Internet Topics: Energy-Saving Technology Required for Data Centers

In April 2011, IIJ began operations at the Matsue Data Center Park ("Matsue DCP") that had been built in Shimane prefecture with the concept of integrating facilities and IT. Electrical and cooling equipment are installed inside conventional building-type data centers to provide an optimal environment for IT equipment at the time of construction. However, the life cycles of the equipment in a data center vary widely, at 30 to 50 years for the building, 10 to 20 years for electrical and cooling equipment, and 2 to 5 years for IT equipment. This leads to issues such as not being able to keep up with advances in IT equipment or supply the necessary power or cooling even though there is enough space. At Matsue DCP these issues were resolved by modularizing IT equipment, electrical equipment, and cooling equipment, making it possible to replace or supplement equipment that has become obsolescent. Because Matsue DCP may reach its maximum capacity of 24 containers in 2012, we are currently working on designs for another park. For our next-generation park we plan to revise our approach to electrical equipment, in addition to making improvements to the "IZmo"*1 IT modules that integrate the IT equipment, buildings, racks, and fire extinguishing equipment we currently operate, as well as the outside-air cooling modules that provide significant power savings.

Japan has largely been dependent on nuclear energy for electricity. But since the Great East Japan Earthquake circumstances surrounding nuclear power have changed significantly, and this impact is being felt in tangible ways such as increased electric power rates. For data centers that consume large amounts of electricity this is an extremely serious issue that will shake the foundations of our business, so we are faced with the need to drastically revise our power infrastructure. This means it will be necessary to promote the integration of IT with both the narrower category of data center facilities and the broader category of facilities that include power plants and grids. It also indicates that the time has come to rethink our approach in anticipation of the easing of power regulations and the spread of smart grids that are likely to occur in the future.

For this reason IIJ is planning proof-of-concept tests*2 involving data center efficiency technology and smart grids under the following three themes:

1. Reducing Power Consumption
At Matsue DCP we have reduced power consumption substantially by using outside-air cooling. However, if we could also cool using outside air during the summer season when outdoor compressor units (chillers) are currently used, it would improve PUE (Power Usage Effectiveness) from around 1.2 to around 1.1. To this end, we will develop modules for all outside-air operation and operate IT equipment that is resistant to high temperatures for one year to confirm stable operation and energy savings. We expect this will cut power consumption, reduce investment costs for outdoor compressor units, and also lower base power rates by keeping peak power consumption down during the summer season.

2. Reducing Power Loss (See Figure 1)
A moderate reduction of power loss has been achieved by installing equipment such as high efficiency UPS (Uninterruptible Power Supply) and transformers, but IIJ will build a test system to confirm the energy savings of high voltage power supplies, DC to AC conversion (no D/A conversion), and distributed UPS placement (built into servers and racks) solutions that are being implemented worldwide. If distributed UPS placement can be implemented it eliminates the need for the building to house UPS clusters, potentially reducing construction costs.

3. Operating Generators and Batteries Efficiently for Renewable Energy and Smart Grids
We will evaluate the stable operation of solar, wind, fuel cell, and other power generation equipment that has not been used as a main power source in conventional data centers, in addition to equipment for leveling the power supply (storage batteries). We will also work towards utilizing equipment such as power generators and UPS with a low operation rate that has been installed as backup for power outages by integrating power supply storage batteries with backup UPS. On top of this, we will examine the requirements for interoperability with external facilities in a smart grid.

We plan to be ready to start proof-of-concept tests at Matsue DCP in phases from the first half of FY 2012.

	Sample Configuration	High Voltage Power Supply	No D/A Conversion	Distributed UPS Placement
Typical DC in Japan	Power Company — AC420V — A/D — BAT — UPS — D/A — AC420V — AC100 — A/D — Server — Rack	No	No	No
HVDC	Power Company — AC420V — A/D — BAT — DC384V — D/D — DC12V — Server — Rack	Yes	Yes	Conditional
Google	Power Company — AC480V — AC200V — A/D — DC12V — BAT — Server — Rack	Conditional	Yes	Yes
Microsoft	Power Company — AC480V — A/D — DC12V — BAT — Server — Rack	Yes	Yes	Yes
Facebook	Power Company — 1ΦAC277V / 3ΦAC480V — A/D — DC-48V — BAT — Rack — A/D — D/D — Server — Rack — BAT capacity 45 sec.	Conditional	Yes	Yes
AC400V High Voltage Power Supply	Power Company — AC480V — A/D — BAT — UPS — D/A — 1ΦAC230V / 3ΦAC400V — A/D — Server — Rack	Yes	No	No

Note: Created by IIJ from published resources

Figure 1: Energy-Saving Technology Trends for Electrical Equipment

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*1 "IZmo" IT modules are container-based modules developed by IIJ for constructing data centers optimized for building cloud infrastructure (www.iij.ad.jp/DC/technology/izmo.html) (in Japanese).
*2 An introduction to the proof-of-concept test equipment for the IIJ group's cloud-oriented data centers (http://www.iij.ad.jp/company/development/tech/activities/dc/) (in Japanese).