FUJITSU

White Paper
Reduce Environmental Impacts through Fujitsu's Platforms

In today's enterprises, taking environmental measures and improving managerial efficiencies are of increasing importance. How does Fujitsu support companies in their energy conservation and environmental efforts? This document is designed to outline and explain specific areas in which Fujitsu helps its customers conserve energy.

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Introduction

Until recently, ICT (Information and Communication Technology) has been looked on as a means to reduce costs and optimize operations. However, the value of ICT to enterprises is shifting to saving energy and promoting the environment. Corporate development in the future will very likely depend on how effectively companies use energy.

Another important factor in ensuring business sustainability is dealing with ever expanding volumes of information, and the resulting impact on ICT costs.

Investments in ICT include not only ICT equipment itself, but encompass installation space, air conditioning and electrical facilities, and many running costs such as labor and power.

Advancing Energy-Saving Measures–The Basics

Green ICT Products

Two key terms are increasingly being used in the same context: environmental measures and managerial efficiency improvement. How can the functionality of each product be best applied toward the advance of energy-saving measures?

Green ICT products reduce the environmental impact of ICT equipment itself. Fujitsu provides ICT products featuring a variety of environmental technologies developed around the four key approaches of lessening power consumption, reducing resource usage, reinforcing product recycling and eliminating hazardous substances.

Saving Power and Conserving Energy

Bringing together small technologies leads to big power savings and energy conservation. Fujitsu adopts power-saving and energy-conserving technologies to improve equipment performance and processing speed, manage systems efficiently, and reduce loss and carbon dioxide emissions.

Virtualization

Virtualization allows consolidation and integration, improving convenience while strengthening functionality. It helps drastically reduce hardware to save energy while lowering costs. This combination of benefits has raised the profile of the Cloud in recent years.

The Software Link

Integrated system control and power management of hardware are vital to saving energy. By efficiently managing ICT resources, high-level hardware technologies can provide a truly powerful and effective force. This is where the opportunity of visualization software can play a major role.

In the management of customers' data centers, the high levels of visualization and system-wide software administration enabled by Fujitsu make energy-saving operation a reality.

Software Supporting the Private Cloud

It is also possible to save power by using virtualization and shared operations to consolidate servers. However, software integration is needed to overcome the challenges of daily operation and manage both physical and virtual servers.

Advantages of the Private Cloud

The volume of information available in the near future is said to be 200 times what it is today. It will become impossible to manage all this data using existing infrastructures. Investment costs will continue to expand for additional systems and new space to hold them.

The Private Cloud represents one method to prepare for this future, to raise efficiency and consolidate resources. Fujitsu therefore expects Private Cloud environments to continue expanding in the future.

Systems concentrated in one location can be used efficiently, reducing requirements for servers, storage and other ICT equipment. Depending on the services provided, server efficiency can be significantly increased through the addition of virtualization. Virtualizing an environment centralizes it, reducing the total cost of operations (TCO). This is possible because the space requirements for facilities and server storage are reduced, as well as operating expenses such as air conditioning and personnel.

Efficiency improvement is therefore the prime advantage of the Private Cloud. However, shifting from dispersed to centralized system management also requires a change in the mindset of the people on the job. The full potential of the Private Cloud cannot be realized without behavioral change on the part of both users and operators. Simply gathering together resources in one location does not ensure reduced costs.

Nevertheless, facility amortization and maintenance costs are incurred even with the Private Cloud, so the key here is how efficient operations can be made.

In the case of the Public Cloud, all the customer needs are terminals and network access. Maintenance, management and amortization of costs virtually disappear. Expenses occur only for the services used. The Public Cloud can therefore be the best option depending on the customer's needs.

The mechanism of paying in line with actual usage is coming into practical use in Private Cloud systems. The objective is to raise the cost consciousness of people using the system, ensuring only the resources required at any given time are secured. Fujitsu believes complete internal visualization of such systems is important because resources can be allocated and adjusted based on actual usage priorities. "Pay per use" and system visualization should let enterprises optimize their server resources and achieve low-cost operation.

If Private Cloud costs are still prohibitive to some customers, Fujitsu can propose and provide Public Cloud services.

Saving Resources

Performance and technique are required to ensure limited resources are used effectively and that no more than the amounts needed are used. Reducing the number and size of parts leads to lower resource waste. For this reason, Fujitsu applies a wide range of proven resource-saving techniques. These start with reducing parts and cables,

improving performance and lessening space requirements, and also include making manuals and other documents digital.

Recycling

From the initial design stage, Fujitsu designs parts for easy recycling. Fujitsu is also fortifying its recycling capabilities to advance the collection and reuse of resources in its products.

Eliminating Hazardous Substances

The Fujitsu Group not only complies with relevant regulations, but it also defines its own stringent rules to eliminate hazardous substances from products.

Optimizing the Environment

To maximize effectiveness and minimize costs, it is important to choose ICT products offering strong environmental performance. However, attention must also be paid to the facilities housing this equipment.

Fujitsu provides optical-fiber temperature measurement systems for large-scale server rooms and data centers. Fujitsu FSAS also markets green facility solutions for server rooms and Facility CUBEs for offices, stores, hospitals and many other facilities. The Company's ever-evolving products and services save energy, space and costs in any environment.

Fujitsu's Approach on the Environment

Since its founding in 1935, Fujitsu has made society and the environment centerpieces of its management philosophy.

Fujitsu Research Institute developed an evaluation technique that analyzes a range of factors to measure environmental impact and eliminate vague estimations. Facts and statistics that make sense to customers help them lower their carbon dioxide emissions and energy consumption.

Environmental Emphasis throughout Product Life Cycles

At the heart of environmental care is the attitude that environmentally conscious product development begins at the initial design phase. Fujitsu focuses on recycled plastics and bio-based plastics, as well as on exhaustive environmental assessments. Leading-edge facilities and tools ensure optimal development efficiency. The Fujitsu Group is also meticulous about green procurement.

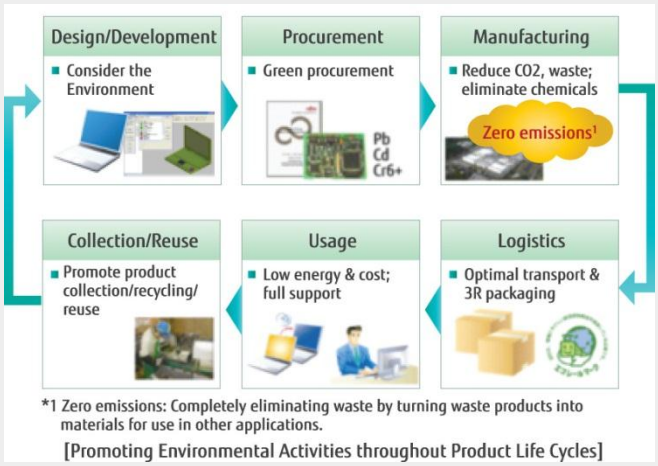
In manufacturing, Fujitsu works to reduce not only electricity usage, but also gas and crude oil consumption. Lessening chemicals and waste materials, and promoting recycling with organic materials have contributed to zero emissions.

Companywide recognition under the Eco Rules of Japan's Ministry of Land, Infrastructure and Transport tells the logistics story. To raise efficiency, Fujitsu ensures a 50% or higher load ratio of trucks transporting its products. The 3Rs (Reduce, Reuse, Recycle) are another major focus in product packaging and raising the recycling performance of packing materials.

Fujitsu also supports customer efforts to cut running costs by reducing energy consumption in facilities.

The Fujitsu Group operates eight recycling centers in Japan, from Hokkaido in the north to Okinawa in the south. This network achieves a product-recycling ratio of more than 90%.

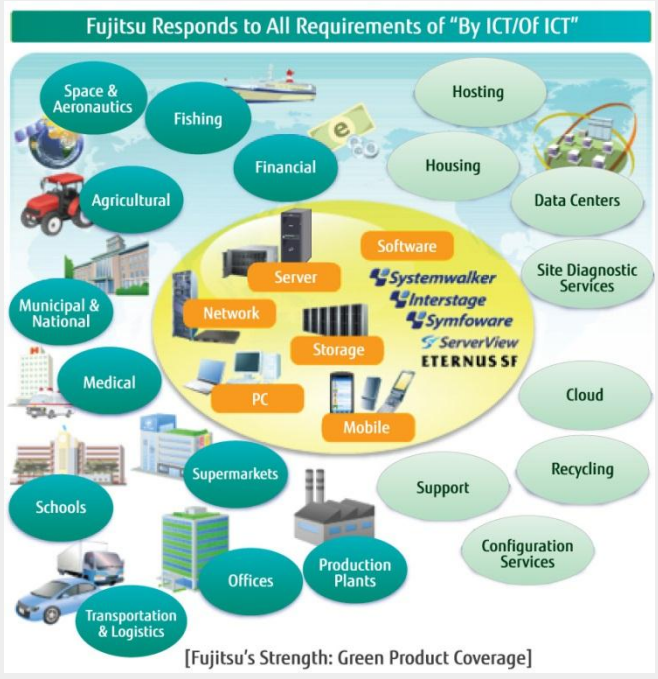
Figure 1. Environmental Promotion throughout the Product Life Cycle



No other company boasts as comprehensive an ICT product lineup as Fujitsu, from PCs to large-scale servers and storage, network and mobile products. The Company also goes beyond hardware to supply software, data centers, recycling center operations, and application-based solutions. Only Fujitsu covers the whole of the ICT world and can offer such a wide range of services and products.

Fujitsu products are based on green guidelines established in 1993 and constantly improved since then. The Company has a powerful structure to support the environmental and energy strategies of its customers.

Figure 2. Fujitsu's Green Coverage



Every three years, Fujitsu sets its Environmental Action Plan, which is implemented throughout the Group's global operations. The sixth

term of this plan is underway now with the target of meeting the challenges of reducing the environmental burden of Fujitsu, its customers and society.

Green Policy Innovation, a project announced in 2007 to lessen the environmental burden through green ICT, is characteristic of Fujitsu's efforts. In fiscal 2007, many companies announced basic policies regarding their reduction of electricity consumption. Fujitsu, however, declared policies of reducing the power consumed by and because of equipment, and lessening environmental burden throughout product life cycles. In other words, Fujitsu distinguished itself by presenting a unique energy-saving message that included ICT usage.

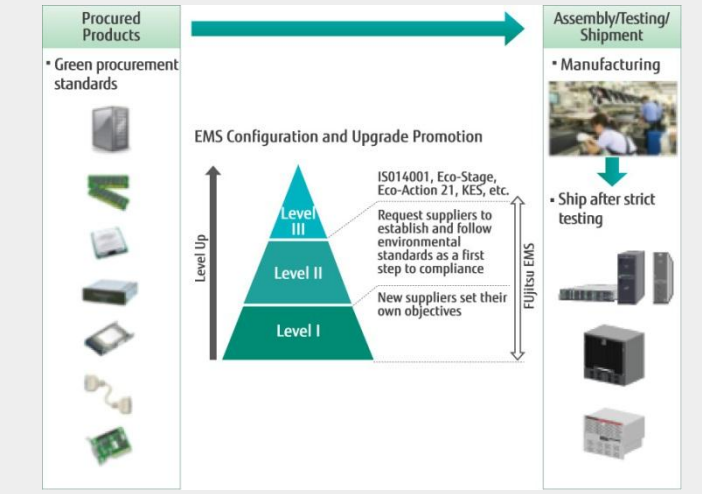
Fujitsu applies a logic that calculates the carbon dioxide effectiveness of introducing new solutions. These calculations are evaluated and used to propose optimal solutions to customers. To lessen the environmental burden of ICT equipment and data centers, Fujitsu has mechanisms to illustrate how much carbon dioxide can be reduced by replacing existing with new ICT equipment. Fujitsu aims to make its evaluation system a global standard and has worked on establishing guidelines at international conferences.

Moreover, under the Green Policy 2020 initiative in Fujitsu's Midterm Environmental Vision, the Company is working to use ICT to reduce environmental impact, conserve biodiversity and improve energy efficiency by the year 2020.

Green Procurement

A wide range of parts, materials and products are required in manufacturing. When procuring these elements, Fujitsu works with its suppliers to promote green procurement, or placing a high priority on procurement that takes environmental considerations into account. By purchasing components and materials that comply with Fujitsu's Green Procurement Direction, the Company can provide customers with products boasting high environmental efficiency.

Figure 3. Fujitsu Group Green Procurement



Fujitsu Group Banned Substances—namely, substances restricted by the laws or regulations such as RoHS Directive in the EU are not used in products sold by Fujitsu. Moreover, candidate substances for Authorization under the EU's REACH regulation are specified as Fujitsu Group Reportable Substances, while those suspected of being hazardous are specified as Fujitsu Group Control Substances. Fujitsu carefully manages substances to be able to rapidly halt their use in the case of new legal or other regulatory restrictions.

Figure 4. Fujitsu Group Controlled Substances

■ **Banned (not used in delivered products)**
Internationally prohibited substances, RoHS Directive prohibited substances and substances prohibited by individual countries/regions

■ **Reportable (must be reported when used in delivered products)**
Candidate substances for Authorization under the EU's REACH Regulation (some are already included in Fujitsu Group Prohibited Substances)

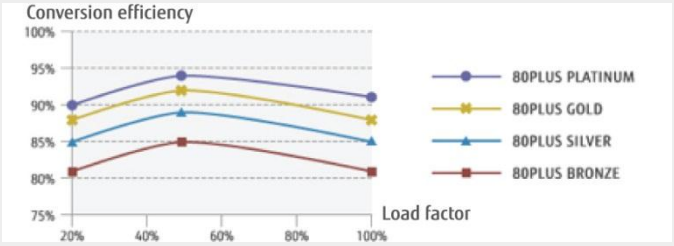
■ **Control (existence and quantities/volumes are controlled)**
Substances of which control is required based on industry guidelines or customer requests

Third-Party Evaluation of Fujitsu's Approach

The International Energy Star Program regulates the minimum power of small-scale servers with CPUs of less than two sockets when the operating system (OS) is idle. Fujitsu has earned recognition primarily for its PRIMERGY entry-class servers.

Fujitsu is strengthening its approach to energy savings throughout its product lines, from the power supply itself to the way ICT equipment is used. The Company adopts high-efficiency power supplies surpassing 80 PLUS™ GOLD and PLATINUM certification standards, providing functionality to use products at maximum efficiency, control power capping and reduce idle power usage. These efforts are all based on customers' organizations and actual usage conditions to achieve the optimal balance of performance and power.

Figure 5. 80PLUS Certification Standards



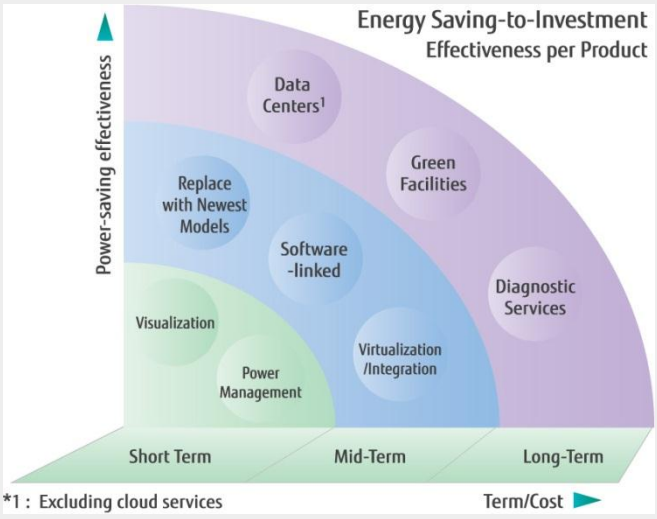
The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) has a major influence on the operation of data centers. In 2008, the Society announced its official viewpoint that a preset temperature of 18°C to 27°C is optimal for data centers. Since then, preset temperatures have been rising around the world. Fujitsu has released its own Installation Environment Guidelines corresponding to those of ASHRAE and was awarded the "Best of Show Award" at Interop Tokyo 2012. In addition, Fujitsu's high effectiveness in reducing carbon dioxide emissions led to the Company being named a Low Carbon Dioxide Kawasaki Pilot Brand by the Japanese city of Kawasaki.

Fujitsu was also recognized at Japan's Green IT Awards 2011 for its web-based EcoCALC eco-contribution estimation tool. This tool quantitatively evaluates the environmental effectiveness of ICT by comparing carbon dioxide emission levels before and after the deployment of ICT equipment. With EcoCALC, companies can calculate the effectiveness of ICT in reducing carbon dioxide. Calculations are based on factors including materials consumption, the movement of people and materials, office and warehouse space, power consumption by ICT equipment and data communications volume.

Energy-Saving ROI by Product

Consideration of the energy-savings return on investment (ROI) is vital to proceeding with energy-saving measures. Here, Fujitsu considers the best measures to be employed by examining the effectiveness of different products in each of three phases. First are short-term measures promising immediate results. Second are midterm measures with results anticipated through the adjustment or replacement of existing systems. Third are long-term measures, when comprehensive renewal is implemented for far-reaching results.

Figure 6. Energy-Saving ROI by Product



Short-Term Measures

To minimize ICT investment and save energy, customers can begin with measures that can be implemented rapidly. The quickest path in this effort is to precisely understand the current conditions, reaffirm the functionality of existing products and deftly make use of them.

Fujitsu first looks at power management. The days of leaving ICT equipment on and connected all the time are over. The key is optimizing power usage. For example, automating the startup and shutdown of equipment based on work schedules can reduce power waste. Naturally, this also leads to carbon dioxide reduction, optimization of system management and improved operational efficiency.

Next is visualization. Every company seeks to reduce the energy consumption of its ICT equipment. However, if the "when, where and how" of electricity consumption are not understood, efficient measures cannot be considered. Being able to visualize operating and execution conditions, and load factors of equipment makes it possible to consider viable means of reducing energy consumption.

Fujitsu is developing a power dashboard system to monitor electricity usage. The system is already in use at 73 Fujitsu Group offices in Japan to monitor power consumption by the hour. At the same time, the amount of power that will be used each day is forecast. The resulting data is used for peak power consumption countermeasures.

Fujitsu employees can check their personal power usage at their desks. Used in conjunction with groupware schedule management, the system is contributing to a 15% power savings.

Fujitsu's expertise lies in the promotion of energy savings via ICT solutions that contribute to the measurement, visualization and improvement of systems.

Midterm Measures

There are countless power-saving and energy-conserving technologies within Fujitsu's products. However, the Company also has a number of midterm measures that take these concepts one step further with even greater effectiveness. Organized under the three themes of "replacement with new models", "the software link" and "virtualization and integration," how are these midterm measures raising the bar on environmental effectiveness and helping optimize entire systems?

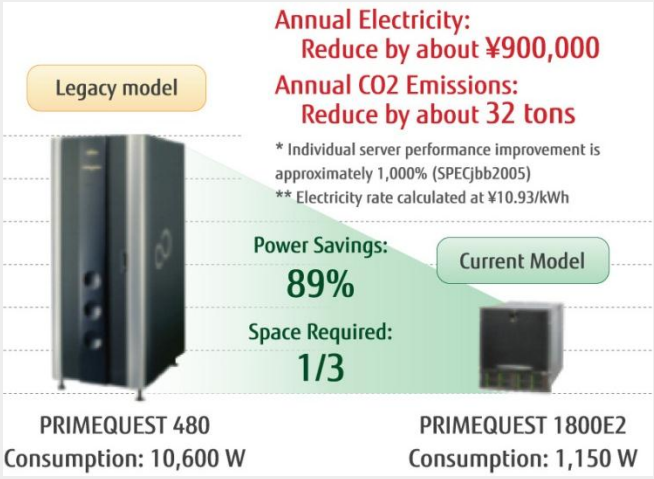
Replacement with New Models

In the past several years, amazing advances have been made in measures to respond to worsening environmental issues. For instance, even a simple comparison with products launched just five years ago shows obvious improvements in performance thanks to technological innovation.

Comparing Power Consumption

With PRIMERGY, Fujitsu has achieved substantial reductions in power consumption compared to three years ago. Replacing servers from even earlier generations can produce more significant energy savings. In addition, Fujitsu products for high-temperature operating environments moderate peak temperatures of hot areas by five degrees compared with previous models. With a guarantee of operation at up to 40°C, these servers reduce air-conditioning costs and save power. Since the PRIMEQUEST 1000 series, launched in 2010 as "super green" systems, Fujitsu has implemented measures including highly effective power sources conforming to the 80PLUS GOLD standard to greatly reduce electricity consumption while improving performance and reducing product size.

Figure 7. Power and Space Savings of PRIMEQUEST

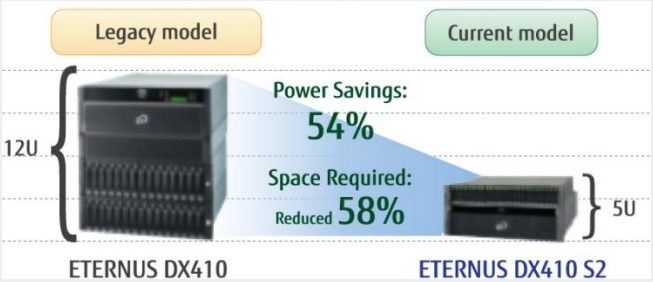


SPARC Enterprise servers running Oracle Solaris thoroughly pursues ecological operation with high processing performance and reliability. In particular, the SPARC Enterprise M3000, which mounts four cores on a processor, packs the performance and reliability required in mission critical systems in a 2U chassis. Performance is 1.3 times higher in a server that takes up half the space and uses half the power of previous models.

Figure 8. Power and Space Savings of SPARC Enterprise

Fujitsu's lineup of ETERNUS DX disk arrays covers every need with models from the entry to enterprises class. With the enhanced S2 model released in 2011, performance was greatly enhanced throughout the series. Fujitsu introduced a high-density mounting design and significantly reduced parts in this model, reducing end-product size by about half that of earlier models. Moreover, power consumption was halved by adopting a highly effective power supply module and 2.5-inch SAS drive. All this was made possible without sacrificing reliability and improved throughput by 4.2 times.

Figure 9. Power and Space Savings of ETERNUS



The Software Link

A survey Fujitsu implemented in 2010 made it resoundingly clear how much customers care about energy-saving hardware operation. The contribution of software in this effort cannot be overstressed. Because different system environments produce different levels of effectiveness, Fujitsu offers tools and services to estimate power-saving results.

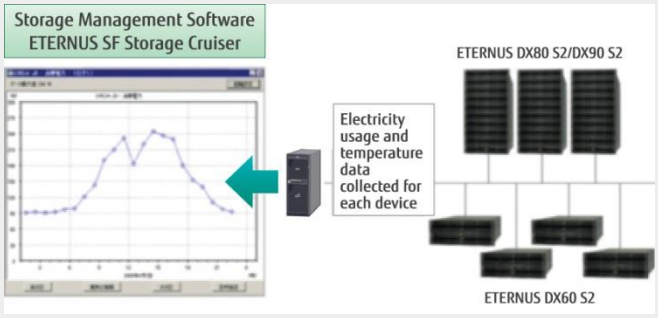
ETERNUS SF AdvancedCopy Manager

The ETURNUS SF system's AdvancedCopy Manager software is linked with the system's high-speed copying functionality. The result is precise control of the hard disk, spinning it during backups and idling it at other times.

Visualization of Power Consumption and Temperature with ETERNUS SF Storage Cruiser

ETERNUS SF Storage Cruiser lets customers monitor device operating environments by displaying current power consumption and temperature readings. Furthermore, it provides storage of historical data by day, week and year. Using the data visualized by this software, specific measures can be devised for different operating conditions, making it possible to see energy-saving and carbon dioxide-reduction effects for storage arrays as a whole.

Figure 10. Visualization of Multiple Machines with Management Software



Synchronizing backup operations using software such as ETERNUS SF Storage Cruiser and ETERNUS SF AdvancedCopy Manager helps customers manage their systems while reducing power consumption.

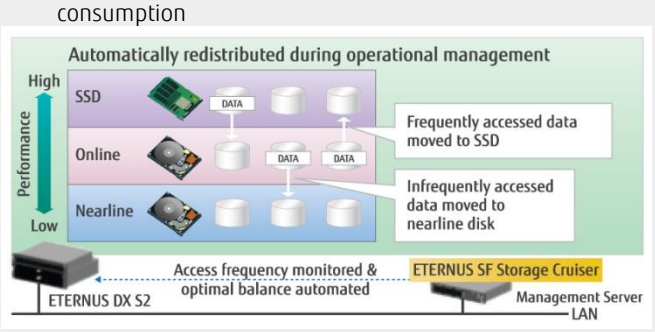
In addition, Fujitsu provides Automated Tiering of storage devices linked with ETERNUS SF Storage Cruiser. This function monitors data access to storage and allocates data automatically between drives according to the system policy. Frequently used data is allocated to high-performance SSDs (solid-state drives), while data that is not often accessed is relocated to less-expensive, high-volume nearline storage.

In other words, Fujitsu's customers can enjoy optimal cost performance. But what is the relationship between this functionality and energy savings?

For example, Ecomode support using MAID technology is an effective energy-saving function when applied with nearline storage containing low-access data. Automated operation also contributes to cost reductions by decreasing data management requirements.

Figure 11. Investment Optimization Using Automated Tiering

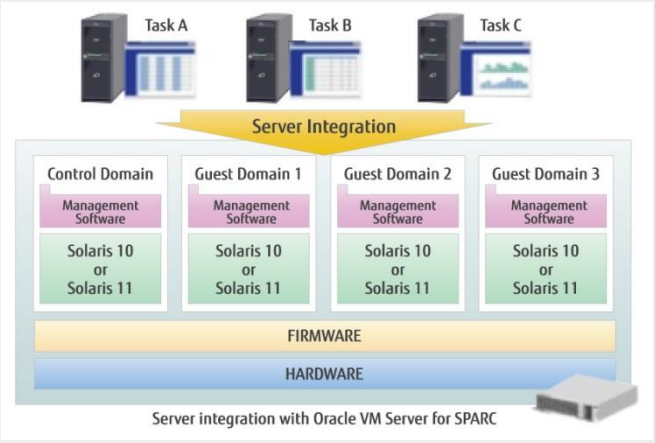
- Management costs lowered with automatic allocation
- Ecomode operation for low-access data reduces power consumption



Virtualization and Integration

Virtualization technologies such as hardware partitioning, Oracle Solaris Zones and Oracle VM Server for SPARC are included standard in our SPARC enterprise servers. Customers can select the best virtualization options for their operations to effectively consolidate their servers.

Figure 12. Server Consolidation with Oracle VM Server for SPARC



Compared with the earliest PRIMEQUEST products, performance has been vastly improved, and today's models greatly reduce power consumption.

DB servers can be operated on physical drives, with application and web servers virtualized. System design is simple, and considerable administrative savings can be realized. Furthermore, because existing 32-bit applications can be run on these systems, there is no need to move existing assets or accrue major cost and time investments to consolidate servers.

MAID Technology to Prevent Needless Operation

Storage products contain many hard disk drives (HDDs). MAID, standing for "Massive Arrays of Idle Disks," is a technology that allows each HDD to be turned on and off as it is accessed. Not all the disks in a multi-HDD system have to be operating all the time, so turning individual disks on and off in this way, is an effective means to greatly reduce power consumption.

Ecomode functions using MAID technology are also good for the environment. Backup disks, for example, are not used during regular server operation and need to be powered up only during backup operations. Using MAID with operations scheduling allows customers to reduce power consumption by turning off backup disks not in use.

Figure 13. Ecomode Operation Using MAID Functionality

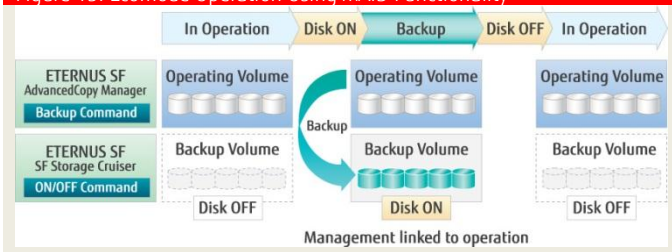
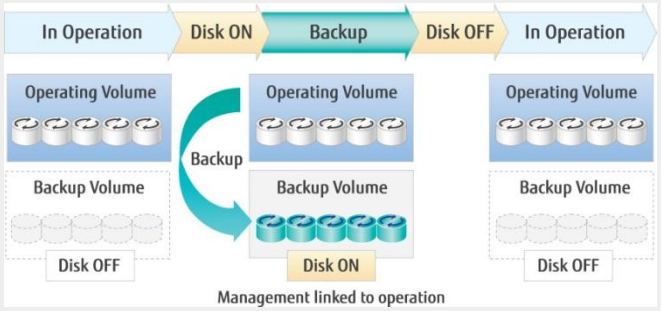
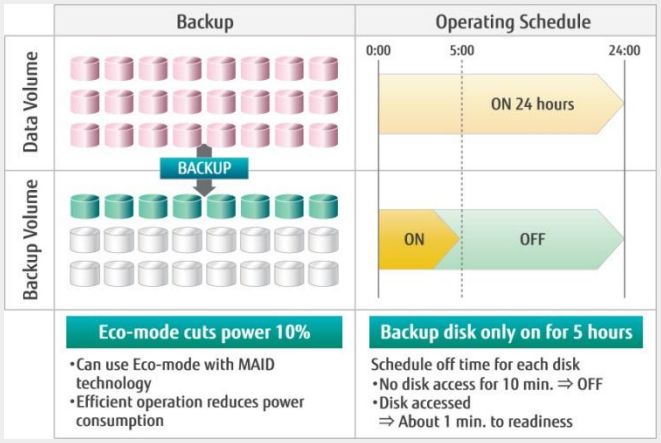


Figure 14. Reducing ETERNUS Power Consumption with Ecomode



Running and stopped times can be also be set for each RAID group in devices.

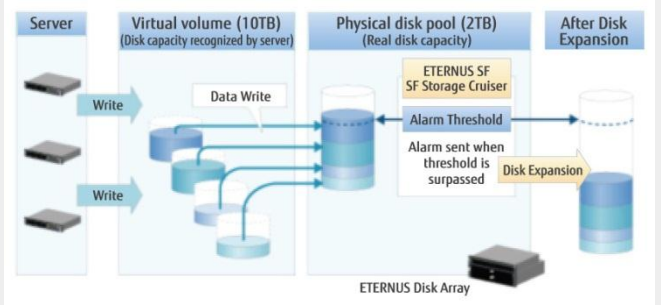
Figure 15. Scheduled Operation of ETERNUS DX80 S2



Storage Integration Using Thin Provisioning

Thin provisioning is a technology that virtualizes the capacity of storage and allocates volume capacities higher than those of physical disks in the server. Preparing excess physical drives in anticipation of future needs expands both the initial system investment and power consumption. Instead, by allocating necessary virtual volumes on the server side, and then allocating only the portion used to physical disks, customers can minimize unused space and the number of disks they need.

Figure 16. Thin Provisioning



Eliminating Duplication from Backups

Expanding data volumes become an issue in terms of backup space and system load. Today, primary backup to other HDDs is the most popular backup method. However, the management of multiple generations of data requires immense amounts of disk space, leading to consumption of resources and power. To resolve this issue, Fujitsu

developed and commercialized the CS800 data protection appliance with de-duplication features to remove duplicate data from backup data. Cases have been recorded in which customers used this technology to reduce data backup volumes to one-tenth the previous level and cut backup processing time in half.

Long-term Measures
Server Room Optimization Saves Running Costs

In today's ICT society, facility power optimization is perhaps a more important issue than green ICT products and efficient system operation in small spaces.

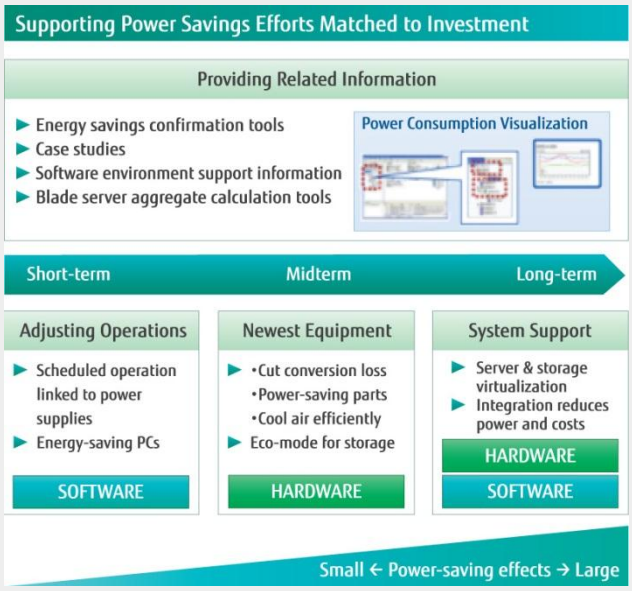
Fujitsu views business, ICT and the environment as three elements of a whole. In addition to providing optimal ICT equipment, Fujitsu offers facility consulting services covering every phase of equipment installation, from construction and operations management, to outsourcing services and recyclability.

Reducing Environmental Burden Product by Product

Effective Power-Saving
The First Step Is Visualization

Being able to visualize power consumption is another way to reduce the power used by air-conditioning equipment. With Fujitsu products, all system states are monitored. The results are visualized and gathered as statistics in chronological sequence according to factors such as energy consumed and temperature. Scheduled operations and virtualization make it possible to use only the equipment needed at any given time, leading to significant energy savings across the board.

Figure 17. Power-Saving Framework for Systems

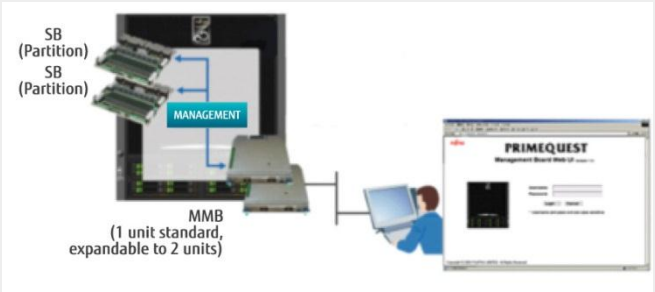


Fujitsu includes status monitoring as standard functionality in PRIMEQUEST and SPARC Enterprise systems. When using operation management software with PRIMERGY, power monitoring allows operations to be scheduled according to actual conditions.

Fujitsu made an early start in 2008, when it added power visualization to the PRIMERGY S4 series of servers. Individual server monitoring is implemented by the iRMC (integrated Remote Management Controller) installed in PRIMERGY units.

PRIMEQUEST servers come with server control units that monitor status throughout the device. This allows monitoring of power consumption, the temperature of parts and surrounding air, and the volume of air exhaust.

Figure 18. Real-time System Monitoring with MMB



Visualization, including operations monitoring, is possible with PRIMERGY and ServerView Suite shared server management software. Monitoring and management of systems with two or more PRIMERGY/PRIMEQUEST servers is a standard function in ServerView Suite.

Visualization of the power usage of SPARC Enterprise systems has been available as part of the overall system-monitoring structure with the SPARC Enterprise M3000 launched in 2008. System status when operating, including power consumption and information such as intake-air temperature and airflow can be viewed at any time.

Fujitsu has developed software solutions not only for servers, but also to help resolve issues related to increased power consumption resulting from ever-increasing data storage.

Software is the ideal tool for integrated management of entire systems. Tracking the status of the system as a whole becomes easy for system administrators. For large-scale customers with hundreds of servers, who face immense hurdles to monitor the status of each machine, the role of software in integrated surveillance is extremely important. The visualization of entire systems, combined with the ability to retrieve cohesive data on power consumption under different operating conditions, makes possible improvements to operating schedules and temperature setting based on real information. This entire process contributes to power savings.

Power-Consumption Computing Tools Reveal Current Status and Effects of New Equipment

How can customers measure the effectiveness of changing their server configurations and operating conditions?

Fujitsu offers a power-consumption calculation tool with PRIMERGY. In addition, Virtualization Effectiveness Examinations are implemented free of charge for customers who consolidate their server systems with Fujitsu software.

With PRIMEQUEST, Fujitsu provides a tool that estimates power consumption, heat generation and mass according to server configuration and capacity utilization to estimate effectiveness.

For SPARC Enterprise systems, Fujitsu has released a power consumption calculation tool based on system usage rates under different optional configurations.

ETERNUS also has a power consumption calculation tool. Power consumption varies widely depending on the kinds, cycles and number of hard disk drives installed. This tool can be used before any changes are made to confirm the effectiveness of power reduction compared to existing devices. Calculating power usage of a new configuration before making a purchase, and once purchased using the functions to optimize status monitoring and operating conditions of each device, leads to the potential for major power savings.

Power Management: Fujitsu's Expertise Comes to Life with Operation Scheduling

Even before saving power and conserving energy became issues, Fujitsu servers offered functions to schedule operations. Power sources are linked to those of each connected input/output device, so skillful use of scheduling to optimize based on actual operating conditions can lead to considerable power savings.

This functionality dates to a time before 24-hour server operation was the norm, a time when scheduling was convenient for many users who set their systems to start at the same time each morning and remain in operation until the close of business. In line with the advance of open systems, servers have been called on to operate 24 hours a day, 365 days a year.

During Japan's years of rapid economic growth in the late 20th century, power consumption was not an issue. Scheduling functionality was almost forgotten by some companies pursuing the optimization of their business activities. In more recent years, however, as issues such as carbon dioxide and energy saving came to the fore, the importance of scheduling operations was at last rediscovered.

Because this historical Fujitsu functionality was given new attention, the Company has made special efforts to ensure its usage and advancement.

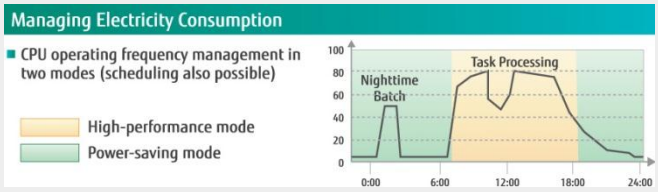
Systems have multiple I/O devices, as well as multiple servers. Imagine the difficulty of powering down every single server and device. This difficulty led to the concept of linking servers and I/O devices, and automatically shutting down devices when their servers were switched off.

While operation scheduling functionality comes standard with the hardware in PRIMERGY products, some other makers require additional software. This illustrates the high demand for scheduling capabilities.

Power-Saving Mode and Power Capping (Limiting Maximum Electricity Consumption)

In the Intel CPUs of PRIMERGY and PRIMEQUEST products, the P-State (performance based on the phased control of a CPU's voltage and clock frequency) can be used to create a power-saving mode. A balance is struck between clock frequency, power consumption and processing capacity by changing the P-State as required by the operating system. Fujitsu has installed iRMCs to control P-State functionality since the PRIMERGY S4 series. Customers have become able to actively set their systems to minimize or maximize CPU clock frequency.

Figure 19. Power Management with CPU Clock Frequency Control



Using scheduled operation, it becomes possible to put servers into power-saving mode during off-peak hours. Operation can be maintained below a set level of power consumption during peak hours. Power Limiting, the name of this function in PRIMERGY servers, is known more generally as power capping. Fujitsu's provision of this functionality free of charge sets it apart from rival manufacturers.

While other manufacturers require additional software and licenses, Fujitsu offers power capping standard in products from the entry-class RX100 S7 model.

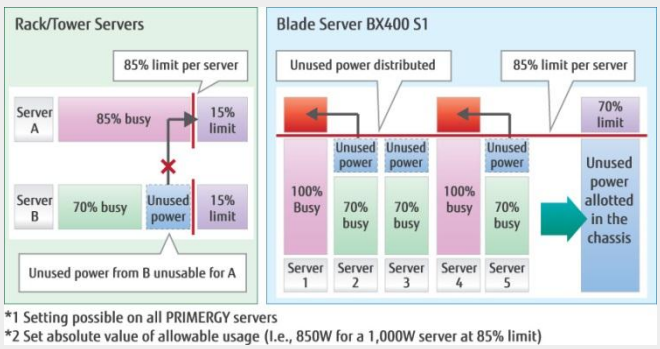
Maximizing Performance within a Set Power Consumption Range

Fujitsu's PRIMERGY BX400 blade server demonstrates an even higher level of power management in the form of Enforced Mode and Low Noise Mode.

Enforced Mode is used to control the power consumption of the chassis as a whole while minimizing the effects on performance and server operation. By setting such controls on the entire chassis, server blades can be operated continuously at low power modes. The level of power provided to individual blades can be decided based on task priority and historical operating results. Since specific blades can be operated with no power restrictions at all, there is no issue with using this functionality when continuous high response or symmetry between clusters and nodes is required. What's more, by enabling the optional Adaptive Budgeting functionality, power can be accommodated between server blades. If a particular server blade is running at a power surplus, this excess can be effectively shifted to other servers requiring more power at a given time.

In other words, performance can be maximized within a pre-set range of power consumption levels.

Figure 20. Power Image When Maximum Consumption Is Set



Next is Low Noise Mode, with which the server is optimized to provide maximum performance while maintaining the noise generated by cooling fans at a low level.

Typically, when the temperature rises inside a server, the cooling fan rotates faster, which results not only in more internal noise, but also in increased power consumption.

In Low Noise Mode, the P-State operation explained above is used to reduce the heat generated by the CPU, allowing the fan to keep the system cool without rotating at high speed. Compared to conventional cooling system control, Fujitsu minimizes power consumption of both the cooling fan and the CPU. This is a revolutionary concept based not on lowering heat, but rather on reducing generated heat.

Switching Power On and Off for Each Partition

In the PRIMEQUEST series, customers who use redundant system boards do not keep the redundant boards powered up at all times. Instead of power control per board, power can switched on or off at the partition level. Scheduled operation is also available at the partition level, so that a partition can be controlled in the same way as an entire server.

Figure 21. Reserved SB

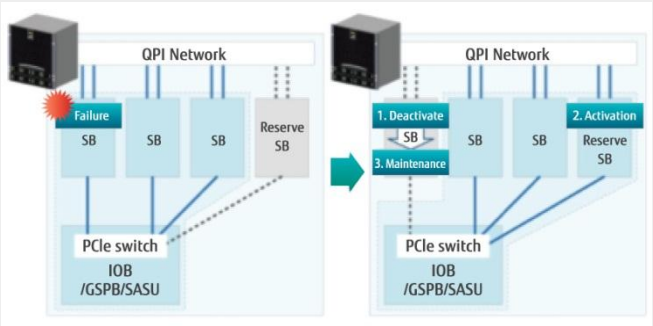
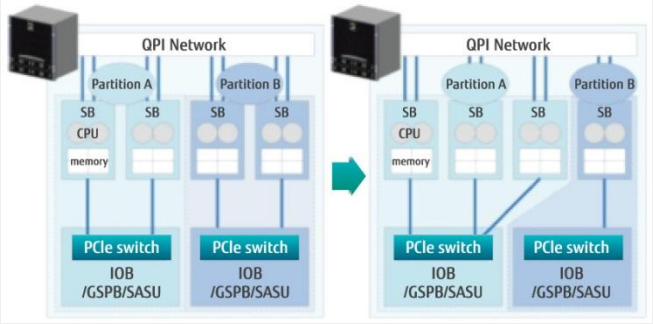


Figure 22. Flexible I/O and Partitioning



Power Supply Synchronization in File-Sharing Servers

Fujitsu has particular expertise in power supply control and synchronization technologies. Essentially, scheduled operation has made possible synchronization with the power supplies of I/O devices. Customers with servers used mainly during daylight hours might want a system in which servers are shut down at 9:00 pm and restarted at 7:00 am the following morning. Simply applying scheduling to automate these tasks can achieve power savings of up to 30%. For customers of Fujitsu, whose hardware comes installed with system control boards to provide such functionality, no new investment is required.

Nevertheless, the full benefits of scheduling cannot be realized if storage power remains on when server power is off.

With storage, when multiple servers and files are shared in clusters, scheduled operation means that tasks are performed using owner privileges on each server. As a result, power-on and -off are controlled based on whether or not the owner is present. In other words, power control is not a simple one-to-one relationship. Although this functionality is provided standard by Fujitsu, other makers do not offer it.

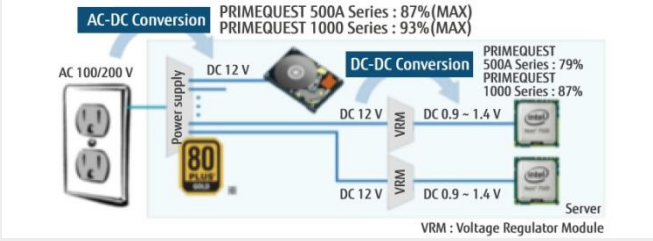
In PRIMERGY/PRIMEQUEST, the ETERNUS power supply synchronization unit's sensor function and a UPS make it possible to switch power supplies on and off.

Power Supply Technologies

Until five years ago, about 36% of the electricity consumed by the power supplies of ICT equipment was used inside the units themselves. This was a result of conversion loss when voltage was generated to run semiconductors and various parts. Minimizing this loss is therefore an important factor in power supply development.

PRIMEQUEST products were the first Fujitsu servers to adopt highly efficient power supply units conforming to the 80PLUS GOLD standard.

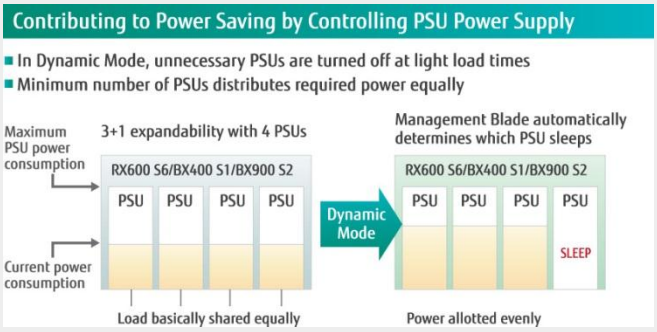
Figure 23. PRIMEQUEST's High-Efficiency Power Supplies



While, almost all of the devices in the PRIMERGY series have adopted efficient power supplies compliant with the 80PLUS PLATINUM standard.

The load on power supplies is monitored in PRIMERGY servers. Individual units supply just the amount of power required if the current supply is insufficient at any given time. For example, in the PRIMERGY RX600 S5 and S6 rack servers, which can hold up to four power supply units (PSUs), cold redundancy ensures that only those power supplies needed are put into use. This leads not only to improved conversion efficiency, but also to rationalized operation at about half the load of conventional systems.

Figure 24. Power Supply Control in PRIMERGY Systems



Because this optimization is performed automatically, some customers might be unaware that their Fujitsu servers are already operating with about 5% less electricity than other products.

Standby Power Cannot Be Ignored

Servers use several watts of electricity for standby systems such as Wake-on-LAN (remote power control over networks), as well as iRMCs and other Baseboard Management Controllers (BMCs). Just as PC users are urged to unplug their machines when not in use, some PRIMERGY

products have power supplies that can completely turn off standby power. Fujitsu offers products with a 0-watt function to cut power completely during standby.

However, wouldn't it become impossible to operate servers remotely with such a system?

Fujitsu resolves this issue by letting customers schedule the times when the 0-watt state is implemented. For example, users can set their devices to reenter standby mode an hour before they are switched on. This functionality is most often used in compact, entry-class tower servers for small to mid-sized systems installed in offices. Users of these machines become familiar with the concept of energy saving from their first purchase and can adapt with power consumption in mind as their systems grow.

Optimal Control of Power Supply Conversion Efficiency and Load

It is important to use power supplies offering high-efficiency conversion, and just as important to use these units effectively. If, for instance, the number of power supplies is doubled, the maximum load ratio is only 50% of the total available power, and the number of power supplies cannot be reduced. To offer a specific case, if a system has two power supplies with 500W capacity, the server can only use up to 500W. This is because, if one power supply were to fail, the server would have to operate continuously on the remaining unit, which can only output 500W. This is the meaning of redundancy. When in normal operation, each Fujitsu power supply operates at a maximum output of 250W, half its capacity, thanks to a function called load sharing. Fujitsu designs power supplies for optimal efficiency when used at 50% capacity. Maintaining power supplies at the most favorable levels for efficient conversion is therefore an effective way to save energy.

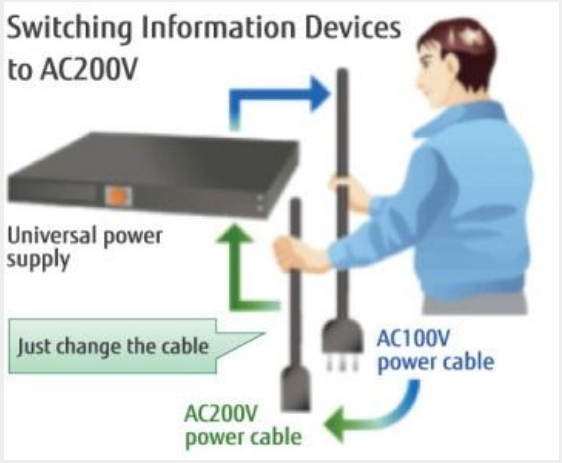
The load ratios of power supplies change depending on the CPU, memory and options installed in servers. In some cases, such as those in which power supplies are made redundant in an N+1 configuration, the configuration could make the load ratio too small. Conversion efficiency would suffer under such circumstances, so Fujitsu employs technologies that raise efficiency by using only the number of power supplies required under a particular configuration. Not only in power supplies that convert AC electricity, but also in units with internal DC/DC conversion, Fujitsu power supplies are controlled based on the system configuration.

Improving Power Supply Efficiency with Universal 220 V Operation

For customers considering devices with AC100V–127V power cables, simply switching to AC200V–240V cables can cut the current supplied to each rack by almost 50%.

Power transmission efficiency is higher than at AC100V-127V, so less heat is generated and energy savings of 2% to 4% can be achieved.

Figure 25. Switching to AC200-240V



PDU Savings by Unifying Power Supply Shape

Because AC200–240V electric plugs all have the same shape, switching makes it possible to reduce the number of power distribution units required in products.

Power-Saving SSDs

Solid state drives (SSD), use semiconductor memories for data storage. Since they have no motors or other moving parts, SSDs make it possible for high-speed data access and power savings.

Compared with a 15,000rpm HDD, an SSD with semiconductor memory offers overwhelmingly higher random I/O performance. This promises considerable effectiveness when used for DBs and other applications requiring strong random performance.

The lack of moving parts also makes SSDs considerably more reliable than HDDs. With ETERNUS systems, for example, the data on dozens of HDDs can be shifted to only several SSDs for improved performance and major power reduction.

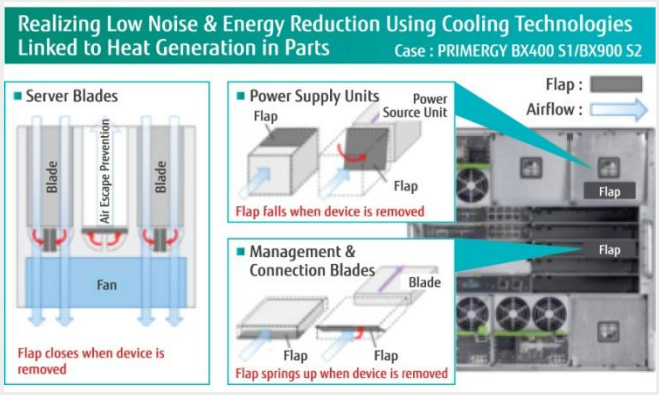
Cooling Technology

In hardware devices, the highest amount of power is used for cooling, which is why Fujitsu has significantly advanced its technologies in this area.

Straight cooling is the technology used for basically every product. Fujitsu raises efficiency by arranging heat-generating components in a straight line, which naturally removes obstacles to air flow and allows collective cooling of every heat center.
During active maintenance, components are connected and disconnected on a per-unit basis. This process can allow air to escape the system, thereby disrupting internal cooling.

While not a great deal of air escapes in this process, in order to maximize cooling the effect cannot be ignored. In large units, Fujitsu installs flaps that keep gaps closed and maintain steady cooling even during maintenance.

Figure 26. Flaps to Maintain Stable Cooling

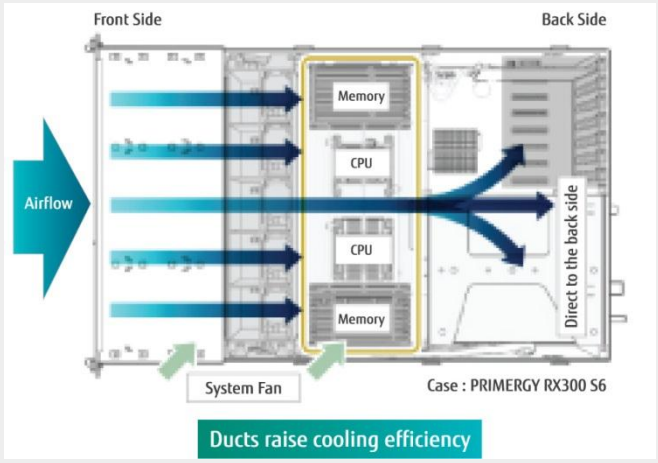


At the same time, Fujitsu optimizes cooling fan cycles in accordance with the ambient temperature and heat generated by internal chips. This measure minimizes power consumption for cooling based on current heat and system load.

Cooling Fan Optimization

The cooling fan is a crucial part of many ICT products. In this area, energy can be saved by devising the most efficient fan placement possible for a particular structural design, which then allows the number of fans required to be optimized.

Figure 27. Cooling Fan Optimization



- Optimizing the number of fans required
- IT flow design to directly cool high-temperature parts
- High-efficiency cooling structure based on thermo-fluid dynamics simulations at the product design phase

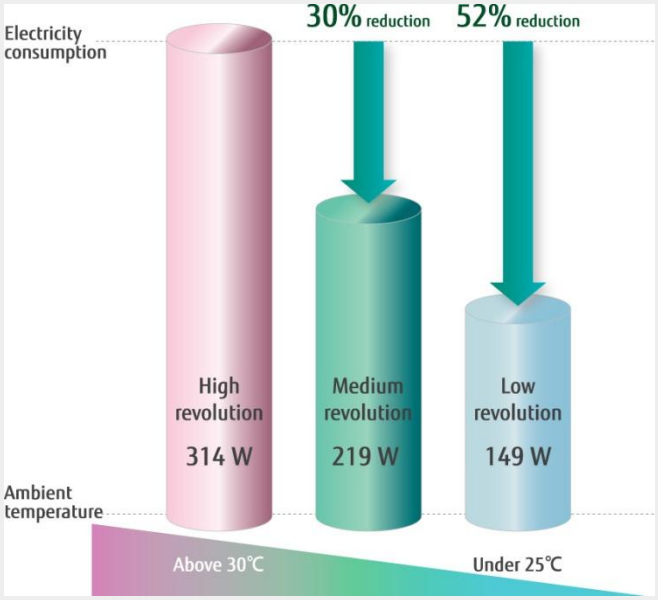
Multistage Control of Fan Rotation Speed

ICT equipment does not usually operate at 100% capacity. During off-peak hours, the amount of heat generated also drops, so fans in Fujitsu products rotate at slower speeds. Optimizing fan rotation based on heat inside the chassis or controlling rotation speed based on the ambient temperature, reduces power consumption.

PRIMERGY and PRIMEQUEST servers use proactive fan functionality. Sensors are placed on multiple base boards and fan rotation is continuously controlled according to the temperatures of individual parts. PRIMERGY products, in particular, feature a highly precise control system in which fan rotation is accelerated near hot spots and decelerated near areas of low activity.

In the SPARC Enterprise products, Fujitsu has also adopted multistage fan rotation control, based on ambient temperature and heat generation inside the chassis. Shifting between high, medium and low fan speeds achieved greater reductions in power consumption. This control is even more precise in the SPARC Enterprise M3000, where linear fan speed control is implemented based on temperature.

Figure 28. In the SPARC Enterprise M5000



In storage, fan rotation is controlled in 10 stages. At high temperatures, fan speed is raised immediately to enhance cooling effectiveness. What's more, Fujitsu has realized fan operation at a comparatively quiet 40 decibels (dB).

Fan Control via Zoning

Blade servers use a concept called zoning. The configuration of blade server systems means that there are multiple server blades on the front of the chassis and multiple fan units at the back. The term "zoning" refers to the placement of server blades and fans based on their positions on the chassis, with fans controlled on a zone-by-zone basis. This system is most effective in the following two situations:

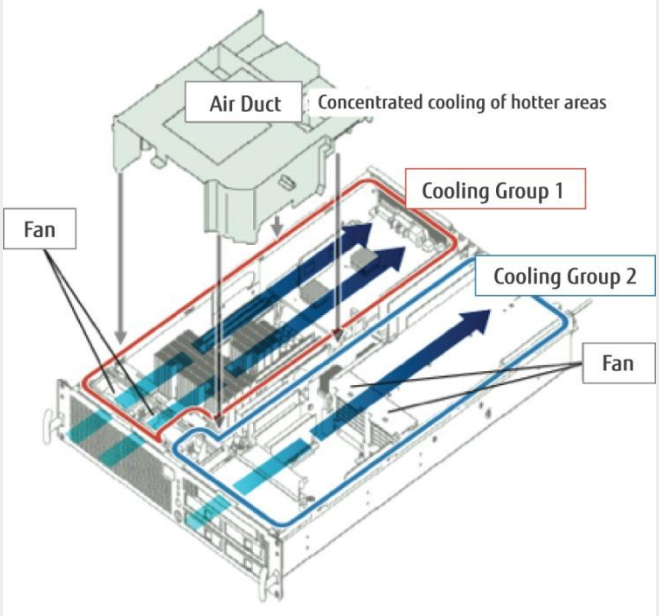
1. When a specific server blade reaches a high temperature, fan speed in that zone is raised.

2. When a particular zone is not mounted with a server blade, the fan in the zone is turned off.

Air Ducts to Improve Cooling Efficiency

In servers, areas are divided based on whether they do or do not generate heat. CPUs, HDDs and memory are among the primary sources of heat. Fujitsu installs air ducts in areas where high heat is generated and separates these parts from the rest of the system. Effective cooling intensified on high-heat areas raises energy efficiency.

Figure 29. Air Ducts to Improve Cooling Efficiency



Reducing Cabling to Improve Cooling Efficiency

High numbers of cables often hinder air exhaust and lower cooling effectiveness. Reducing cabling is therefore another important element in improving efficiency. PRIMERGY blade systems require only nine cables, an 87% reduction compared to the 70 cables used in rack server systems. The high number of cables in rack systems can obstruct the exhaust of hot air, leading to heat buildup and bad air flow. Cables can even raise the ambient temperature and temperature of surrounding equipment. More power must be expended for cooling, an unnecessary waste. Blade server systems help alleviate such situations, reducing cable usage and reducing power consumption.

Temperature Optimization in Data Centers

Recently, the number of customers seeking to raise the preset temperature of their server rooms has increased.

In power-saving PRIMERGY models for data centers, Fujitsu has optimized fan control at high temperatures. The tuning knowhow of the Fujitsu Research Institute has achieved the optimum of cooling without increasing fan speed, even at high temperatures. For instance, these servers minimize fan speed up to temperatures as high as 28°C or 30°C without triggering heat alarms.

In server storage and other system products, when customer companies anticipate five-year life spans, Fujitsu has generally recommended that facility temperature be maintained at 25°C or less to ensure stable operation.

However, reducing carbon dioxide emissions has become a growing concern as a countermeasure to global warming. Efforts to raise data center temperature settings have begun. In a recent survey, more than 60% of Fujitsu's customers responded that they have raised the temperature settings of ICT equipment operating environments.

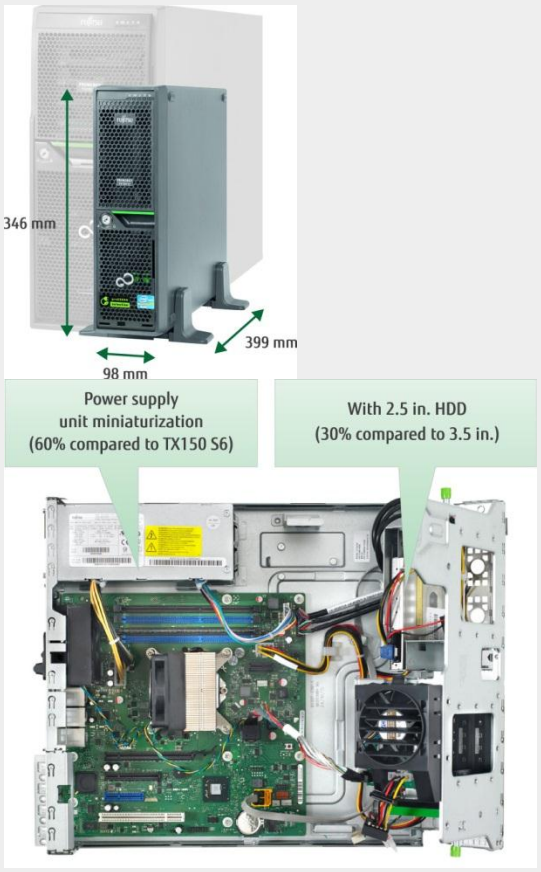
In Japan, Fujitsu raised the temperature setting of its own data centers by 3°C in the summer of 2012 in response to government-prescribed energy saving targets.

Reducing Parts and Board Size

In crafting products, smaller sizes with fewer components help save resources. The same is true for ICT products. In this area, Fujitsu develops compact boards with as few parts as possible while improving performance and maintaining reliability. In addition to resources, product development strives to reduce costs, breakdowns and other issues.

The installation space of the PRIMERGY TX120 S3 is 391cm^2. This is equivalent to about one-third the installation space of conventional one-way tower servers (not including the stand). By creating a server the size of a desktop PC, systems that previously required dedicated server rooms can be easily fit into even small offices.

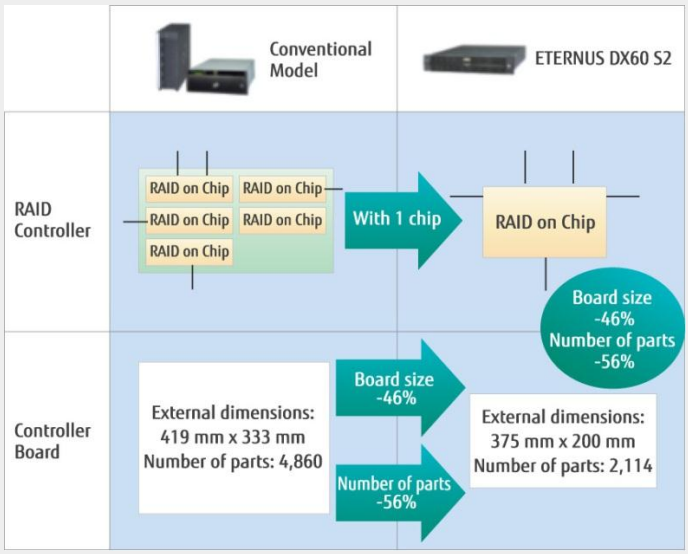
Figure 30. PRIMERGY TX120 S3



In the PRIMEQUEST 1000 series, Fujitsu has achieved great space and power savings by reducing the types and parts of boards compared to previous products.

The ETURNUS DX60 S2, for instance, uses 56% fewer parts than its predecessor thanks advancements such as the integration of several functions onto a single CPU.

Figure 31. Examples of ETERNUS DX60 S2



Reducing Cables

The backs of ICT products, especially when multiple devices are connected together, can require a large amount of cabling. Reducing cables saves resources and improves maintenance efficiency by reducing connection errors and signal interruptions.

Digitalization of Manuals

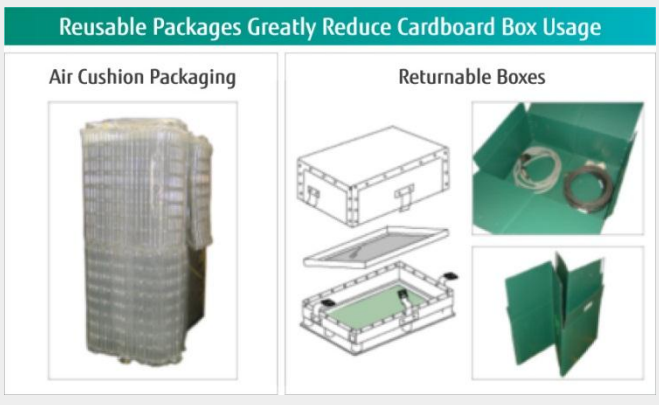
Until recently, product manuals have been printed on paper. However, taking the environment into consideration, Fujitsu is now providing product manuals in digital (pdf) format to conserve paper and reduce our resource usage.

Reusable Packaging Materials

When delivering floor-installation servers to customers, Fujitsu has replaced disposable cushioning materials with reusable inflatable air cushions. The Company also uses returnable and reusable boxes and cushioning materials in its PC products and is studying their use in server products. Such efforts are helping Fujitsu considerably reduce packaging materials and cardboard boxes.

At present, packaging return and reuse services are only available in Japan.

Figure 32. Reusable Packaging Materials

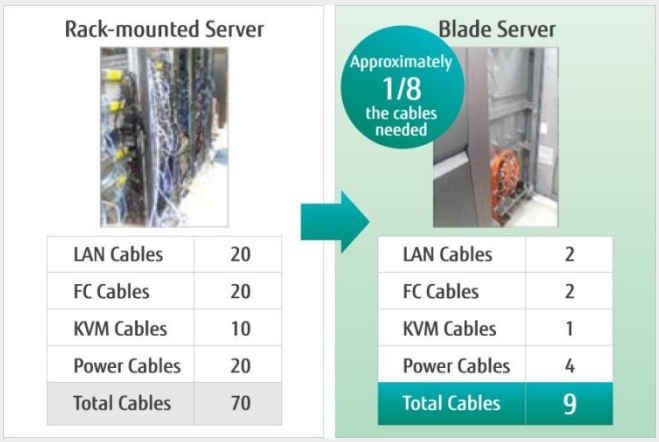


Recycling

Simplifying wiring can have major benefits in manufacturing by reducing processes and facilitating product dismantling. Fujitsu's recycle centers depend first and foremost on human labor to retrieve most materials for reuse, so making products easy to disassemble contributes to their lifecycle effectiveness.

Services such as these are being implemented by the Fujitsu Group in Japan and FTS, based in Germany.

Figure 33. Promoting Environmental Activities throughout Product Life Cycles



Determining how products can be reused and how much of a product should be made easily reusable are important questions. In recycling, Fujitsu considers products from the moment of conception, through to the time of disposal, including logistics phases. Not only materials and shapes, but also developing reuse mechanisms and organizations is important. The desire to devise ever more effective recycling is given life throughout Fujitsu's manufacturing.

Fujitsu has established a recycling system and begun offering Business IT Recycling Services for companies. IT products from corporate customers are collected and transported for processing and resource reutilization at five Fujitsu Recycle Centers around Japan.

Figure 34. Product Recycling System

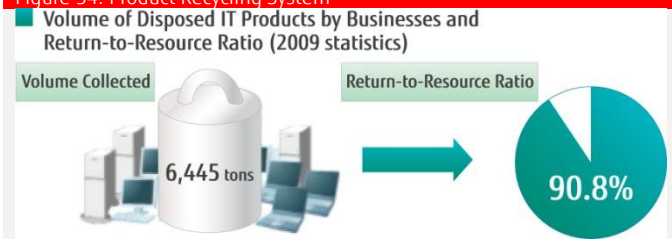
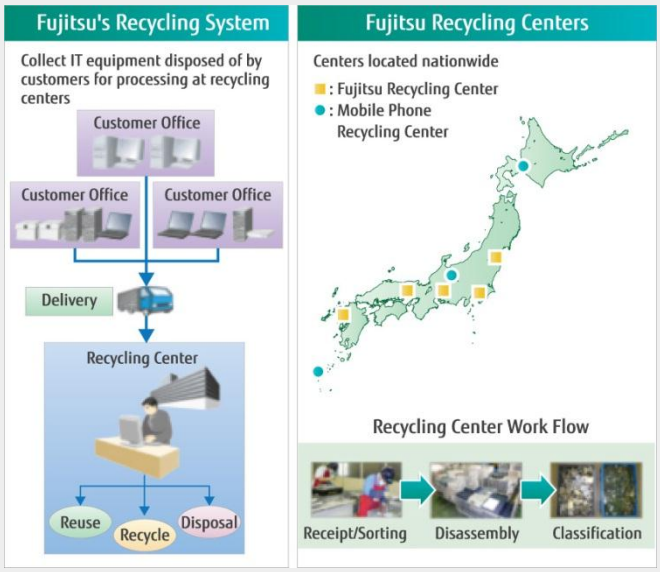


Figure 35. Product Recycling System

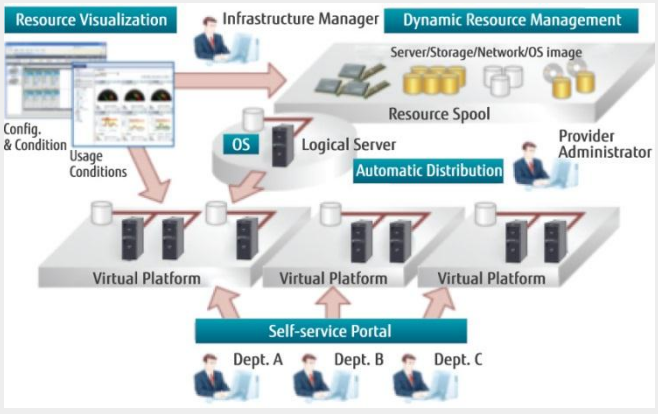


Software Products

ServerView Resource Orchestrator

Not so long ago, many companies maintained servers, storage, networks and other hardware combined with software in separate system environments for each part of their business operations. This resulted in unused resources at non-peak times. Overall resource usage rates were low, and because even unused equipment was left turned on, power consumption was excessive. What's more, implementing changes becomes difficult once a system has been configured. This adds to the complexity of flexibly distributing resources and scheduling automated operation. From this point of view, using virtualization technologies and related software to manage data in the cloud, allows customers to avoid deploying multiple resources for peak usage times. Being able to immediately deploy and manage resources when they are required makes possible system configurations that reduce power consumption. Fujitsu provides the following cloud-related software and, in November 2011, began global sales of ServerView Resource Orchestrator V3. This solution helps customers configure multitenant cloud environments that can be shared by multiple customers and business departments.

Figure 36. Cloud Utilization Diagram



ServerView Management Blade Frontend

From the current generation PRIMERGY BX900 blade server, SVMF (ServerView Management Blade Frontend) software provides the capability to manage servers by monitoring every blade in the hardware. Monitoring enables the visualization of power consumed by each chassis as a whole.

ServerView Operations Manager

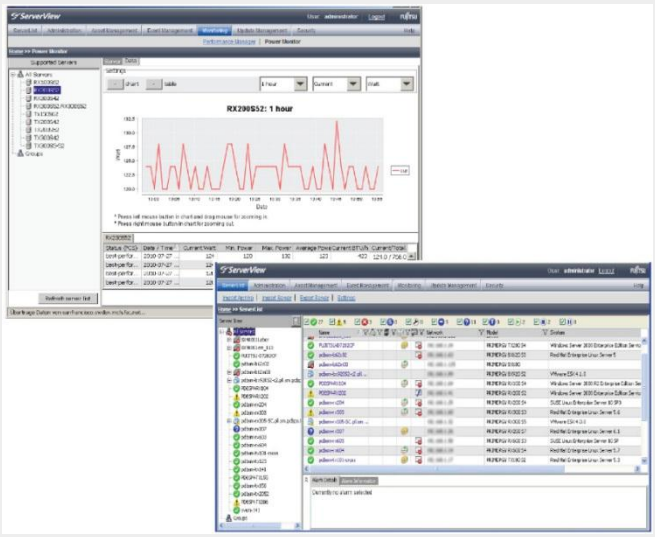
To monitor multiple PRIMERGY servers, customers can use the Power Monitor function of Fujitsu's ServerView Operations Manager software. This software compares historical power consumption data via graphs and displays total power consumption for multiple servers during specific periods of time.

ServerView Suite

Visualization of server operating status has been possible since the first release of Fujitsu's ServerView Suite software, which displays graphs of usage rates of CPUs and memory, and can monitor threshold values.

Today, this software even supports the visualization of the threshold values of guest resources in virtual servers. Graph displays and threshold values are handled by the software's Performance Manager and Threshold Manager, respectively.

Figure 37. Server Monitoring Software Screens



ServerView Suite comes standard in PRIMERGY products, and power visualization functions are all provided free of charge.

This functionality has evolved with Fujitsu's systems, from the S4 series released in 2008 to the newest S7 series. In the current version, graphs that have until now been presented on bases of averages can also be output for peaks and minimum usage conditions. These functions are at the top of their class in the industry.

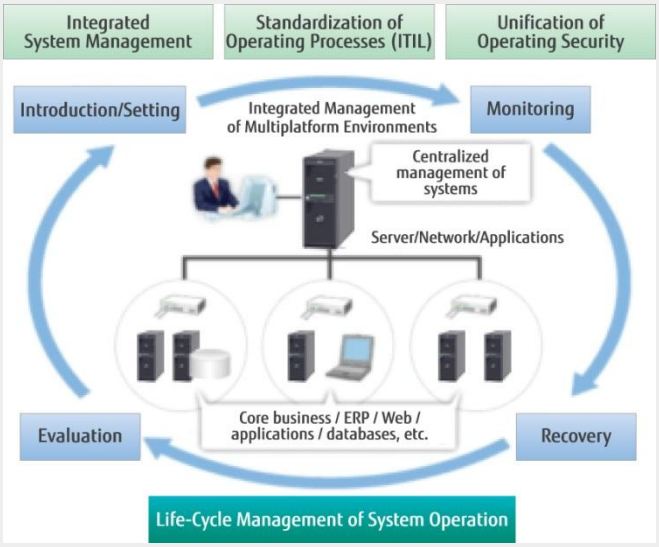
Systemwalker Centric Manager

This integrated operations management software, which is already in use by many customers, is effective for understanding the operating conditions of entire systems.

Servers, clients, routers, gateways and other network equipment are automatically detected, and the operating status of the system as a whole can be monitored, including conditions during power-on and power-off states. Furthermore, system administrators can receive event warnings when changes are detected in operating status.

As an in-house measure to reduce power consumption, Fujitsu has introduced the feature of powering down unnecessary servers. Systemwalker Centric Manager is designed to show whether these servers are operating properly by monitoring the operating status of internal systems as a whole.

Figure 38. Life Cycle Management of System Operation



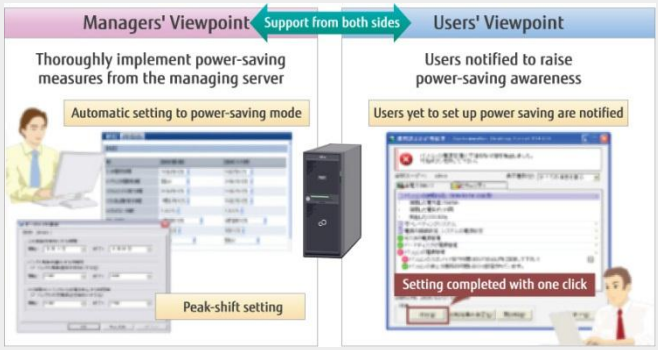
Systemwalker Desktop Patrol

PCs and printers are said to comprise about 45% of the electricity consumed in offices, but the most recently released notebook PCs come with peak shift functionality. In other words, the software connection is taking place even inside offices.

Systemwalker Desktop Patrol is a client management product designed to support power savings by PCs and printers. It provides unified management of PCs, printers, software licenses and other ICT assets, and automatically implements security software updates and audits. In 2009, Fujitsu added functionality to reduce power consumption and visualize each unit's power consumption, carbon dioxide emissions and operating status. In June 2011, by linking the peak shift settings installed in notebook PCs with Systemwalker Desktop Patrol V14g, Fujitsu made it possible to effectively manage power-saving settings. This solution can be found in every one of the approximately 130,000 PCs in use throughout the Fujitsu group.

Systemwalker Desktop Patrol makes it possible to improve PC power savings with little new investment. If even greater improvement is needed, Fujitsu proposes purchasing new equipment. Energy efficiency and power performance are greatly improved in new models, so the number of machines required can be reduced. In addition, virtualization using software and power consumption visualization allow Fujitsu to propose overall optimization, including air conditioning.

Figure 39. Reducing Unnecessary Power Consumption by PCs



Systemwalker Operation Manager

Turning servers off after working hours and on holidays, or scheduling their operation in line with working times, leads to major energy savings and a reduction in carbon dioxide emission compared with 24-hour operation.

For example, with Fujitsu's Systemwalker Operation Manager job-management tool, the status of the entire system is visualized, and tasks from powering on servers and clients, to booting the system, starting and ending individual operations, and shutting power off can be automated. Waste and excess are removed from system management, operations are more efficient and power consumption and carbon dioxide emissions can be effectively reduced.

Figure 40. Automization with Systemwalker Operation Manager

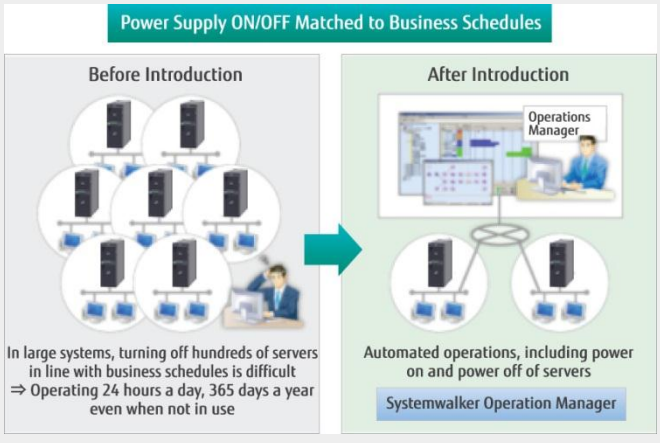
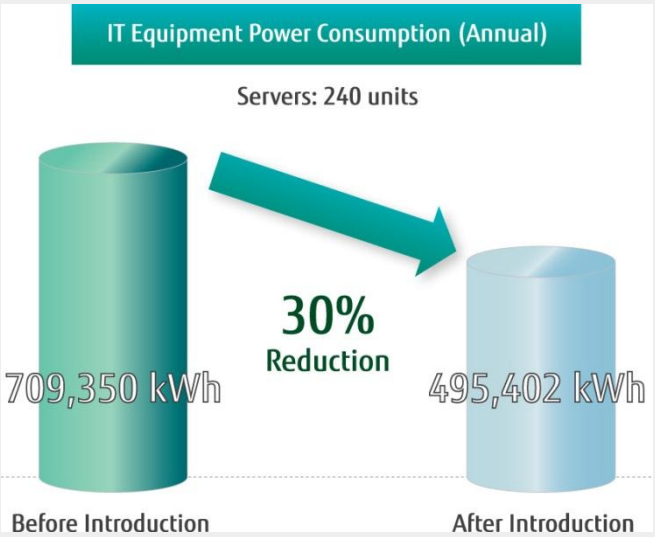


Figure 41. Effectiveness of Automated Operation



Systemwalker Runbook Automation

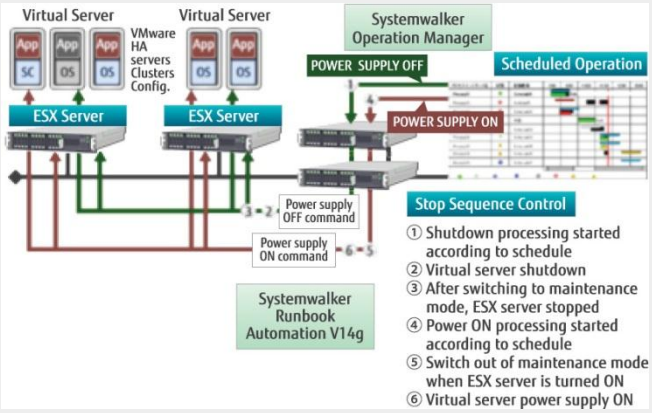
This solution realizes power savings via automated operation and power supply control matched to the operational flow of data centers.

For instance, the following procedures are necessary to safely power down system environments with two or more virtual servers on a single physical server:

1. Removing the environment from monitoring
2. Separating it from business networks
3. Closing of business applications on virtual servers
4. Shutting down virtual servers after confirming that applications have been halted
5. Confirming that all virtual servers on the physical server have been shut down
6. Closing virtualization software on the physical server
7. Turning off server power

With Fujitsu's solution, these procedures are provided in a workflow template that can be automated on multiple servers. In addition, multiple scheduled implementation patterns can be defined, making it possible to set up schedules with flexible startup timing and operation automation to attain highly precise power consumption savings.

Figure 42. Power-Saving Data Center Operation (Safe Stop)



Systemwalker Service Quality Coordinator

This solution automatically collects performance information (such as CPU utilization and memory capacity) and power and temperature conditions (power consumption, electricity capacity, temperature, etc.) for multiple servers. This information can be displayed on a dashboard view that can also be customized to suit individual user preferences.

Figure 43. Visualization of Power and Temperature

Column

The next six sections discuss services and products available mainly in Japan. Some of these services and products might not be in demand in all markets.

[Column 1] Practical Case: Fujitsu Numazu Software Development Cloud Center

Through practical testing using Fujitsu products, from 2008 to 2010 this center collected product development environment servers from six domestic facilities and shifted them to the cloud. Today, the center operates the system with state-of-the-art measures, including power supply control linking servers and storage devices. The air intake and exhaust temperatures of servers are monitored using optical fiber temperature sensing to prevent overcooling and overheating, and thereby improve air conditioning efficiency.

Figure 44. Numazu Software Development Cloud Center Visitors' Course

First, as this was an experiment in the practicality of the Private Cloud in data centers, more than 1,800 development servers at six facilities around Japan were collected at the Cloud Center.

In 2005, virtualization technologies started rapidly coming into their own. As Fujitsu worked with these technologies at its sites, the idea was raised of expanding their use companywide. At the same time, company management was raising the question of whether there were too many servers in operation at Fujitsu.

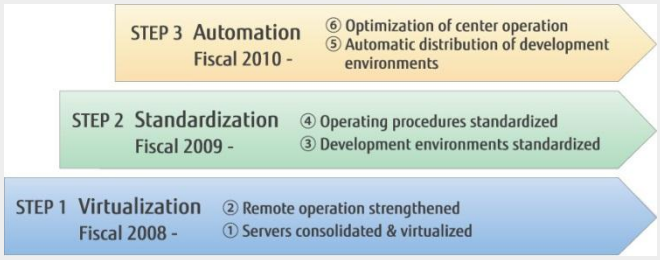
These two initiatives, one to test the viability of virtualization technologies and the other to reevaluate the number of servers spread throughout the group, were in harmony.

Moreover, the ever-increasing workloads of engineers configuring development environments at existing facilities were becoming an issue. As a result, Fujitsu made a major investment in virtualization in 2008 as it was decided to bring all of its servers to the data center at the Numazu Plant.

In the three years from 2008 to 2010, internal discussions advanced to the idea of even more effectively using server resources. The further step was taken of providing development environments in the Cloud in addition to introducing virtualization.

In April 2010, when Fujitsu announced its software products for the Private Cloud, the Cloud Center used them to create a Cloud operation system. In other words, three years were spent on implementing the three steps of virtualization, standardization and automation in order to provide services to Fujitsu engineers.

Figure 45. Three Steps for Cloud Center Establishment



Costs Reduced 7 million yen a Year while Adding Speed and Environmental Effectiveness

Fujitsu first set its sights on the Shin Yokohama area in Kanagawa Prefecture, moving servers to Numazu and simultaneously pursuing virtualization. At the time, Fujitsu offices were scattered among several buildings. Servers were being procured separately by each department, and in many cases these servers were placed right next to the desks of their administrators. By removing these servers, reorganizing offices and more efficiently utilizing space, the Company was able to end its lease on an entire building.

Members of the management team visited each office to make sure that no servers remained.

Server collection in 2008 resulted in the movement of the equivalent of 40 eight-ton trucks of servers to the Numazu Plant data center. Costs were eventually cut by 200 million yen per year with the return of the now unnecessary building.

Not only existing servers, but newly procured servers were to be included in the project. As a result, server investments today are coordinated at the Cloud Center.

Compared to the years before this project was implemented, Fujitsu is saving about 700 million yen per year in costs associated with office leasing and server management.

Figure 46. ROI of the Cloud

Servers Halved, Functions Reinforced and Convenience Improved

The total number of physical servers Fujitsu operates started at 1,800 units, but today that number has been reduced to 1,000 units. Although, the actual number of virtual machines in use comes to about 3,000.

Power used by servers themselves was greatly reduced, and by eliminating server rooms Fujitsu has been able to significantly bring down power consumption and costs for air conditioning and space requirements. In fact, this project resulted in the elimination of an impressive six server rooms.

Moreover, the shift to centralized management at the Cloud Center revealed that 348 development environment patterns (combinations of the numbers of CPUs, memory capacities, numbers of disks, and types of operating systems) were in use throughout Fujitsu. From these, 51 highly utilized patterns were selected, turned into templates and distributed at the Cloud Center to considerably improve environment configuration speed.

Fujitsu engineers have commented that removing the bother of configuring environments and maintaining servers, has made their lives easier. What's more, if a server is suddenly needed to meet customer demand, Fujitsu can respond flexibly.

Contribution of Software Products

Fujitsu applies ServerView Resource Orchestrator in the operation of the Private Cloud environment at the Cloud Center. When a server is needed, a user simply selects a standard template on the web screen. The newly configured VM environment is then ready in about 10 minutes. The system is also extremely convenient for administrators at the center. Because users can quickly make changes they need, such as adding CPUs, memory, storage and other resources, the need no longer exists for extensive hardware preparations in anticipation of future demand. This is a software development environment, so users themselves implement batch processes as required for their environments. There are also a variety of maintenance functions, such as automatically captured system snapshots, to reduce the maintenance load.

Fujitsu had already been working on power-saving measures for quite a while. In 2010, the Company commenced automation of power supplies for performance testing of equipment in large-scale systems. This process confirmed power consumption reductions, particularly during off-peak hours. Load tests for products are carried out at night with no administrator oversight. Scheduling power-on and power-off is handled by users based on their specific needs. In the beginning, many users worked on the assumption of 24-hour equipment operation for the sake of convenience. However, because the power supply control interface with various devices was enhanced with Systemwalker Runbook Automation, users began contributing to power savings on their own. Today, the test phase has been completed, and it is a matter of course for users to schedule the automatic powering down of servers and storage. To monitor power utilization conditions, electricity consumption and operating status are displayed side by side for each device on the Systemwalker Service Quality Coordinator dashboard. This has led many users to take notice of excess consumption and see for themselves the effectiveness of power-saving functionality. The software was rapidly adopted in backup centers.

[Column 2] Optical Fiber Temperature Measurement System

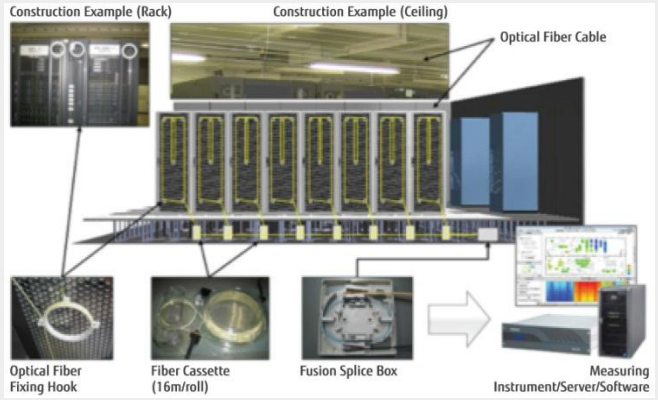
The Fujitsu Laboratories Ltd. and Cloud Center in Numazu are collaborating on practical tests of Fujitsu's Optical Fiber Temperature Measurement System. This system comprises optical fibers installed in the data center (or server room) to precisely visualize temperature distribution throughout a facility. It presents temperature data not at specific points, but over surfaces, providing easy-to-see results of conditions in racks, and at floor and ceiling levels, all in real time.

In the Cloud Center, this system monitors temperature distribution, and the position and direction of cooling system exhaust ducts are adjusted accordingly. Fujitsu has shown with this system that room temperature, which was previously set at 19℃, can now be set at 24.5℃ without causing any problems. Raising the preset temperature of air conditioning systems is leading to major power consumption reductions. In the case of conventional packaged air conditioners, it is said that raising the preset temperature by 1℃ reduces power consumption by 2%, and a 5℃ increase uses 10% less energy. This system played a significant role in the collection of all servers at the Cloud Center.

Figure 47. A Single Optical Fiber Monitors Temperature Conditions

In the Cloud Center, a few optical fibers snake along the ceiling at 50 cm intervals, runs around the fronts and backs of server racks and even under the floor before it connects to the measurement device.

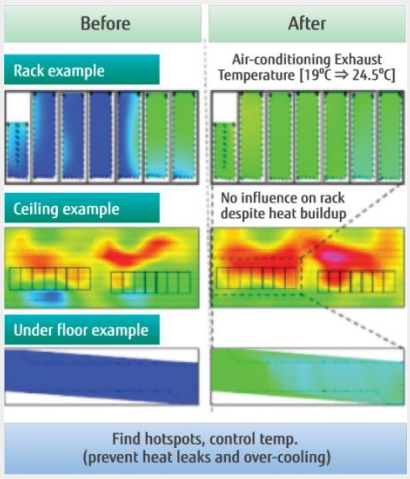
Figure 48. Fiber Layout Example at the Cloud Center



Real-time Visualization Rapidly Shows the Effects of Trials

The figure below shows actual data from the Cloud Center, specifically, the effects on temperature using data from before and after power-saving measures were implemented. The air-conditioning temperature setting was raised in slow steps. In the end, the Center was able to increase the temperature setting by 5.5℃, all the while confirming the results in real time.

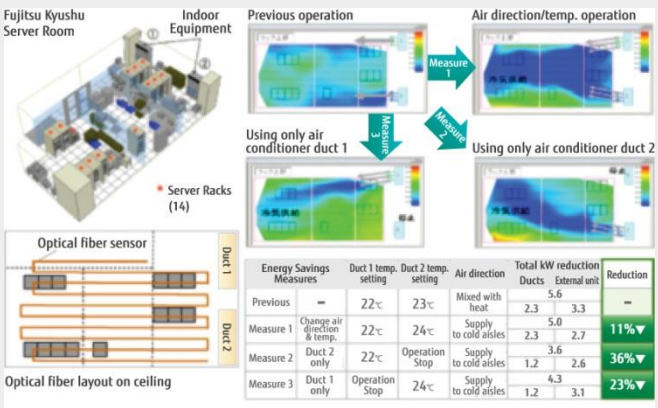
Figure 49. Temperature Gradation Displays



Another trial was implemented in the Fujitsu Kyushu office, which deployed 14 server racks. The figure below only shows temperature data from the ceiling, but in fact data was taken simultaneously from the ceiling and the floor of the server room. Before power-saving measures were introduced, the room temperature was recorded rising to 30℃ at times. The cooling system was adjusted on the assumption that this was the maximum temperature likely to occur. Results were then measured in terms of power saved. Previous temperature settings of 22℃ to 23℃ were increased to 24℃, and tests were also performed on what would happen if only one of the facility's two air conditioners was operated. This trial confirmed an 11% electricity reduction in the first phase, and decreases of up to 36% in the second phase, a cut of almost 40% from the power required previously.

An hour of this data can also be compressed into a 20-second animation. Working from the results, Fujitsu engineers made system improvements including changes in the direction of air flow from air conditioners to focus on the highest-priority areas for cooling. No more than an hour was required to determine the priority cooling points, a task that would normally require half a day or more via manual examination.

Figure 50. Fujitsu Kyushu Office Case Study



The ability to visualize the flow of cool air with temperature gradients clearly shows areas for improvement. What's more, real-time measurement makes possible real-time trial and error and more rapid achievement of the best results.

This visualization capability is the most important result of Fujitsu's in-house trials. Being able to see the data including air speed distributions would be ideal, but optical fiber can only currently be used to measure temperature.

The trial in Kyushu, Japan, showed that turning air conditioner fins even a few degrees too far in one direction could lead to temperature rises elsewhere. This phenomenon can have a major impact on pinpoint effectiveness. What if, by changing air flow direction, a device that was operating fine before suddenly broke down? It is easy to see why people on site, especially inside a facility, would be reluctant to manually test improvements.

However, since this system clearly demonstrates heat reduction effects, engineers on-site can feel safe about raising or lowering air conditioner settings as required.

Calculating Cost Performance: Investment Recovery in Less than Three Years

Calculating cost performance assuming a major facility of 100 racks, against an initial investment of ¥17 million, changing only the air conditioning temperature setting from 18℃ to 22℃ would reduce total power consumption by about 438,000 kWh per year (at 24-hour, 365-day operation). In other words, the initial investment could be recovered in a little less than three years. Fujitsu estimates that major improvements could be made especially in data centers where customers have neither measured nor kept information on temperature conditions. Such improvements would also contribute to the reliability and stability of the data center as a whole.

A facility with 100 server racks would be truly huge and costly to measure, which is why Fujitsu continues efforts to provide low-cost temperature measurement systems.

In the case of data centers, even if the server room is designed to hold 100 racks, that does not mean all of the racks are installed when the facility opens. Such centers usually open with five or 10 racks, the number of which is increased steadily as needs arise. The temperature of the facility can rise considerably over time. By the time the 100th rack is installed, the temperature balance of the room might be seriously altered, making the ability to visualize temperature all the more important. Today, in particular, even though servers are designed for replacement after five years, the replacement cycle is moving toward four, or even three years. This cycle will further impact server room temperature balances and only increase the need for accurate visualization.

State-of-the-Art Technologies Precisely Reveal Temperature Distribution throughout the Facility

The thorough implementation of high-precision temperature management is vital to improving air-conditioning efficiency and saving energy. The optical fiber temperature measurement system developed by the Fujitsu Laboratories Ltd. therefore plays an important role.

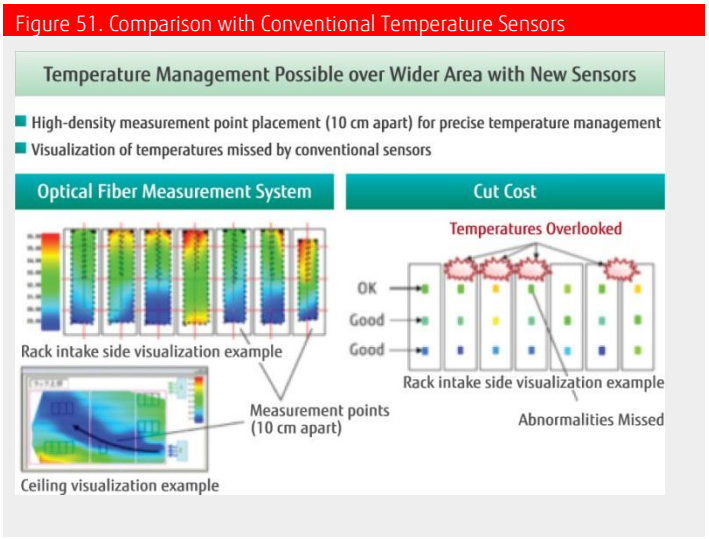
Data center operators would like to raise their facility temperature settings, but this involves risks. Furthermore, operations must remain stable even if air conditioning is reduced. The optical fiber temperature measurement system is designed to resolve this concern and has been commercially available through Fujitsu Network Solutions (FNETS) since 2012.

This system, packed with state-of-the-art technologies, uses optical fiber to cover every corner of a room and provide highly accurate, in-depth temperature distribution data. First and foremost, the system allows the precise, simultaneous measurement of more than 10,000 points unaffected by electromagnetic noise generated by servers. With a single optical fiber, it provides measurements that would require conventional sensors placed every 10 cm throughout the room, and it displays temperature gradations as detailed as those of thermography instruments in real time.

Today, the cost benefits of this system are most keenly felt by operators of data centers with 100 racks or more, for which more than 600 sensor points are required to achieve the same accuracy.

The following figure compares the difference between a three-point sensor system (sensors placed at the bottom, middle section and top of the rack) and Fujitsu's system.

Figure 51. Comparison with Conventional Temperature Sensors



Temperature Management with a Margin of Error of less than 1℃

In the above figure, a thermography-style display on the left-hand side clearly shows hot spots present in the server. Conventional sensors provide a hint that the temperature is high. This hint might be missed. Herein lies the largest benefit of Fujitsu's system, which does not miss any changes in heat distribution.

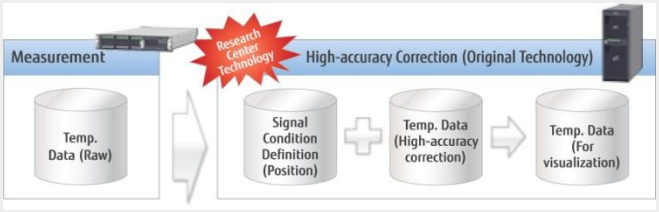
The optical fiber sends light signals of different intensity to the measurement instrument, which converts them into temperature data. The theory was known as long as 20 years ago, but the complex and precise distribution of temperature in data centers made the margin of error too high. Fujitsu developed an original algorithm to realize excellent precision and data reproduction. Temperatures can be measured in the range of -10℃ to +85℃, easily wide enough to cover most server rooms with a margin of error of less than 1℃. This system is extremely effective in reducing air conditioning in server rooms. In the future, it will also be adopted in many fields requiring accurate temperature management.

Even if the fiber were to be cut at some point, accurate measurements would still be received up to that point at intervals of 10 cm, which would also make it easy to find where the breakage occurred.

One break in the optical fiber line does not affect the system's functioning because the fiber is double-ended, connecting to the measuring instrument at both ends. Temperature is measured in both directions, so continued operation is theoretically ensured if only a single break occurs.

Usually, the optical fiber is first placed under the floor of a server room. It is then laid out at the fronts and backs of racks, and finally along the ceiling. Temperature data is processed in a server, which visualizes and displays the results. Data analysis is usually at about 30 seconds/1 m but, using the algorithm developed by the Fujitsu Laboratories Ltd., precision is enhanced to the level of 30 seconds/10 cm.

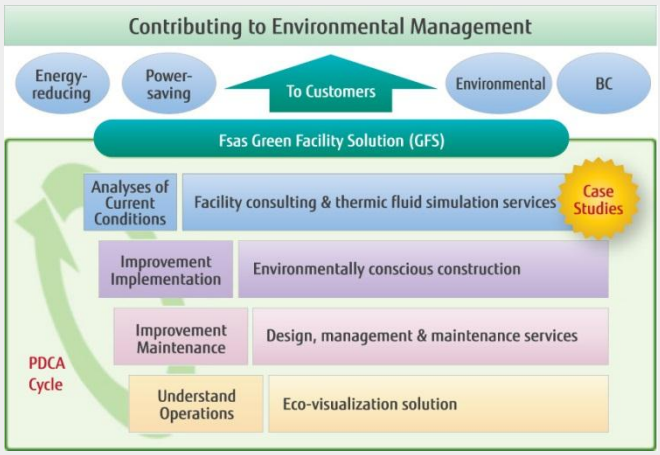
Figure 52. Data Flow in Optical Fiber System



[Column 3]
Fsas Green Facility Solution

In today's world, electricity supplies are no longer guaranteed, making it important for companies like Fujitsu to guide its customers toward more energy-efficient facility construction and management. Fujitsu seeks not to recklessly pursue power savings, but rather to develop methods for achieving energy-saving environments effectively and efficiently. To this end, considerable success has been achieved with the Fsas Green Facility Solution. This comprehensive solution starts with environmentally friendly construction based on analyses of current conditions and continues through customer support via facility maintenance.

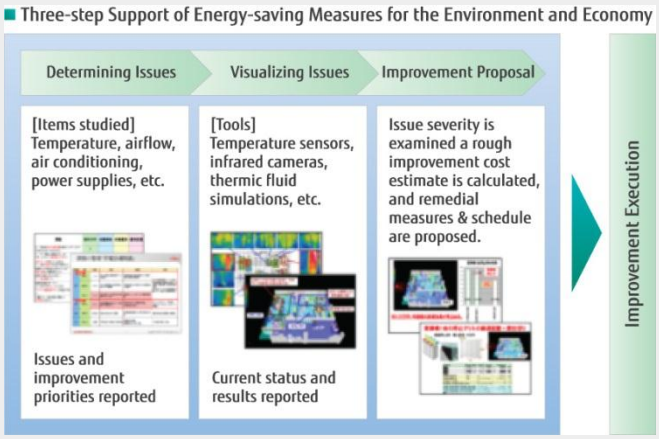
Figure 53. Fsas Green Facility Solution



The Fsas Green Facility Solution comprises the above four main phases. First, analyses are made to accurately understand the current conditions in customers' server rooms. Fujitsu then implements and maintains improvements, and observes operations. Analyses make use of environmental consulting, thermo-fluid dynamics simulation and other tools to examine existing conditions in server rooms. The results are used to detect areas for improvement and propose measures. Next come construction, maintenance of the new environment and visualization of operations in an ongoing PDCA (Plan, Do, Check, Act) cycle.

Simply examining server room temperature and other conditions leads to an understanding of issues such as equipment layout and air conditioning waste. Improvement effectiveness is simulated so that highly realistic plans can be made and implemented.

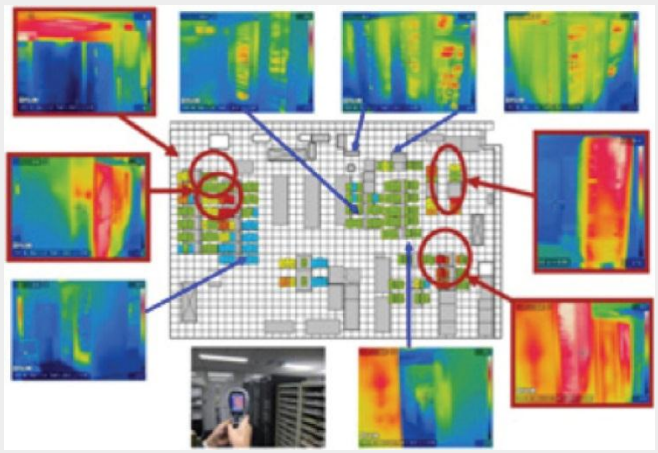
Figure 54. Step-by Step Total Support



Red Is Hot and Blue Is Cold

When energy saving by enterprises was made mandatory by the Japanese government following the Great Eastern Japan Earthquake and tsunamis in March 2011, a large customer in Tokyo expressed the desire to raise its server room air-conditioning temperature. However, the presence of known hot spots prevented this. Asked if it could help, Fujitsu sent engineers to the customer's location to study factors such as the layout of equipment, temperature and airflow speed. Temperature distribution was illustrated over a surface drawing of the room to facilitate an understanding of current conditions. To make visualization easier, Fujitsu went one step further and photographed the room with an infrared camera. The results were clear.

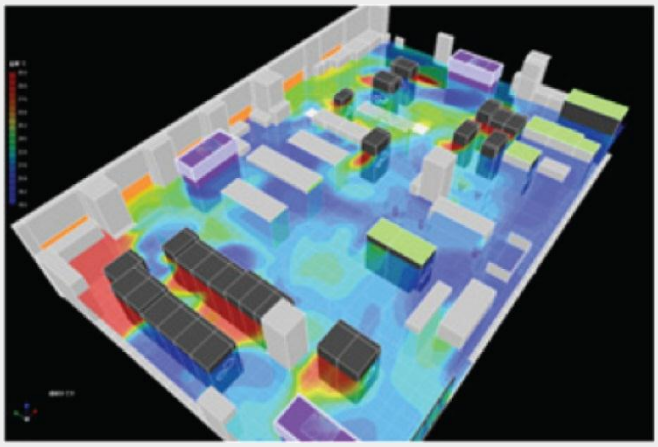
Figure 55. Step-by Step Total Support



Next, Fujitsu compared the heat generation of equipment in the server room to the air-conditioning capacity. This exercise showed that there was more than enough air conditioning. The conclusion was that it should be possible to reduce power consumption by shutting down one air-conditioning unit.

However, the highest priorities in server rooms are removing hot spots and maintaining stable equipment operation. Fujitsu sought the causes of hotspots and potential solutions by analyzing airflow based on thermo-fluid dynamics simulations. These analyses showed which of the customer's four air-conditioning units could be shut off with the least impact on the overall room environment.

Figure 56. Airflow Analysis Using Thermo-Fluid Dynamics Simulation



Shutting One Air Conditioning Unit Down and Raising Room Temperature by 2°C

Simulations based on current conditions demonstrated what was causing the hotspots. These causes included the lack of air-conditioner grills in the right places on the room's floor and cables under the floor that inhibited the flow of cool air. Fujitsu confirmed that shifting grill locations to improve airflow efficiency would remove the hotspots and enable the shutdown of one air conditioner without adversely affecting the room environment. Shutting down one unit, even if the remaining three carried the full cooling load, would result in power cost savings of about ¥1.25 million per year.

In addition, a simulation using simple space partitioning to prevent heat from circulating throughout the room showed that the temperature setting could be raised by 2°C. This would result in another ¥600,000 in annual utility bill savings. In other words, simply by improving airflow efficiency the customer could realize electricity savings up to ¥1.85 million yen a year. This concluded the first phase of the Fsas Green Facility Solution and if the results satisfied the customer, Phase 2 would begin.

Figure 57. Effects after Shutting Down One Air Conditioner

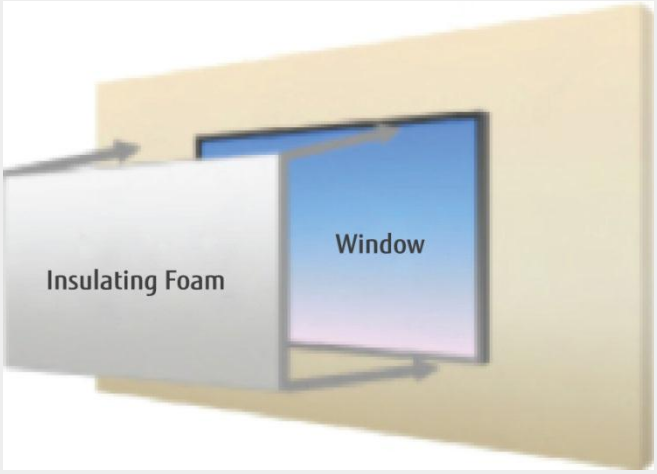
Proposing Energy Savings and More Strengthening Earthquake Resistance and Raising Airflow Efficiency

This section introduces the case study of an actual improvement plan implemented by Fujitsu. The customer wanted to use the opportunity of a move to strengthen earthquake resistance at its new facility.

In addition to taking on the mission of strengthening earthquake resistance, Fujitsu proposed a more advanced plan that focused on energy-saving and environmental initiatives. First of all, because the new location had windows, Fujitsu engineers faced the issue of how to prevent outside heat from entering the room.

Fujitsu adopted the architectural concept of zoning to block heat from sunlight through the windows. This involved separating the operator room and server room. In the server room, which would not be regularly staffed, insulation panels were installed to reduce the effects of external temperature and sunlight. Considering the possibility of the roof caving in during a strong earthquake, an earthquake-resistant ceiling was put in place. Free-access tiles were adopted for the floor, which would prevent widespread damage if one part of the floor were warped in an earthquake.

Figure 58. Insulation Panels Reduce Effects of External Temperature and Sunlight



Another point of focus was reducing space. Many customer requests relate to the amount of open space created in server rooms following shifts from mainframes to open system servers. In the case under review, Fujitsu minimized and rationalized space for printers, servers and the maintenance area, measuring the space requirements for every element and placing them in a layout of the room. In addition to reducing space, Fujitsu recalculated air conditioner capacity. Reductions made possible on the ICT side thanks to virtualization and other efforts resulted in a 45% cut in electricity requirements, or a savings of about ¥4 million per year.

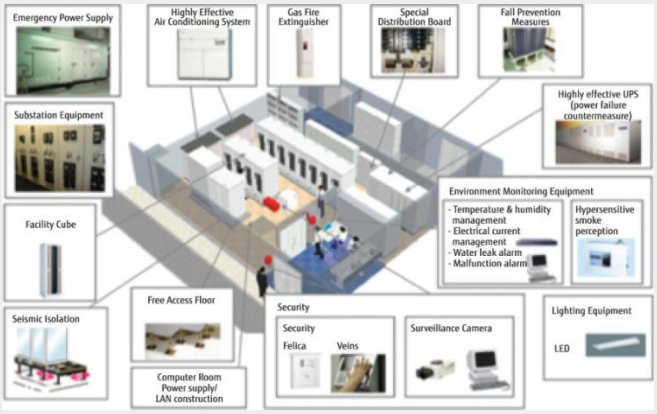
Figure 59. Space-Saving Layout Proposal

Fujitsu provides comprehensive support toward the realization of sever rooms that are environmentally friendly and generate profits.

Using analyses of existing conditions, Fujitsu rapidly responds with environmentally conscious construction initiatives. Finally, Fujitsu

provides a support structure that includes management and maintenance of facilities after improvements are completed.

Figure 60. Space-Saving Layout Proposal



The Time for Change Is Now

Some Fujitsu customers use server rooms built as long as 15 years ago and have made very few changes to their original design. The same air-conditioning systems are in use. Although servers continue growing in density, and shrinking in size and numbers, air-conditioning settings remain the same as they have always been. This translates into considerable waste and is another area in which simulations can prove beneficial.

Excellent results can be achieved simply by replacing old air-conditioning units with more efficient inverter system units. However, this does require new investment.

All companies work to reduce costs, but the unit charge for electricity looks small, so related measures tend to take the back seat behind more obvious cost-cutting plans. Customers assign budgets, but in many cases server room improvement is postponed to future years.

However, examined on an annual basis the cost of power becomes much more significant. Large-scale customers can, for example, save tens of thousands of yen every month simply by reducing their electricity usage by 100kW. In addition, when companies face the prospect of rising power rates, they are quick to take action. This was the case following the March 2011 disasters in Japan, which gravely impacted the nation's power generation industry.

Fujitsu has strived to demonstrate the benefits of action by becoming an example.

When Group companies replaced fuel-oil boiler air conditioning systems in use for 25 years with the newest electric turbo air conditioning systems, operating efficiency was improved by more than 68%, and major cost savings were realized to the extent that we estimated we could recover our initial investment in three years. In fiscal terms, Fujitsu Group companies implemented a variety of improvements in 2011 to save more than ¥18 million per year in electricity payments.

Start Small: Focus on Easily Implemented Improvements

The hot-aisle, cold-aisle separation Fujitsu implemented for the customer in the case study above was implemented relatively easily. Customers, too, find the improvement process easy to understand when the work starts with small changes. Customers with few servers and other IT equipment are also more open to the idea of change.

Simply adding panels to prevent the crossover of hot air and cold air can yield significant results.

The most common example is using blank panels on areas of racks where no equipment is installed. When Fujitsu's Cloud Center in Numazu implemented this plan, there was a sudden drop in the number of hotspots. Thermography imaging of heat before and after the panels were installed made the effects perfectly clear.

In another example, a customer who installed blank panels recorded a drop of 3°C in the temperature at the front of racks. This difference made it possible to raise the air-conditioning temperature setting.

Small adjustments and easy improvements, when considered from a long term perspective, can have major results. Opportunities to improve, and save, should not be missed.

[Column 4] Network Products

The latest network equipment uses far less power than previous models. For instance, in Fujitsu's SH series of standard switching products, the SH1515B from about 2007 consumed 12W. The newest model, SH1516C, provides the same specifications but consumes only 2.4W, a savings of about 80%. Even though the power per unit is small, SH series products are heavily used in many offices, therefore the total energy savings can be significant.

Figure 61. Power Savings of Network

As an example of network-related cooling technologies, our SR-X switch series was designed for connection with servers.

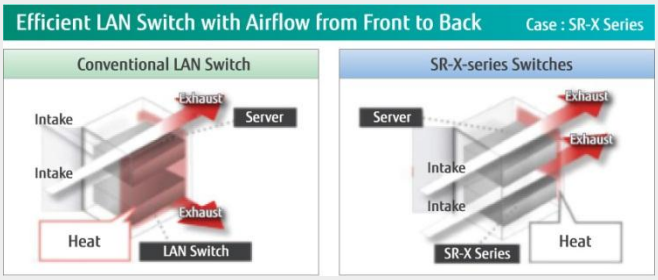
Usually, when servers are installed in racks air is taken in at the front, and hot air is released from the back. On the other hand, many network products pull in and exhaust air from one side to the other. When placed in data centers and other facilities, this structure would create unstable airflows and hotspots. This is why Fujitsu designed the SR-X series with the same airflow structure as servers.

In the days when standalone products were the mainstream, there were few network boards, and network products were placed on top of or next to servers. However, rapid expansion of the Internet and advances in semiconductor technologies increased demand for rack-installed products that allowed a large number of devices to be installed in small spaces. Today, rack-installed system products comprise more than 60% of the market as a whole.

The rapid expansion of networked environments has placed the priority on miniaturization and maximizing ports in network products. Nevertheless, most products are based on the concept of simply being able to place them in racks.

In recent years, heat generated by compact, high-density servers has become an issue, and the importance of security has grown with the spread of data centers and expanding network environments. As a result, network products are increasingly being affixed to server racks. Demand has grown for products that do not impact cooling inside the rack even if a large number of cables are connected.

Figure 62. Designing LAN Switchers for Efficient Cooling Inside Racks



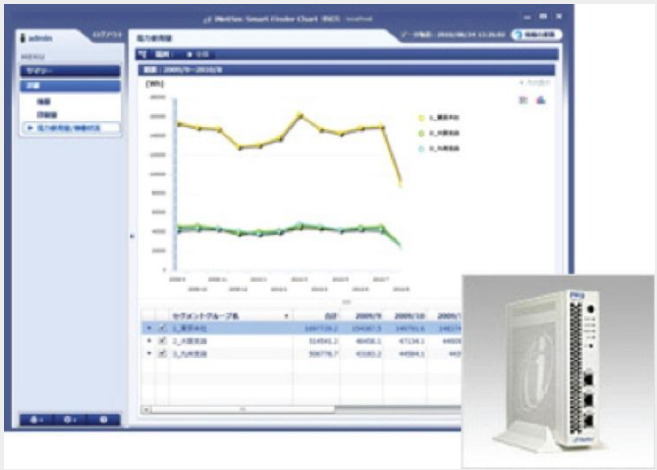
Since Fujitsu took the lead in developing these kinds of products, it had to overcome many hurdles in product development.

One hurdle was related to design. Network products were designed with ports at the front of the chassis. Since this design left insufficient space for air intakes, air had to flow in one side of the product and out the other. Fujitsu resolved this issue by placing the ports at the back of its products, making possible server-style front-to-back airflow and lessening the potential for hotspot creation.

Placing the ports at the backs of products not only prevented hotspots, but it also allowed for shorter cables because the ports are on the same side as server ports.

Network products also present the potential of accelerating visualization. Fujitsu's iNetSec Smart Finder is a compact product that, when connected to a network, collects data such as MAC addresses so that all connected devices and their level of power consumption can be determined.

Figure 63. iNetSec Smart Finder



Scheduled Operation of Network Products in Constant Operation

Because network products are assumed be running 24 hours a day, 365 days a year, the idea of scheduled maintenance might not seem to make sense at first glance. However, many of the servers, PCs, copying machines and other networked products in offices are turned off at off-peak time and days off. This pattern presents the opportunity for scheduled operation.

If a connected product is turned off, the corresponding port in the network product will link down. However, in fact only the power to the part that transmits data over the network is shut off. All of the internal hardware of the network product is still running. This is a waste of energy. Starting with the SR-S series, Fujitsu added functionality to schedule port usage, taking ports offline when their connected products are turned off. The corresponding hardware inside the network products also powers down, adding to energy savings.

The level of energy savings per board might be small, but considering the high number of boards in floor switches connected to PCs and other terminals, major reductions can be achieved.

Figure 64. Secure Switch

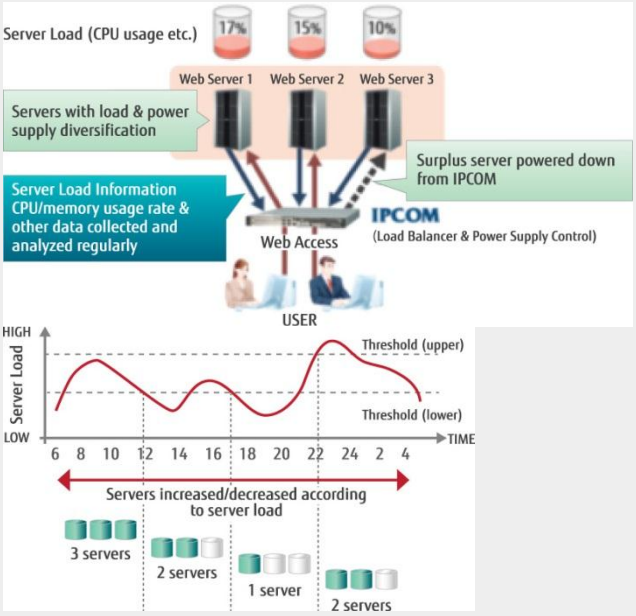
Server Energy Saving only a Load Balancer Can Provide

The IPCOM EX series, which Fujitsu launched at the end of November 2011, comes with a server link function that allows server power control.

Large-scale customers install an IPCOM EX server load balancer to disperse access to Web servers. Using the server link functionality, IPCOM EX products can monitor server load, and individual servers can be turned on or off from the IPCOM EX as load peaks and drops. Fujitsu has shown that, for large customers whose servers are accessed less at off-peak hours, this function can reduce overall server power consumption by about 30%.

Because load balancers can steadily reduce server access when maintenance is performed, using the function together with server link ensures that turning off a single server will not cause a service interruption.

Figure 65. IPCOM Series Server Link Function

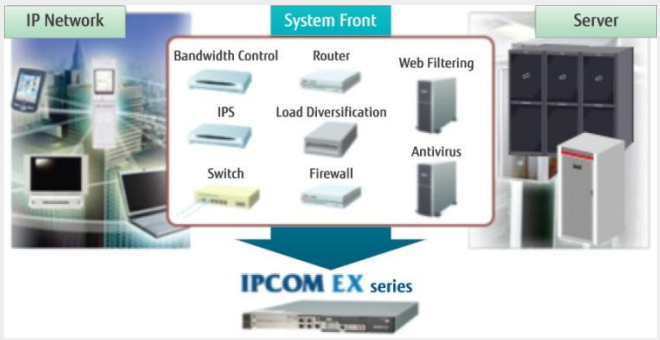


This is the kind of product only Fujitsu could conceptualize. There are currently no load balancer products from other makers that provide this feature.

Integration of Network Product Functions

IPCOM products combine in a single device functions such as router, load balancer and firewall. Using them to integrate network products reduces configuration and operating costs, installation space and power consumption.

Figure 66. High Reliability with the IPCOM Network Server



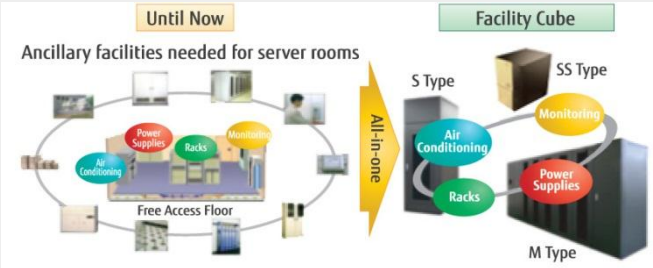
[Column 5]
Facility Cube Airtight Cooling Server Racks

ICT investment does not stop at the purchase of ICT equipment. It also includes a variety of running costs, such as securing, maintaining and operating the installation space, air conditioning and power equipment. To limit running costs, it is necessary to reduce space, operate systems efficiently and optimize facilities.

This section looks at Fujitsu's Facility Cube, an airtight cooling server rack that effectively utilizes space and creates the optimal environment for ICT equipment.

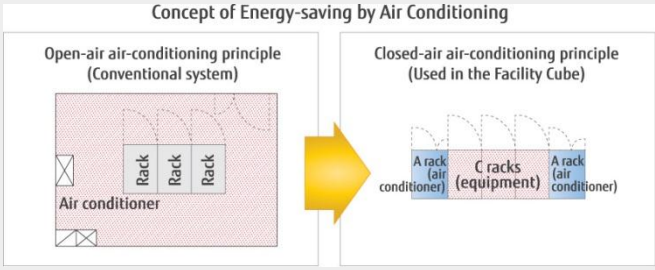
With conventional racks, in addition to installing servers it is necessary to purchase accessories such as air-conditioning packages and monitoring functions. By unifying these accessories and installing them into the rack, savings could be achieved both in space and power consumption. This is the development concept of the Facility Cube. Because this system does not require large-scale facilities or space, optimal server environments can be created even in the existing free space of offices.

Figure 67. Optimal Server Environment Realized by the Facility Cube



Until now, the principle of cooling in server rooms has been based on cooling the entire space with open-air systems. The Facility Cube is a closed, airtight environment that has its own system for cooling only the rack itself. This concept realized extensive energy savings.

Figure 68. Concept of Saving Energy via Air Conditioning

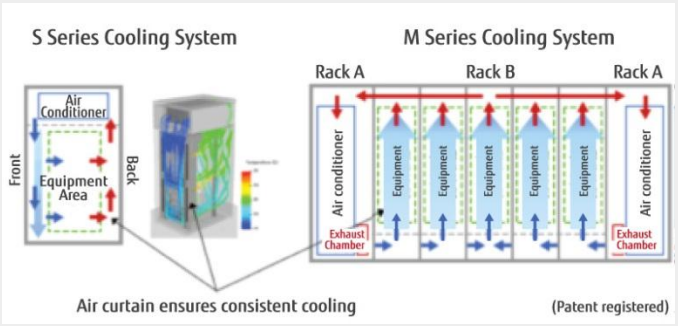


For the cooling unit of S Type and M Type, Fujitsu adopted a sensible heat system that reduces heat generated by devices without unnecessarily dehumidifying the interior. This system leads to excellent cooling efficiency compared with conventional air conditioning. In addition, because air flows only inside the Facility Cube, it is highly dust resistant and quiet during operation.

Efficient Circulation Cooling in a Minimal Airtight Space

Fujitsu's S-type Facility Cube (one rack with one air-conditioning unit) is a good example to explain the method of cooling by circulating air. Cool air flows down across the front of the rack from the air-conditioning unit set at the top of the product. This air becomes heated as it travels through servers and switching equipment. As the air proceeds from behind this equipment, it is circulated back to the air-conditioning unit to be cooled and sent on its way again.

Figure 69. Cooling System Principle of the Facility Cube



This flow of air down the front of the Facility Cube becomes an air curtain, so administrators can open the front door and work on the ICT equipment inside. During maintenance, the air curtain is so effective that administrators are rarely disrupted by temperature alerts that commonly occur in other products, even where air conditioning is installed in the rack. Fujitsu's smart design enables work to be performed without powering down the unit.

Perhaps the greatest benefit of this system is that, even if it is placed in an office environment, it is not affected by the ambient temperature. The Facility Cube also does not affect air temperature around it, so people can work in comfort next to autonomous server environments.

Moreover, since the circulation efficiency of cool and warm air within the unit can be maximized, the cooling ratio of the air conditioner inside the rack is greatly improved.

With conventional power supply packages, if the power fails, the switch must be manually turned on again to restart the unit. In the Facility Cube, however, if the power fails for some reason, the air conditioner restarts automatically when power returns. What's more, since the air-conditioning unit operates at all times, there is no longer any need to adjust room temperature settings on days off, in the summer and at night.

In the past, even though servers were running day and night, there were cases in which workers turned off the air conditioning when they left the office. During the hot Japanese summer, the off-peak temperature can rise to as high as 35°C, a dangerously high temperature for servers. With the Facility Cube, there is no longer any need to worry about turning off room air conditioning.

In the M-type (midsize) Facility Cube, up to five racks can be linked together. Racks installed with air-conditioning units are placed at both ends of the lineup, so even if one unit fails, the other can be depended on to keep the whole environment cool

Growing Importance of Saving Energy in Server Rooms

The idea of saving energy in server rooms is only a few years old. Traditional thinking dictates that server rooms be kept cool at all times. After the March 2011 earthquake in Japan, however, customer awareness has changed considerably. This was not an area of focus previously, and many customers who sought solutions found the Fujitsu Facility Cube.

Major Cost Savings from Reducing Space and Saving Energy!

The comparably low height of Facility Cube products also relieves the sense of oppressiveness that tall conventional racks can instill. Up to

12U of installed server space is available, and air-conditioning capacity is 4kW.

The most important issue with ICT equipment is the installation environment. There are high costs associated with facilities and installation spaces for ICT equipment. But Facility Cube products can be placed in an existing office, so a company can install a server for a specific department, for example, even if it does not have a server room. If a larger-scale server system is needed, a Facility Cube product can still be installed if there is enough space for a conventional rack somewhere in the office.

Lineup

The growth of the Cloud has made it possible to remove multiple racks of servers from conventional server rooms. However, demand will remain for some in-house servers for sensitive tasks such as storing customer information and performing product development. Then again, leaving one or two racks in the server room is an extreme waste of space. The Facility Cube is a viable alternative. The M-type is good for up to five server racks, while the S-type holds the equivalent of one rack. By switching to Facility Cube products, customers can achieve space and electricity savings, while at the same time opening up the old server room for other uses.

In addition, Fujitsu has launched the even more compact SS-type Facility Cube suitable for a wide variety of spaces. When the S-type was launched, some customers said it was still a bit too large for convenient placement in offices. They asked Fujitsu for something even smaller. The SS-type is the result and comes in at about half the size of the S-type.

The concept of both the M-type and S-type was to provide a replacement for conventional server rooms. Fujitsu designed the SS-type, however, to be easily placed in offices or even school classrooms. While server racks have almost always been black, there are three different SS-type designs to choose from. One comes in a wood-like finish, one with red lines on a white chassis, and one with silver lines. There is an SS-type Facility Cube for every environment, from offices and hospitals, to academic facilities.

Figure 70. Facility Cube Lineup

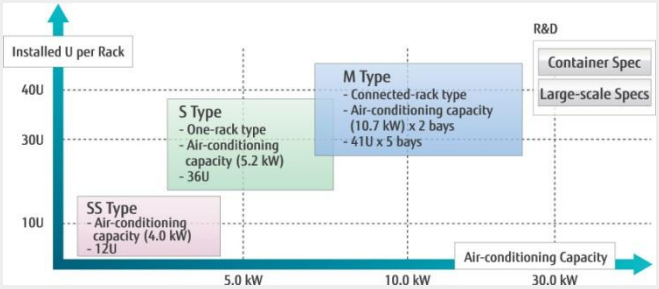


Figure 71. Facility Cube Design

Figure 72. Facility Cube Installation Image

By installing ICT equipment in the Facility Cube, noise can be reduced by 15 dB

Growing Number of Potential Application Environments

How dustproof and water-resistant are Fujitsu's Facility Cubes? Facility Cube products meet the IP4X Protection index. Dust resistance is a feature likely to be of interest to customers with manufacturing plants. Facility Cubes can be placed in area exposed to dust and dirt, environments that would be detrimental to conventional racks. They can even be used in workshops, machine shops and other places where oil might splatter. For example, a customer in the logistics industry could set up a Facility Cube in the corner of a warehouse or on bare ground.

Figure 73. Where Facility Cubes Could Be Used

Fujitsu Facility Cubes are compact, all-in-one solutions. They run quietly and are resistant to dust, which opens up a new world of potential applications for servers.

[Column 6] The "Modular Data Center" Container-type Data Center

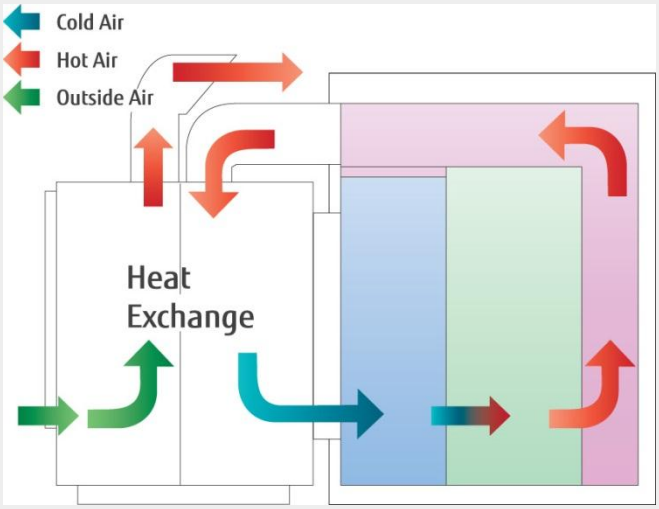
As Cloud computing has advanced, so has demand for data centers. Momentum is growing to set up backup sites, remote data centers and other countermeasures for natural or other disasters. At the same time, several issues remain with data centers, such as large-scale initial investment, long-term ROI and lengthy construction schedules that can lead to lost business opportunities and unused space.
To respond to the current market environment, Fujitsu is offering container type data centers that adopt indirect air-cooling systems.

Figure 74. Modular Data Center

Indirect Air Cooling Containers for Use Anywhere

Heat exchange inside the container is performed using external air, with expelled warm air reused, so there is no need for an external water-cooling device to maintain temperature. In addition, external air cannot directly enter the container, so there is no need to adjust external temperature or worry about dirt or insects getting inside. Furthermore, refrigerant gas can be used in hot external environments for efficient heat exchange.

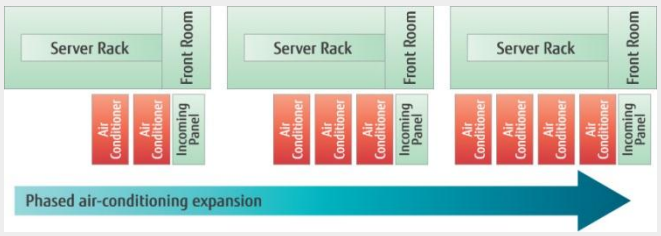
Figure 75. Indirect Air Cooling Method



The Air-Conditioning Unit Can Be Expanded in Phases

In Fujitsu's solution, the container, air-conditioning unit and electricity panel can be separated for easy transport and maintenance. The air-conditioning unit itself is modular, so a small unit can be used at the start and expanded as ICT equipment load grows. This product also features a redundant configuration and dual power feeds. Even if the eight racks of 50Us each (400Us), designed specifically for the container, are filled to the limit with ICT equipment, four air-conditioning units are sufficient to keep the container cool.

Figure 76. Phased Air-Conditioning Unit Upgrades



Racks Optimized for Mounting in the Container

The container's racks conform to the 19-inch rack specification structure (EIA310-D). By removing the front and back doors, as well as the casters, Fujitsu made racks lighter than conventional models. A dedicated PDU is attached to the left side at the rear of the rack to support cable optimization. A dedicated cable holder on the right side also makes possible optimal cable layouts. Finally, a rack slide configuration makes it easy to install ICT equipment even in the tight confines of the container and also contributes to high-density mounting and high reliability.

Operation Management Software for ICT and Facility Equipment

The configuration information and current conditions of all equipment in the container, from racks, air-conditioning, power supplies and other facility equipment, to the ICT products installed, are centrally managed. The container has door, smoke, temperature and humidity sensors. Information from these sensors can be collected and output in reports. System policies can be set in advance, so automated control and operation cut in when an event falling under the policy specifications occurs.

Figure 77. ServerView Facility Manager

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2013-01-25 WW EN