Application Research of Integrated Prefabricated Module Computer Room Solution Based on Computer Communication

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Abstract. Modular machine room is to divide the whole machine room into several independent areas. The scale, power load and configuration of each area are customized according to the requirements [1]. A module is a single, independent, small data center. With the continuous expansion of business demand, independent modules are added, which can be combined flexibly to meet the different requirements of different customers for reliability level, power density and security level, so as to realize the purpose of rapid construction.

Keywords: Modular Machine Room, Module, Data Centre

1. Introduction
Efficient modular data centers adopt standardized interfaces and modular architecture, standardized batch production of components, flexible architecture, on-demand capacity expansion, support phased deployment, match predictable business growth, and effectively avoid overinvestment [2]. This facilitates the systematic energy-saving design. Each modular data center has an independent, adaptive refrigeration system, which can effectively avoid excessive refrigeration phenomenon, and the flexible architecture does not need additional auxiliary refrigeration system to generate additional waste.

2. System advantages
2.1. Advantages in structural
The modular machine room integrates all subsystems such as cabinet, power supply and distribution, refrigeration, wiring and intelligent management, supports the flexible deployment mode of single or double row closed cold/hot channel, and the maximum power consumption of single cabinet can reach 21kW. Modular machine room can be customized, rapid deployment [3]. By standardizing and modularized products, it can weaken and even eliminate the consultation and design of users, deepen the design process, shorten the construction period of data center and save relevant resources. The modular machine room can synchronously start the micro-module pre-manufacturing and predictive test during the decoration process of the machine room. After the factory production, the site can be rapidly deployed, and the construction period can be improved by more than 50%.
2.2. Advantages in combination
The modular machine room can be used as an overall solution, and can also provide separate channel closure, cabinets, wiring, power distribution, intelligent management and other components products, seamless combination with any other brands, the new cooperative brand products from the factory drawing, production, assembly after disassembly to the site assembly, provide supporting assembly manual [4].

2.3. Advantages in appearance
Professional design team elaborate design, the aesthetic and function, color can be customized according to customer demand, main products for champagne body close and the perfect combination of black aluminum alloy bar cabinet, with colorful bridge, make the boring machine visual impact, improve aesthetic feeling, do not break again at the same time science and technology of solid and sealed.

2.4. Advantages in air distribution
The modular machine room can be closed with cold or hot channels in combination with air conditioning supply, which can effectively solve energy waste and improve the refrigeration efficiency of air conditioning.

2.5. Advantages in power distribution
The power supply mode of the distribution system is bus monitoring or intelligent distribution unit. Compared with traditional cable power supply, bus power supply unit can be flexibly configured and can be added at any time, plug and play.

2.6. Advantages in lighting
The combination of working lighting and background lighting is adopted. LED cold light source is adopted for working lighting to meet illumination requirements, and LED technology blue is adopted for ambient lighting.

2.7. Advantages in security
The access control system is adopted for the closed door of the passage, and a variety of schemes are optional, which can realize linkage control with working lighting [5]. Color camera is installed in the channel to monitor the channel in real time.

2.8. Advantages in intelligent management
Develop special micromodule environment management system [6]. Management system through the IT infrastructure equipment, air-conditioning equipment, lighting equipment, temperature and humidity, video monitoring, channel, entrance guard, skylight frame, fire control linkage system, the real-time monitoring, testing of the power consumption situation of intensification of statistics and analysis, real-time to provide room key indicator PUE value of energy efficiency and capacity management, asset management and other functional modules, each channel 10.2-inch touch-screen terminal 3d display, remote access to the computer room power environmental monitoring system.

3. Scheme introduction
The closed cold channel integration scheme integrates an uninterruptable power supply system, power distribution system, precision air conditioning system and power monitoring in one body, providing customers with reliable, compact, efficient, rapid deployment and carefree management experience [7]. MDC modular data center design concept is adopted in the machine room, and one MDC micromodule is planned, which contains complete subsystems of power distribution, refrigeration and control.
The data center can be realized by adopting micro-module scheme. (1) Rapid deployment: Due to the higher degree of coupling between each subsystem and its decoupling from the construction, the lower degree of dependence on building decoration, etc., and the standardized design, the deployment speed of modular data center is 30% ~ 50% faster than the traditional scheme. (2) Rapid capacity expansion: On the one hand, the smooth capacity expansion of modularized UPS can realize the business capacity expansion inside the module. On the other hand, business expansion, growth and investment can be realized through the deployment and expansion of micro-modules [8]. (3) High thermal density refrigeration using inter-row air conditioning, close to the heat source, nearby cooling, shorten the return air path, can solve up to 1OkW/Rack equipment heating problem, eliminate hot spots. (4) The PUE value of the modular data center for energy conservation and emission reduction can be as low as 1.6 ~ 1.7 (depending on different working conditions and technical conditions). This is beneficial to a large number of energy-saving technologies, such as high-efficiency UPS technology, closed cold channel technology, flexible refrigeration technology with variable cooling capacity, etc. (5) Engineering productization: A large number of modular data center projects are productized, which reduces the difficulty of field construction, reduces the construction period, and ensures product quality from the whole life cycle. (6) Easy management: Integrated management and control of data center infrastructure can be achieved through the management and control of micro-environment within each module.

3.1. Reliable overall architecture
No single point of failure for IT main equipment, refrigeration and signal transmission, as shown in Figure 1

![Figure 1. Overall architecture diagram](image)

3.2. Electrical system of data center
Electrical engineering is the basic system engineering of the whole machine room, which requires high reliability of power supply and distribution system. The safety, reliability, maintainability and online expansibility of the power supply and distribution system are the key points of this project. The distribution of computer systems and communications systems must go through UPS power. Distribution cables, distribution cabinets and corresponding circuits are designed to meet the peak power consumption load. Strong and weak current should be separated. The strong and weak current cables in the machine room should go through their own channels. Reliable power supply and distribution: fine detection, active prevention and automatic elimination of hidden dangers, as shown in Figure 2.
3.3. Data center refrigeration
The refrigeration system adopts the refrigeration mode of air-cooled row precision air conditioner + sealed channel: air-cooled row precision air conditioner and equipment cabinet jointly constitute sealed channel to realize cold and hot air isolation [9].

The working principle of the air-cooled grade precision air conditioner is as follows: after the unit is started, the low-pressure steam of the refrigerant in the refrigeration system is sucked into the compressor and compressed into high-pressure steam and returned to the condenser. At the same time, the outdoor air inhaled by the axial flow fan flows through the condenser, taking away the heat released by the refrigerant, making the high-pressure refrigerant steam condenses into high-pressure liquid. The high-pressure liquid is injected into the evaporator after passing through the filter and throttling mechanism, and evaporates under the corresponding low pressure to absorb the surrounding heat. At the same time, the cross-flow fan makes the air continuously enter the fin of the evaporator for heat exchange, and sends the cooled air into the direction ratio after heat release. In this way, the air circulates continuously to reduce the temperature.

The travelling air conditioner is close to the heat source, and the air supply distance is greatly shortened, thus reducing the air pressure loss and the leakage loss of cold air caused by the distance, and improving the utilization efficiency of cold air.

3.4. Closed cold channel
With the high development of IDC data center, the problem of energy consumption in the computer room is becoming more and more serious, and the cooling system in the computer room, as a large energy consumption, has become the focus of attention. How to improve the utilization rate of cooling capacity and reduce the frequency of air conditioning use has also been deeply discussed. Based on several years of data center refrigeration experience, combined with the current development trend and demand of data center energy conservation and emission reduction, high heat density, etc., the innovative closed cold channel silk piece is introduced [10]. Closing the cold channel can effectively improve the utilization efficiency of cold air in the cold channel of the machine room, improve the air intake efficiency of the cabinet, prevent the mixing of hot and cold air, and ultimately improve the energy efficiency of the machine room and reduce the PUE value.

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