Data Center Service That Supports Cloud Infrastructure

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Abstract

Data centers play a key role in supporting today's information society. Building on NEC's 30 years of experience in data center operation, we opened NEC's new flagship data center - the NEC Kanagawa Data Center - in January 2014. In this paper, we describe the management technology and systems incorporated in the NEC Kanagawa Data Center, which features a Power Usage Effectiveness (PUE) - the principal index for measuring the energy efficiency of data centers - of just 1.26, which is one of the best ratings in the Tokyo Metropolitan Area. In addition to its reduced energy requirements, the NEC Kanagawa Data Center is optimally located in an area less disaster-prone than elsewhere, while being easily accessible from central Tokyo. Specially designed to support the NEC Cloud IaaS cloud platform, the NEC Kanagawa Data Center accommodates 3,000 racks and is equipped with comprehensive, highly redundant security measures.

Keywords

data center, energy saving, PUE, hybrid, cloud, housing, Tokyo Metropolitan Area, Kanagawa, FISC

1. Introduction

Data centers (hereinafter referred to as "DCs") are integral to the smooth functioning of today's highly networked information society. Ever since Japan was shaken by the Great East Japan Earthquake in 2011, the need for DC facilities capable of protecting IT systems has become of critical importance to private and public organizations alike.

NEC has been building, operating, and managing DCs for three decades. Using the wealth of experience and expertise that we have accumulated in that time, we designed and built a state-of-the-art DC - the NEC Kanagawa Data Center - which opened for business in January 2014 (**Fig. 1**). Bigger and more advanced in every way than any of our other DCs, the NEC Kanagawa Data Center is positioned as our flagship DC and boasts the highest levels of reliability, energy efficiency, security and technology.

Fig. 1 NEC Kanagawa Data Center.

Providing stable support for our cloud infrastructure, the NEC Kanagawa Data Center also provides secure housing services for our customers. By integrating the DC infrastructure, cloud services and housing services, we are able to optimally manage the entire system, achieving rationalization and energy saving.

2. The Primary Functions of a DC

There are three major social roles a DC must perform.

(1) To protect IT systems from disasters

A DC's primary role is to protect IT systems. Accordingly, various facilities are installed in a DC. Potential disasters that must be protected against range from earthquakes to typhoons, floods and high tides.

(2) To protect IT systems from vandalism and burglary

A DC also needs to be able to protect IT systems commissioned by customers from physical vandalism and burglary. This means that, in addition to well-controlled and secure operation, mechanisms must be provided that do not allow intrusion (physical outer walls and patrolling security guards, as well as security equipment including intrusion detection sensors, electronic security systems, access control systems and authentication systems).

(3) To reduce energy usage

Building a server room in the corner of an office and operating it after installing Package Air-Conditioner (PAC) results in unnecessary and excessive consumption of energy. Helping reduce the load on the environment is one of the three critical issues that pertain to DCs. A DC needs to be able to offer significantly more efficient power consumption than on-premises server rooms - even rooms that have been individually optimized.

3. Providing Solutions

To meet the requirements just described, the NEC Kanagawa Data Center has been designed and built to satisfy the most rigorous standards.

3.1 Location

In order to avoid suspension of services should a disaster strike, the location of a DC is critically important. The location of the NEC Kanagawa Data Center offers the following key advantages.

- More than 14 km from a major active fault
- Almost no risk of the liquefaction at the site and in the surrounding area
- More than 30 km from the coast and approximately 135 m above sea level
- Approximately 2 km from the nearest major river

This setting means that there is almost no chance of the DC being exposed to an earthquake with its epicenter located directly below. Nor is there any risk of liquefaction and or possibility of damage from tsunamis or floods. A DC can no longer function if buried communication wiring and electrical wiring are damaged by liquefaction. Thanks to its location, there is no chance that the functions of the NEC Kanagawa Data Center could be shut down by liquefaction.

A DC can no longer function effectively if communication wiring and electrical wiring are damaged by liquefaction. In consideration of this, the NEC Kanagawa Data Centre has been located in an area where there is almost no risk of being shut down by disasters such as earthquakes, liquefaction, tsunamis or floods.

3.2 Architecture

The NEC Kanagawa Data Center is supported by piles driven all the way down to the bearing layer. This ensures that the buildings will not tilt or be damaged in the event of an earthquake.

Based on this foundation, the center is constructed with solid frames that comply with Comprehensive Anti-Seismic Design Standard for Governmental Facilities Type I[*1], providing further assurance of safety and reliability in the event of a major earthquake. In addition, each of the server rooms employs floors equipped with a two-dimensional seismic isolation system to prevent earthquake vibrations from being transmitted directly to IT equipment.

3.3 Electrical Facilities

The NEC Kanagawa Data Center maintains a backup power supply that uses in-house gas-turbine generators plus one backup unit (N+1 system) to ensure a reliable, uninterruptible supply of power for up to 72 hours without refueling. And thanks to a priority supply contract to guarantee fuel delivery, the power supply can be maintained for even longer, enabling continuous long-term operation in the event of a wide-area power outage. The N+1 system also incorporates uninterruptible power supply (UPS) units in order to cope with momentary voltage drops and to cover system startup time and power transmission time for the in-house generators.

3.4 Air-conditioning Facilities

A centralized heat source system is used for the center's air-conditioning facilities. For air conditioning in rooms, a conventional down-flow air-conditioning system is not used; instead, a newly developed revolutionary overhead air conditioning system (patent pending) is used. In this NEC-original system, the ceiling is constructed using a dual structure (Double Layered Ceiling), while the server room is divided into hot and cold aisles. Appropriately cooled air is sent from the ceiling fans (**Fig. 2**) according to the heat generated by the server racks.

This system has the following benefits.

- Highly energy-efficient DC motors help reduce power consumption related to air conditioning by 26% (compared to PAC down-flow air-conditioning system).
- Variable-speed fans are incorporated in the cold aisle ceiling to appropriately control the air flow rate according to the heat generation of the servers, thereby reducing excessive air-conditioning power at partial load.
- The underside of the floor is made into a space exclu-

[*1] Anti-Seismic Design Standard for Governmental Facilities is a standard that specifies the anti-seismic capability of facilities that used by public and government agencies. Type I is the highest class.

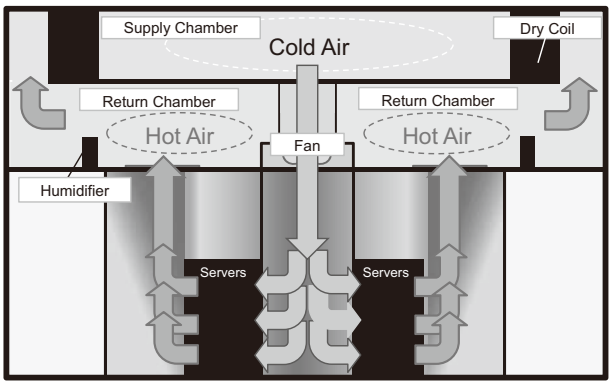

Fig. 2 New method of air conditioning for server rooms.

Photo Circular gate and face recognition device.

sively for wiring to prevent deterioration of air-conditioning capability due to the accumulation of old cables over long periods of time.

The temperature conditions in the rooms are based on the US ASHRAE standards, and the latest standards for server rooms have been adopted. Free cooling equipment that uses an indirect outdoor air cooling method has been introduced for use in the winter. In combination with the highly energy-efficient air-conditioning system described above, this contributes to the improvement of the Power Usage Effectiveness (PUE), a principal index for energy efficiency capabilities of DCs, as well as preventing air pollution in the rooms and keeping humidity in control.

3.5 Security Facilities

As for security, we have built a system featuring seven-step safeguards that protect each server from external access with access permitted only to areas where permission has been applied for in advance, and only after body search and baggage inspection with a metal detector.

Our original biometric authentication system - the KAO-ATO face recognition system[*2] - is adopted. Combined with a tailgating prevention mechanism, this system provides rigorous access control (**Photo**).

4. DC Functionality

In addition to providing safety and security for critical applications and data, DCs are also expected to offer greater convenience and lower costs.

4.1 IT System Operation Support (integrated operation management)

Conventionally, IT systems were housed in a structure which required that technical staff be permanently stationed on site and to which additional personnel could be promptly dispatched in case of emergency. However, the costs and labor required to operate such a system were exorbitant, resulting in significant cost inefficiencies. Today's DCs are expected to offer improved operational support such as provision of remote surveillance and on-premises operation services.

NEC offers remote IT system surveillance and operation using the integrated IT service management center (ITSMC), as well as on-premises physical operation services.

4.2 High-capacity, High-efficiency, High-availability Facilities

DCs need to be able to achieve floor load, power capacity, and air-conditioning capacity that would be impossible with server rooms built in offices. Using the technologies described in the previous section, high-density construction and high availability can be achieved in DCs - something which is not possible with server rooms built in offices located in office buildings. Steep rises in electricity rates recently have increased the risk of fluctuations in operation costs. As a result, customers are looking for ways to save energy and minimize those risks.

4.3 Security

Assigning specialized security personnel to on-premises server rooms in office buildings is expensive and inefficient.

On the other hand, specialized personnel can be assigned to perform manned surveillance in a DC, efficiently achieving high security without compromising convenience.

4.4 Cloud Linkage (hybrid)

As clouds become increasingly popular, many corporations are starting to migrate parts of their IT systems to the cloud. However, since it is not currently possible for cloud platforms

[*2] This system is one of the products that adopt the NeoFace engine, which has been rated the world's number one in MBGC and MBE precision evaluation contests held by the US National Institute of Standards and Technology (NIST).

to provide full coverage of all IT applications, it is necessary to connect and link in-house IT systems with clouds via communication lines.

With the NEC Kanagawa Data Center, a room dedicated to the provision of the NEC Cloud IaaS cloud platform service is located on-premises to achieve a design that facilitates direct linkage with in-house mission-critical IT systems. This makes it possible to achieve highly reliable, high-speed connections at low cost, including initial running costs.

5. Integrated Management

Our DC efficiently offers management services that leverage our highly integrated operation surveillance and NEC's specialized personnel, as well as various energy and cost saving measures. Below we introduce two mechanisms that support these operations.

5.1 Integrated Monitoring System

In pursuit of safety and reliability, we have built an integrated DC monitoring system designed to achieve the following five objectives.

(1) Strengthening the prompt response structure by visualizing scenarios in which we respond to effects caused by DC equipment abnormalities and external factors.
(2) Improvement of service levels by specifying suspected areas and deriving solutions for problems based on the records of previous problems and their solutions in order to shorten response time to any problem that arises.
(3) Reduction of service charges by improving efficiency through automation of reporting and various other procedures.
(4) Reduction of error/failure occurrence rates using proactive maintenance measures based on premonition monitoring.
(5) Provision of integrated operability independent of a DC (location) and managed objects.

To achieve these goals, we have established a DC facility management system (Butics), security management system (SafeWare), and integrated DC monitoring system that link with the server rack management system. Receiving management facility alert information and operation information from various linked systems, the integrated monitoring system establishes alert linkage with surveillance servers and collects a variety of operation data. This makes it possible to connect via email with the appropriate personnel, notifying them in near real time of abnormal conditions of the electrical facilities, air-conditioning facilities, security facilities and server rack environment.

As for the future, we are planning the following: First, facility operation data will be made available on the portal site according to access authorizations, and then usage environment data such as server rack temperature and power usage will be offered to users, enabling information regarding the DC's conditions such as equipment capacity and usage conditions to be shared among those concerned. Moreover, by using the accumulated data for trend analysis and premonition surveillance, we can make DC management even more effective and more efficient. Finally, by incorporating a wide range of other data such as weather reports and public transit system information, we can apply this system to other DCs, facilitating centralized management of multiple DCs and further improving convenience.

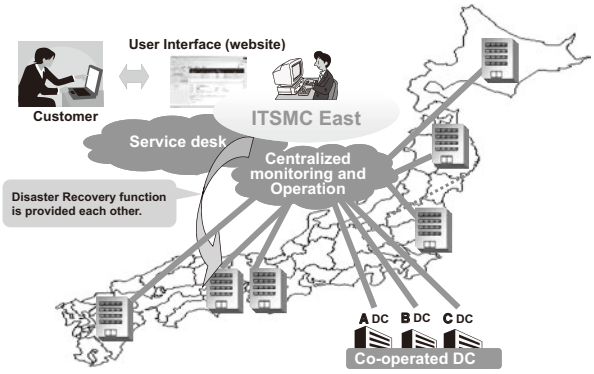

Fig. 3 Conceptual diagram of integrated IT service management center.

5.2 Integrated Operation Management

In addition to remote surveillance and operation of IT systems from the ITSMC (**Fig. 3**), we offer physical operation services on-premises. Management in the event of a disaster is handled by trained personnel.

By using this operation service, our clients can monitor and operate IT systems without having to build a specialized structure with surveillance personnel and operation personnel who are on duty 24 hours a day, 365 days a year.

6. Conclusion

Our recently opened flagship DC, the NEC Kanagawa Data Center, was built and designed using the latest technologies and facilities. Decades of experience and expertise have been distilled and crystallized in this unique, cutting-edge facility. Highly redundant safety and security systems combined with seamless data throughput and high-speed performance allow our clients to use our cloud and housing services with confidence, making our DC the platform for their IT equipment.

We are committed to continuing our efforts to help reduce our clients' capital expenditures and operating expenditures, while further improving safety by combining multiple DCs with the flexibility of our Software-Defined Networking (SDN) and clouds.

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