IoT based service cloud design for distributed generator sets

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Abstract. To satisfy the technical requirements of life-cycle service of the distributed generator sets (GenSet) during the after-sale stage, this paper proposes a service cloud architecture based on internet of things (IoT) technology. This service cloud consists of generator set remote control, maintenance and repair, even the health management. It has the characteristics of simple architecture, physical and material connection, safety and reliability, and cost-effective. This service cloud can be implemented on a private cloud system or a public cloud system. At the same time, this GenSet service cloud can fully play the role of IoT technology, information technology, etc. in improving the efficiency of traditional manufacturing industry. Through the real-time monitoring of the GenSet, this cloud can timely sample and master the global operation of the GenSets, scientifically and reasonably evaluate the safety, reliability and quality of the GenSets, timely respond to and dispose of all kinds of operation alarms. Through the maintenance management of the GenSets, this cloud can effectively save and manage the maintenance account of the whole life cycle of the GenSets. Through the service dispatch, this cloud can shorten the distance between the customer and engineer and optimize the resource allocation.

1. Introduction

In the power generation industry of internal combustion engine (ICE), with the development of Internet of things technology and cloud computing technology, as well as the development of internet and economy, the IoT perception and cloud service of GenSet controller have become a recognized development trend in the industry [1-2]. To deal with the lack of cloud controller and cloud service platform for the whole life cycle of the generator set industry [3], this paper proposes a service cloud architecture based on internet of things (IoT) technology. This service cloud consists of generator set remote control, maintenance and repair, even the health management. This GenSet service cloud can play the role of internet of things technology and information technology.

2. GenSet cloud service system structure

According to the system function design, this study designs the scheme of the cloud system structure as shown in figure 1. The cloud service system includes cloud controller networking parameter setting, order tracking, generator set delivery information management, operation monitoring, remote auxiliary diagnosis, operation data statistics and analysis, maintenance management, service dispatching, mobile service office, overseas communication module, generator set spare parts push service, dealer management, GenSet leasing and coordination, system configuration, system maintenance module, etc
[4-6]. These functional modules interact with various users of the system through workflow control and unified system interface, interact with database, interact with customer relationship management system and data collection system (cloud controller) of the company, and interact with data and relevant instructions to ensure the stable operation of the system.

![GenSet Service Platform](image)

**Figure 1. GenSet cloud service system structure**

### 3. System topology relationship

According to the system function structure, the design of cloud service platform for the GenSets follows the principle of convenience, speed and reliability, and constructs the topological relationship of the three-layer structure, as shown in figure 2. The program adopts the existing mature RS485 industrial bus, GSM/GPRS network and GPS global positioning technology, and sends the operation data collected by the Fortrust 7600 series controller and the locally collected GPS position information to the GSM communication base station through the GPRS data link. The communication mode is compatible with 3G/4G [6-9]. Then, through the network of communication service providers and industrial ethernet, the GenSet cloud data server, enterprise intranet and extranet server for large enterprises are set up [7-10]. At the same time, based on the enterprise's actual information infrastructure foundation, number of the GenSets and user scale, the technical solution can construct the application-oriented flat cloud service topology, namely the GenSet-cloud controller-cloud server (also as cloud data server and application server).
In the sensing layer, the Fortrust 7600 series GenSet controllers are used as the IoT device to form the data sensing and transmission part of the whole system. In the storage layer, the data transmission is carried out by Industrial Ethernet or the Internet, and the GenSet data service adopts a primary and secondary server running without interruption, which ensures the reliable operation of the cloud service platform. the storage GenSets record all kinds of data, such as generator set maintenance data, mobile service office data, cloud platform operation data, etc. In the business level, GenSet OEM enterprises, operation and maintenance enterprises, leasing companies and other users access the cloud platform through the mobile terminal (mobile phone or tablet APP) and the website [10-11], as well as complete lots of work, including cloud controller networking parameter setting, generator set order tracking, factory information management, operation monitoring, remote auxiliary diagnosis, operation data statistics and analysis, maintenance management, service dispatch, mobile service office, overseas communication module, spares push service, sales or distributor management, generator set leasing and adjustment, system configuration and maintenance. From a security perspective, the cloud platform uses server-specific firewalls and mainstream anti-virus software to control all kinds of abnormal access in real time, eliminate various types of computer viruses, and ensure reliable and stable operation of the system.

4. Cloud registration process design
New users of the GenSets are required to register first before they can access the cloud platform for related operations. The web registration process is shown as below in the figure 3.
4. Feasibility Analysis

4.1 Technical feasibility
This project adopts mature UC/OS-II embedded multi-task management technology, Internet of Things technology (including QR code identification technology, RS485 fieldbus technology), GPRS communication technology, GPS localization technology, cloud storage technology, cloud application service and development technology (MS.NET), etc. The technical standards are common, the specifications are clear, and the interface compatibility is high, which ensure the stable and reliable operation of the technical architecture of the entire GenSet cloud platform.

4.2 Market feasibility
At present, the cloud system mostly adopts the four-layer network architecture of the generator set-controller-cloud, modem-cloud server, which has a complicated structure. Many operations cannot be realized, and fault diagnosis and troubleshooting are difficult. Fortrust 7600 series cloud controller
integrates the cloud modem function, simplifies the existing four-layer architecture in the market, and realizes the three-layer architecture of the GenSet-controller-cloud server. It’s beneficial to reduce the complexity of the cloud service system and improves the system reliability, which is the direction pursued by market development. Launching a new generation of GenSet controller products that “the controller that can access the Internet” can effectively fill the gap in the market.

5.3 Economic feasibility
From an economic point of view, the launch of the controller cuts the cost of external cloud modems (foreign product prices are 2100 RMB - 2800 RMB, while domestic product prices are 680 RMB - 1500 RMB). On the one hand, it helps lower costs for users. On the other hand, for Fortrust company, there is no doubt that it can improve product technology, increase customer viscosity, expand market share, and finally bring greater economic benefits.

6. Summary
To satisfy the technical requirements of remote control, maintenance and repair, even the health management for generator set, this study proposes a service cloud architecture based internet of things (IoT) technology. Being capable to run on a private cloud system or a public cloud system, this new cloud is simple, safe and reliable and relatively low-cost. The operational feasibility analysis about technical, market and economic features validate this new design for service cloud used in the life cycle management of electrical generator sets.

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