System delay capability: Compared with uncached, the first buffer delay of power system data is reduced by 20%, and the download speed is increased by about 50%. Compared with the core network cache, the wireless cache has a certain gain, but its advantages are not significant. Download success rate: At its peak, the hit rate of the network cache reached 17%. This is because the user's data is concentrated, so there is a high chance of coincidence. Save transmission bandwidth: Save 16% of transmission bandwidth. Experiments have proved that the deployment cache using the MEC edge computing power system platform shortens the distance between users and content, and improves the browsing service of 5G network users to the network; the benefits of users gather characteristics, which can ensure the power system cache accuracy. Figure 2 shows the experiment of applying MEC technology to realize the transmission delay of LAN on edge computing platform.

Table 2 Delay test results

Delay Type With MEC Without MEC Gain

Delay 25ms 50ms 50%

The localized transfer of MEC requires the functions of path analysis and address conversion, so local transfer can be performed. The delay experiment of the MEC LAN was carried out in the power grid, and the delay in the LAN was compared. According to the data in the above table, the power system delay of the local forwarding platform is shortened by 50%, and the deployment effect of the MEC edge computing platform based on the 5G network in the power system is faster, the delay is shorter, and the efficiency is higher.

## 5. Conclusion

In the early stage of application, the entire application of MEC should be avoided as much as possible, and operations should be performed where there is demand to achieve low-latency local services of MEC; in the power market, the application of the MEC-based edge computing platform in the power system Development requires the integrated development from the wireless network to the core network, and considers the idea of MEC from an overall perspective. The application field of MEC also focuses on low latency, and is aimed at local area network expansion for vertical industry users. Although there has been a lot of progress in the work of MEC, the deployment location of MEC still needs to comprehensively consider factors such as performance, management complexity, and cost-benefit ratio. Grasp the combination of emerging technologies such as edge computing based on 5G networks and industrial technologies, cultivate momentum with informatization and intelligence, and become an enabling innovator of industrial intelligence in the power field.

## 6. project name:

Foundation Item: The National Key R&D Program of China  
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