Introduction to the Shiroi Data Center Campus

Note for readers of this English translation

This document has been translated from the Japanese original for reference purpose only. In the event of any discrepancy between this English translation and the Japanese original, the Japanese original shall prevail.

December 19, 2019

Internet Initiative Japan Inc.
Infrastructure Engineering Division
Data Center Technology Department

Shiroi Data Center Campus

- Overview
- Why
- Data Center Specifications

Introduction to the Shiroi Data Center Campus

A modular system data center that combines IIJ's existing technologies and proactively incorporates new ones!

The facility aims to capture demand for data centers as digital transformation hits full stride.

* Construction was completed in April 2019

(The Above image depicts the facility at the time of planned future completion)

Maximum Receiving Capacity	50MW
Location	Shimousa Plateau area with low earthquake risk
Equipment Capacity	6,000 racks * When used at an effective average of 6kVA / rack
Site Area	Approx. 40,000 m^2

Purpose

A large-scale data center campus *1 catering to the explosive growth of data processing and accumulation due to IoT, AI, cloud services and so on.

Main Applications

- To serve as a site for the IT services (cloud computing, networking, etc.) provided by IIJ
- To house customers' IT equipment (housing service)

Main Features

1. Shortened construction schedule, reduced construction costs and flexible facility expansibility thanks to adoption of the modular system approach *2
2. Energy savings due to outside air cooling-based air conditioning
3. Facility utilizing AI / Integrated IT control
4. Operational automation, personnel saving and unattended operation through the use of robots, etc.
5. Designed PUE of 1.2 *3

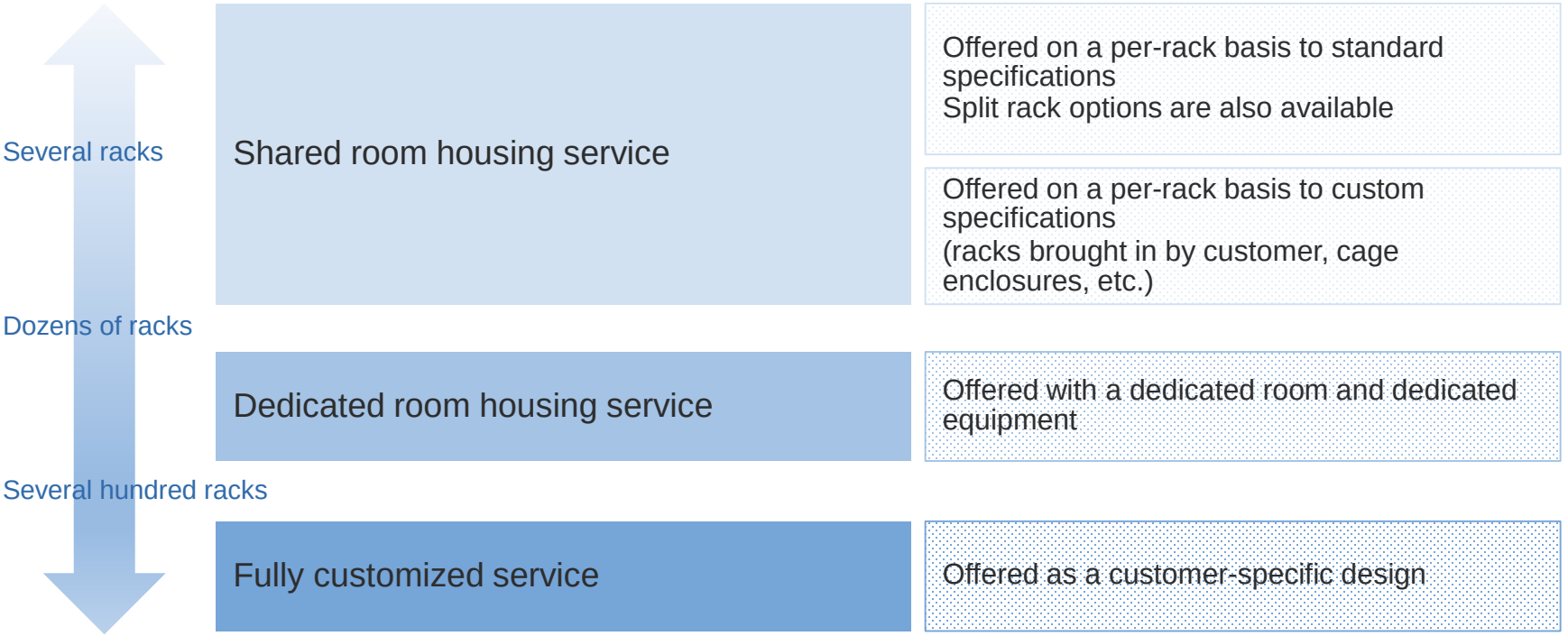
Launch Period

Start of operations on May 1, 2019

*1 Ideas expressed by "Campus": The name was chosen to reflect the desire to make the facility a location or hub (=campus) to create new value by consolidating the explosive growth of digital data and flexibly catering to new technologies and new needs and services. *2 Modular system data center: Construction materials were standardized and the construction and production process was developed into a system. This approach enables quality to be maintained while achieving shorter construction periods and cost reductions and offering excellent expansibility. *3 PUE (Power Usage Effectiveness). An indicator of power usage efficiency determined by dividing the total power consumption of a data center by the power consumed by the IT equipment within. The smaller the number, the lower the proportion of power consumed by non-IT equipment.

Usage Scenarios

Various usage scenarios making use of large scale and high capacity



Caterings to various applications to support the gradual expansion of business

Usage Examples

1. Housing of on-premise equipment for use with cloud services
2. Housing of a system comprising dozens of racks in a cage enclosure can be provided with individual security, individual operation and even a project room
3. Provision of a dedicated room housing 100 racks designed for service providers. Can be used as a "data center in a data center," and supports the installation of cloud infrastructure while maintaining expansibility.
4. Install cooling technologies such as immersion or liquid cooling to build a dedicated high performance computing (HPC) farm.

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Why did we plan a new data center?

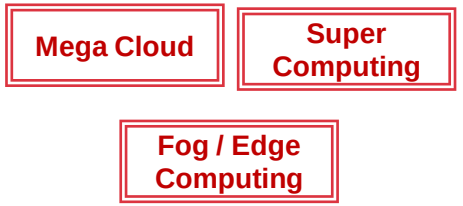
Because we needed a large-scale data center able to adapt flexibly to growing and increasingly diverse demand for data centers, and this could only be achieved by designing in-house.

The Changing Market

Shift to asset-less corporate IT environments

Expanded demand for cloud computing due to the introduction of IoT

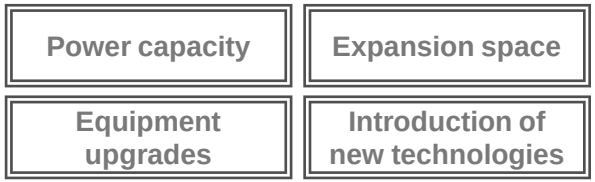
Increasing size of data centers due to growing data volumes



Increasingly diverse data center demand

Current State of IIJ Data Centers

IIJ has accumulated expertise in the building and operation of data centers



Leased data centers have many limitations

Promoting the relocation of aging data centers is essential

Why did we choose Shiroi in Chiba Prefecture?

Requirements for a data center

Speed ✖ **High quality**

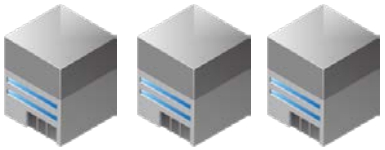
A data center must provide the required volume of resources while balancing speed and quality.

What is needed when selecting a location

- ✓ A large area of land that can support scaling out
- ✓ The ability to be connected to highly reliable power and communications infrastructure in a short period of time
- ✓ Firm ground
- ✓ Ease of access

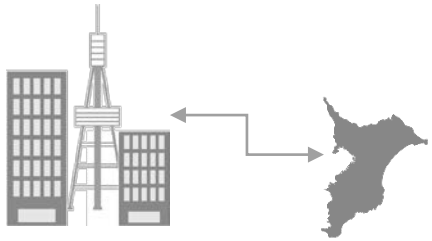
We selected the Chiba New Town district, an area with a concentration of data centers.

Compared with urban areas, it is easier to secure an large plot of land.



There are already multiple data centers in the area, with power and communications infrastructure already developed

(A highly reliable shared utility conduit is used as the cabling route).



The site is situated on firm ground on the Shimousa Plateau approximately 32 km away from the city center (Otemachi).

Why was a modular system adopted?

Requirements for a data center

Speed ✖ **High quality**

A data center must provide the required volume of resources while balancing speed and quality.

State of Services

- ✓ It needs to be possible to continually implement a flexible design for increases and decreases in the medium to long-term to form the basis for a diverse range of services.
- ✓ Speedy construction is essential for sites housing cloud services.

The Evolution of Container-type Data Centers

Container-type data centers are optimized for data centers with between several dozen and a hundred racks. Modularization has been an issue for data centers with several thousand racks.

Adopting a modular concept

- ✓ The expertise gained through the development of Matsue Data Center Park and container-type data center was applied to the floor scale (around several hundred racks).
- ✓ A system architecture that can cater to needs for larger sizes was adopted.

Flexible Expansibility

Fast-track construction

Low price

Pillar-free server rooms with large open space

High quality (uniformity since construction materials are fabricated at a factory)

[System Construction]

- This construction method standardizes the components that make up a building and develops commercialized building structures and the entire building production process into a system. The components and materials are fabricated at a factory to maintain quality while **reducing costs and shortening construction periods**.
- The steel materials used in high-rise buildings and bridge girders are used to achieve the efficient use of space with pillar-free open spaces (up to 60 meters). This method has a proven track record in the construction of gymnasiums, production plants, warehouses and similar structures.

Why pursue energy savings and high efficiency?

Experience in Data Center Operation

From operating the Matsue Data Center Park, we have experienced the importance of reduced running costs. We aimed to enhance the competitiveness of the facility by employing the technologies and know-how we have cultivated and making further improvements to energy savings (efficiency).

Actively Adopting Energy-Saving Systems and Equipment

1. Using system architecture to install an outside air cooling-based air conditioning system for low-rise building structures
2. Introducing high-efficiency IT equipment
3. Employing three-phase four-wire UPS and bus ducts
4. Energy savings through integrated facility and IT control
   (Integrated control of facility and IT equipment through AI)

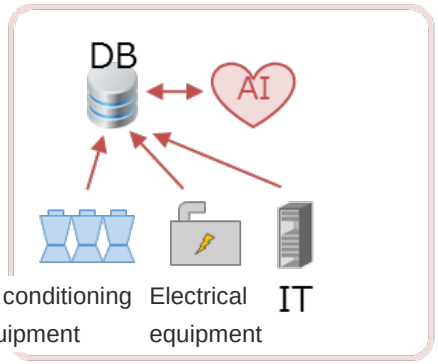
* Items 1 through 4 have been adopted by the Ministry of the Environment's "FY2018 Subsidy for the Costs of Projects to Control Carbon Dioxide Emissions."

Period from data center establishment to launch

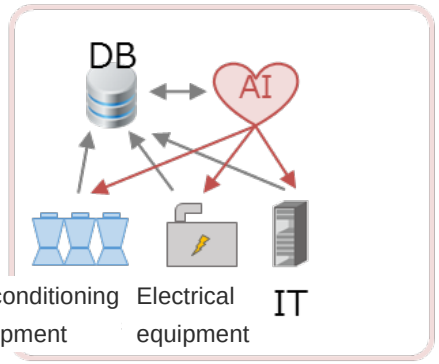
After data center launch

[Consider introducing rule-based control and machine learning]

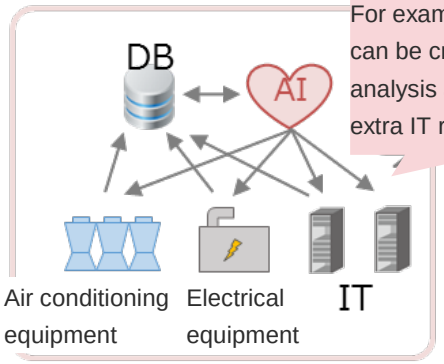
[Fusion of machine learning-based control verification and rule-based control]



Building of the environment, initial data collection and learning



AI-based improvement and continual learning
AI-based autonomous control and preventive maintenance



For example, spare capacity can be created through AI analysis and used to install extra IT racks

Improvement and continual learning through artificial intelligence. Results fed back into hardware

Why promote automation and unattended operation (personnel saving)?

Changes in the Labor Environment and Data Centers

Data centers are increasing in size

✖

The decline in the workforce has made it difficult to secure human resources

→

We plan to conduct operational demonstrations based on robot technologies

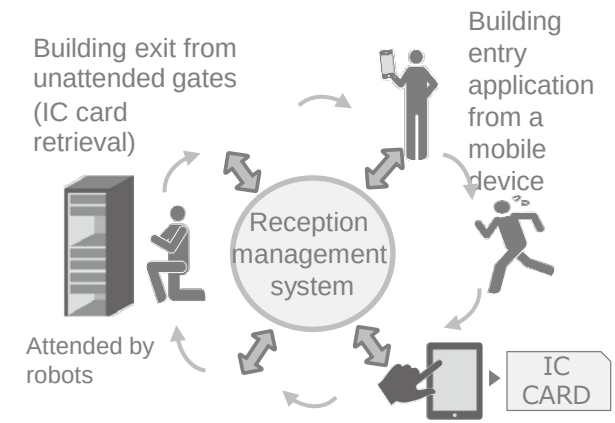
In partnership with Sohgo Security Services Co., Ltd. (ALSOK)

Reducing operating costs and improving quality to enhance competiveness

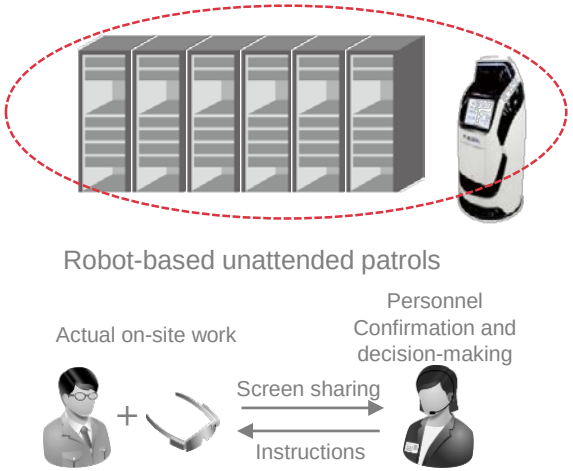
Tasks Applicable to Automation and Unattended Operation (Personnel Saving)

Scope of tasks performed by robots: patrol and surveillance of indoor and outdoor areas, attending to visitors, detecting suspicious objects

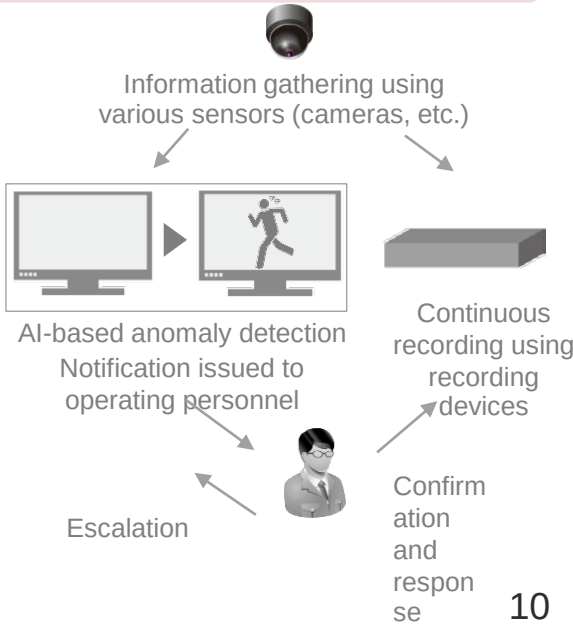
Reception and building entry management tasks



Equipment maintenance tasks



Surveillance tasks



Use of lithium-ion storage batteries

Achieving peak-cut and peak-shift operation

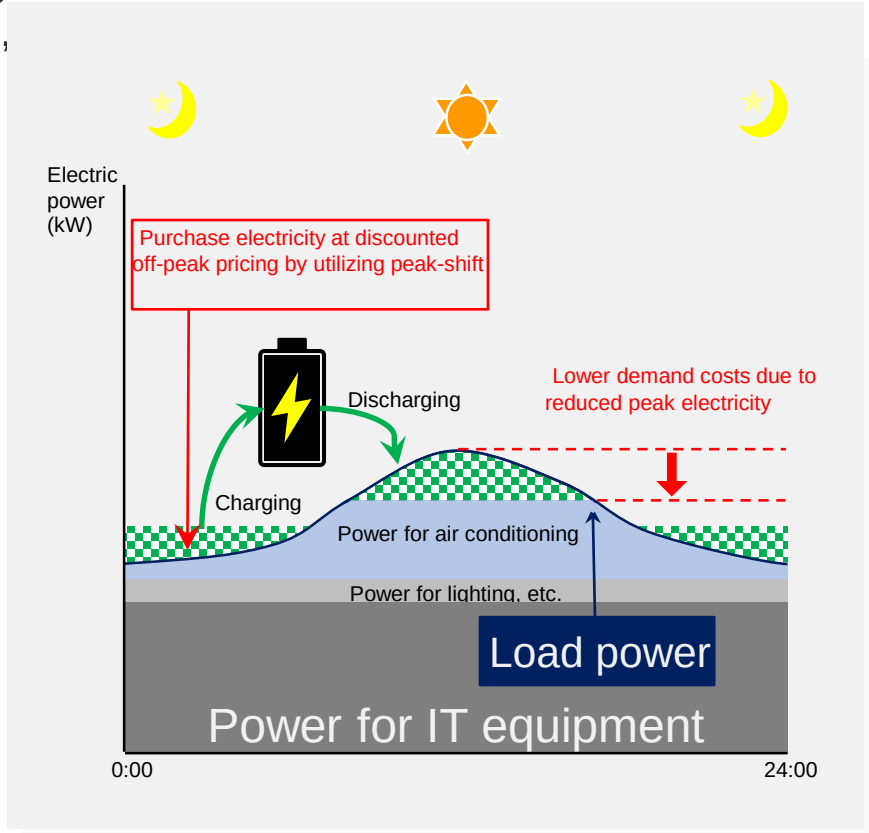
Began operation on November 1 In addition to functioning as an air conditioning UPS, the system achieves peak-cut and peak-shift operation with the aim of reducing the data center's demand values (peak electricity) by around 15%.

IT load has little variability over the day and night. Power for air conditioning varies greatly over the same time.

Working to Transform Power Supply Systems into Something Dynamic

Traditionally, the role of UPS and emergency generators at data centers has been behind the scenes to ensure high quality. In the future, which they are used as energy resources for data centers and work to transform the business model.

Utilizing Power Supply Systems as an Energy Resource for Data Centers



Conceptual diagram: Data center power demand and peak-cut/peak-shift

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Location

The facility is situated on the Shimousa Plateau, area with low disaster risk

Area with a concentration of financial data centers

- Chiba New Town to the east (and Tama New Town to the west) developed as concentrations of data centers due to the old FISC safety standards recommending a 60-kilometer separation between data centers. The location is in a so-called "endorsed" area that has a low disaster risk.
- The facility is located around 32 kilometers from the city center (Otemachi).

What is the Shimousa Plateau?

The Shimousa Plateau is a stretch of rolling hills between 20 and 40 meters above sea level that spans eastern Saitama Prefecture to northern Chiba Prefecture. The loamy layer of the Kanto region is deposited in the upper layer of the ground.

Structure of Foundations

In light of the results of a boring survey and the low-rise structure of the buildings, a spread foundation offering excellent safety, ease of construction and economy was adopted.

State of Various Hazard Maps

Susceptibility to shaking	• Level 1–2 out of 5
Susceptibility to liquefaction	• Not subject to liquefaction • A boring survey also determined there are no layers that would undergo liquefaction.
Building susceptibility to flooding or landslides	• The possibility of a landslide disaster, flooding or inundation from inland water can be discounted. • About 15 kilometers from the shoreline • Around 1.6 kilometers away from the nearest Class A river • Approximately 23.8 meters above sea level

- The site for the administration building and phase 1 server building is classified as "Class I-B: Plateau and hilly terrain. Diluvial deposit (Kanto loam), ground bearing capacity of 100-1000 kN/m^2" according to the terrain classifications indicated in the Guidelines for Planning Geotechnical Investigation for the Structural Design of Building Foundations published by the Architectural Institute of Japan.
- The guidelines state that a spread foundation caters to low-rise buildings between one and three stories in height on sites with a Class I-B terrain classification.
- From the results of the boring survey, an N-value of 68 was confirmed.

Architecture

Modular System Enables Rapid Construction and Expansion

Features of the Modular System

Components that make up building are standardized
Components and materials are fabricated at a factory to maintain quality while reducing costs and shortening construction periods.

The steel materials used in high-rise buildings and bridge girders are used to achieve the efficient use of space with pillar-free open spaces (up to 60 meters)

Server Building

From start of construction to completion of framework

4 months: July 2018 (start of construction) to November 2018 (completion of framework)

Seismic resistance level

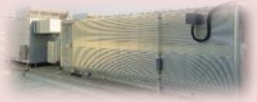
Compliant with the new Building Standards Act

Shortened construction period due to modularization

Achievements from the Matsue Data Center Park

- Construction of base components taking approximately 6 months
- Expansion of modules (containers) taking approximately 3 months

IZmo 9 racks



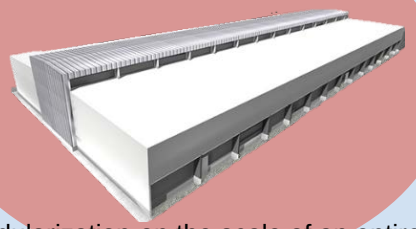
Modularization on a per-container (standalone) basis

co-IZmo 4-26 racks

Modularization on a per unit (connected containers) basis

Modular System

Basic units of 150 to 1,000 racks



Modularization on the scale of an entire floor through system architecture

Electricity

Extra-high loop power receiving equipment ensures receiving capacity up to 50 MW

The facility is equipped with an extra-high loop power receiving equipment that receives up to 50 MW of power. Various high-efficiency electrical equipment able to use up large quantities of power is installed.
A highly reliable power supply system is equipped with combination of emergency generators, oil tanks with capacity for 72 hours, and UPS.

Enables large-scale construction and scaling up

- Ensures power capacity up to 50 MW
- Users can expand inside the campus (within the same premises) as their businesses grow

Installation of high-density equipment

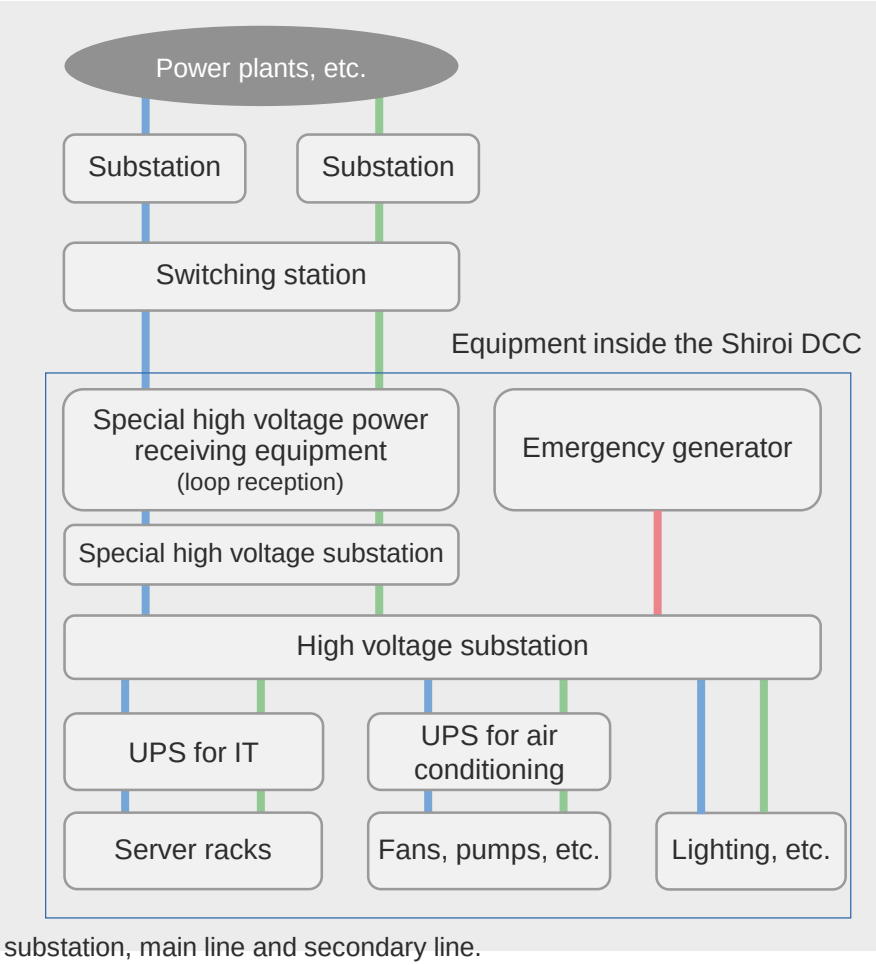
- Equipped with power distribution equipment that copes with high-load racks in the 20kVA/Rack class (6kVA/rack provided on standard floors)

Improved efficiency

- The use of bus ducts improves ease of construction and reduces voltage drops
- High efficiency 3 phase 4 wire UPS system that achieves 98% efficiency is installed

Emergency Generators and UPS

- An emergency generator is installed in case of a commercial power outage
- Fuel enabling continuous operation for 72 hours is stockpiled at all times
- High-quality power is supplied to the IT equipment from the UPS
- Backup systems for critical equipment are installed to protect against failures
- Power transmission routes to server racks include alternate routes for redundancy



* When the data center opens, high voltage power is received through the substation, main line and secondary line.

Air conditioning

Outside air cooling is employed as the base air conditioning, with support for high loads also provided

Supports cooling for 20kVA/Rack class Hybrid air conditioning enabling significant reductions to power consumption in summer through the use of outside air
High efficiency operation of the air conditioning system is achieved through precise temperature and humidity monitoring and control that feeds back various instrument readings.

High load support

- Supports the heat generated by 20kVA/Rack class (6kVA/rack provided on standard floors)

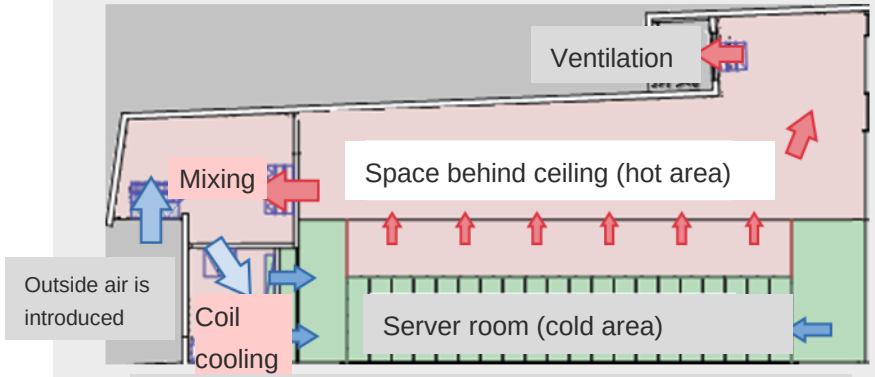
Air conditioning using outside air and wall blowoff system

- The use of outside air reduces chiller load and lowers the power consumption of air conditioning equipment
- Air conditioner blower power is reduced to around one-third compared with a floor blowout system with the use of rectification units, hot-aisle capping and wall blowout system air conditioning. The system equalizes rack intake temperatures and prevents heat spots from occurring

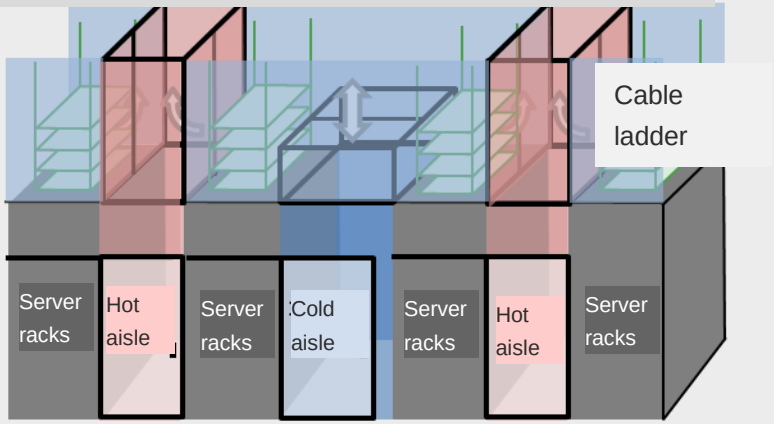
Redundancies and handling of power outages

- Redundancy with N+1 configuration as standard
- Chilled water circulating pumps and blower fans are protected with a UPS power supply. When a commercial power supply outage occurs, the UPS prevents server cooling from going offline until the emergency generator engages
- A buffer tank for chilled water is installed in case of chiller restart

Chiller-related equipment



Conceptual image of hybrid cooling operation with outside air and coils



Cross-sectional view of server room

Monitoring and Security

In addition to operators, the facility has a full-time engineer

A flexible design able to provide the required security level based on needs and in compliance with FISC safety standards

Building entry and exit logs and footage from surveillance cameras are retained for at least one year, and biometric authentication (fingerprint authentication) is equipped as standard.

24-hour, 365-day support

- Reception during building entry and exit, inspection of goods carried in or out
- Internal data center information is centrally monitored on a large multi-screen
- Building entry and exit logs as well as surveillance camera footage are continually recorded (Retention periods of at least one year)

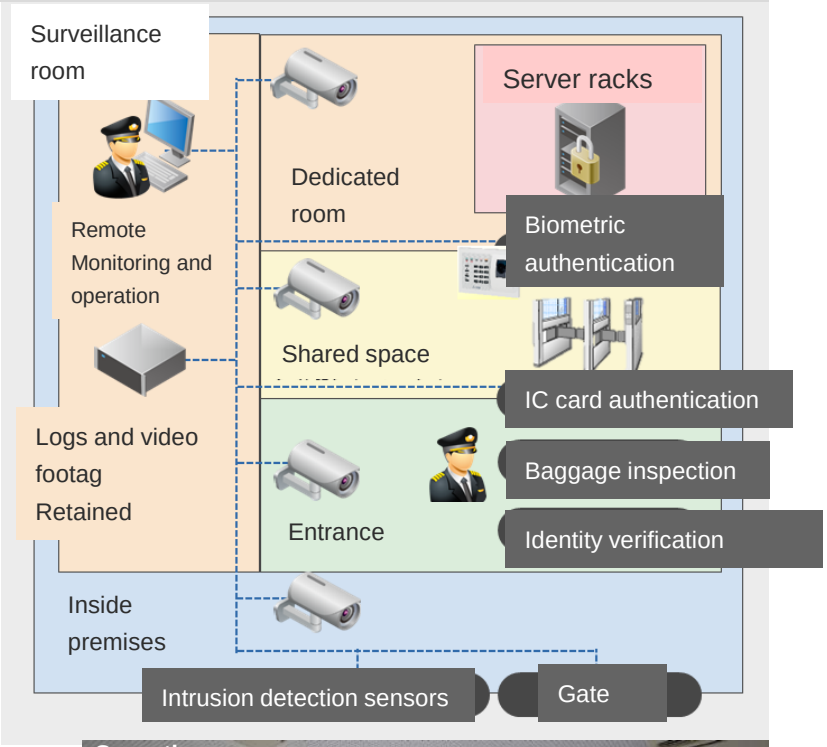
Multi-level security

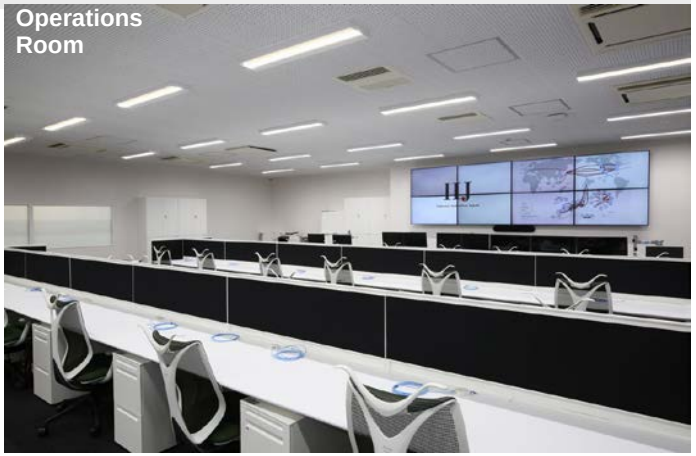
- Multi-level security zones are established up to the point of reaching server racks. Multiple security authentications are required until a person reaches server racks
- If needed, gauges can also be installed inside server rooms.

Enhanced perimeter security

- Depending on the shape of the exterior, multiple intrusion detection measures are implemented
- For intrusions from outside the premises, surveillance camera records are retained, and by using multiple sensors, a system enabling high-precision detection has been developed.

Security zones are formed using authentication units and other measures, and an intrusion detection system based on various sensors has been implemented.





Housing Room

Seismic isolated floor employed as standard
Customers can bring in their own racks

Housing room with seismic isolated floor that can accommodate around 300 racks per section
Supports installation of tall racks (2,700 mm) and handles different routes for power supply and communication lines

Server racks

- High density installation is possible with a withstanding load of 1.5t per rack
- Server racks up to a height of 2,700 mm can be installed, and racks of various configurations are flexibly supported (a customer's own racks can also be brought in to the facility)
- Electronic locks will be supported for the racks offered as standard

Wiring routes

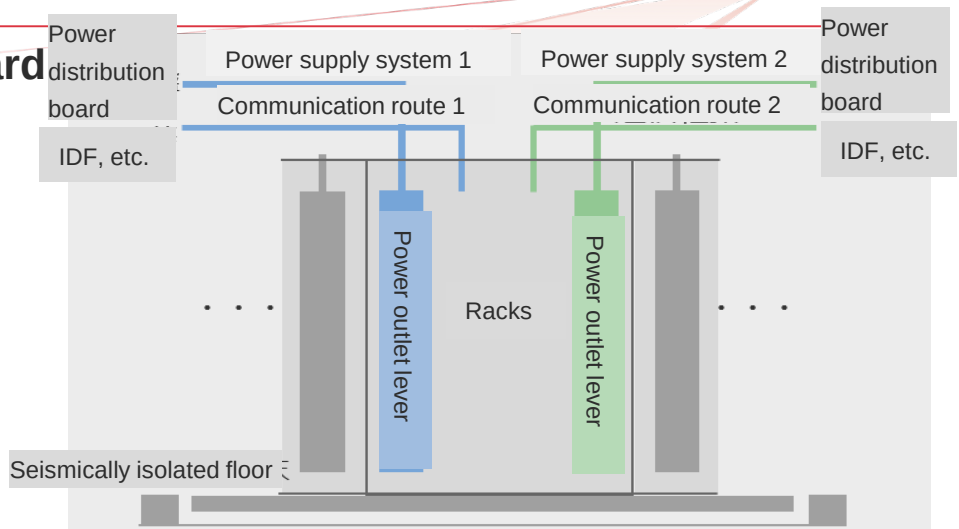
- Both electrical and communications support different route wiring
- Cable racks installed in the ceiling are used for wiring

Gas fire extinguishing system

- A fire prevention system detects fires within the server room
- N2 gas is used to extinguish fires without causing water damage
- Sound-reducing heads are used to suppress the effects of sound pressure during gas fire extinguishing

Equipment (goods available for loan)

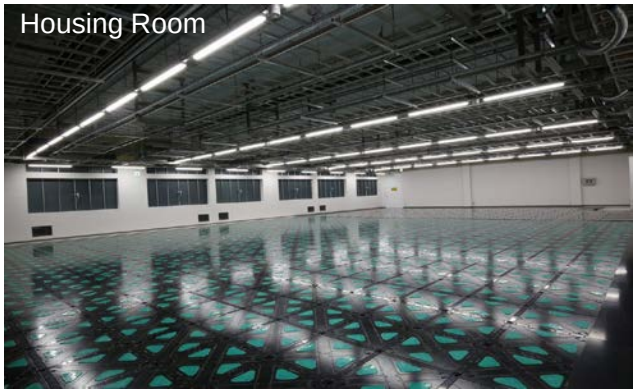
- Work benches and chairs
- Shelves, cage nuts and blank panels
- Work tools



Rack specifications provided as standard

Width:	: 700mm
Depth:	: 1200mm
Number of units:	: 47U (split racks will also be offered)
Doors	: YES

Power supply specifications: 6 kVA as standard



Telecom Carriers

Three different incoming communication routes from outside the premises are set up to connect the data center with the outside, and a carrier-free approach that does not restrict use to a particular carrier has been adopted. This ensures high reliability and equips the facility with leeway for the future.

Carrier-free support and three routes for incoming connections

- Three different incoming communication routes from outside the premises are set up to ensure a high level of redundancy
- With no restrictions on carrier use, customers can freely customize their communications environments

Internet connection environment provided

- Connections to IIJ's broadband backbone can be made via on-premise wiring

Multiple wiring routes within the premises

- Support for wiring along different routes within the premises

- Incoming connections can be directed outside the premises along three completely distinct routes
- Both buried and overhead methods are supported for incoming connections.

Other Facilities

Operations and monitoring rooms, as well as rental office space designed for use as BCP offices are available
Various refreshment facilities offer relaxation and comfort during visits to the facility

Media storage room

- Equipped with a dedicated room for the storage of tape and other media
- Temperature and humidity control suitable for media storage is implemented
- High security level operation is supported

Rental offices

- Meeting rooms of different sizes are available in the administrative building
- Customers can secure dedicated rental office space. Interiors and other elements can be customized based on customer needs

Refreshment facility

- Equipped with a refreshment room available at all times to facility visitors
- Nap room and shower room support late night work and BCP usage
- Beverages and other items are sold in vending machines

Equipment and Facility Specifications

Location

- Location: Shiroi-shi, Chiba Prefecture

Buildings

- Building Construction: Two aboveground floors (administrative building), one aboveground floor (Server Building 1)
  - Earthquake-resistant Structure (partial seismically isolated floor)
  - Data center services can continue to be provided even after an earthquake on the scale of the Great Hanshin-Awaji Earthquake or Great East Japan Earthquake
- Floor load: 1,500kg / rack

Power Supply Equipment

- Power receiving system: Special high voltage loop power receiving (high voltage power receiving at the time of facility opening)
- Emergency generator: Gas turbine generator
- Generator fuel reserves: 72 hours (under maximum load)
- UPS equipment: N+1 redundant configuration
- UPS battery life: 5 minutes (under maximum load)

Air Conditioning Equipment

- Configuration: Outside air / cooling chiller hybrid
- Air conditioning system: Wall blowoff system

Monitoring and Security

- Monitoring System: Operational staff stationed 24 hour a day, year-round.
- Surveillance Cameras: Installed for all doors and between rack mounts
- Intrusion Detection: Fence sensors, infrared sensors, other equipment
- Zone Restrictions: Security gates, IC card and biometric authentication

Disaster Prevention Equipment

- Fire detection: Ultra-high-sensitivity smoke detectors
- Fire extinguishing method: Nitrogen gas-based fire extinguishing system

Telecom Carriers

- Telecom carriers: carrier-free
- Incoming connection method: incoming connections can be established from three different routes
- Wiring routes: wiring via different routes is supported

Compliance with Standards

(including planned compliance)

- Japan Data Center Council (JDCC) Tier 3+ facility standard
- Center for Financial Industry Information Systems (FISC) safety standards
- ISO 27001 (ISMS)
- ISO 14001 (EMS)

IIJ

Internet Initiative Japan

The internet started in Japan in 1992, along with IIJ. Since that time, the IIJ Group has been building the infrastructure for a networked society, and with our technical expertise, we have continued to support its development. We have also continued to evolve our vision for the future and innovate to make it a reality. As an internet pioneer, IIJ has blazed the trail so that others could realize the full potential of a networked society, and that will never change. The middle "I" in "IIJ" stands for "initiative," and IIJ alway starts with the future.

Disclaimer

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