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ADVANCE

Advanced Solutions

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Changes for the Better

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Cover Story

As a core of Mitsubishi Electric's growth strategy, we are focusing on advanced solutions that link multiple businesses. This feature introduces solutions that meet customer needs of security and safety, attract other customers and enliven the city, tackle global warming and promote city redevelopment.

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Technical Reports

Overview

Author: *Ken Matsumaru**

Our Growth Strategy on “Group Collaboration” and “Synergistic Effects”

The growth strategy of Mitsubishi Electric consists of the VI (Victory) strategy and the AD (Advance) strategy, which are inseparably linked with each other. The VI strategy is intended “to make strong businesses stronger,” and is pursued mainly by business groups. On the other hand, the AD strategy is intended “to reinforce solutions business centered on strong areas,” and is pursued by the Corporate Marketing Group, which provides overall coordination of, and assistance to, projects being conducted by multiple business groups.

This feature on “Advanced Solutions” introduces various solutions developed from the AD strategy activities. The key points to succeed in advanced solutions business are focusing on those businesses whose markets are predicted to expand rapidly in the near future, and which are expected to grow substantially by combining the strong technologies and products of the Mitsubishi Electric Group. This means that marketing at the corporate level by collecting overall information from various business groups and identifying technology trends in collaboration with factories and laboratories are indispensable.

We hope that this feature articles will be informative and assist the growth strategy of companies in the group.

**Corporate Marketing Group*

Advanced Solutions to Achieve Our Growth Strategy

Authors: *Nobuo Asahi** and *Koichi Asami***

1. Introduction

Mitsubishi Electric's growth strategy has consisted of two main aspects since 2003: the VI (Victory) strategy which is intended "to make strong businesses stronger," and the AD (Advance) strategy which is intended "to reinforce the solutions business centered on strong areas." These two strategies are one of our management approaches to identify "the optimum direction for a general electric manufacturer with specialized business."

It is generally said that general manufacturers lag behind in terms of concentration and selection and are inferior in competitive position in individual business segments compared to specialized manufacturers. However, if a great store of market information and technical information, gathered from multiple business segments, can be analyzed satisfactorily, the general manufacturer can also make good use of this information for its business development. The measure to take for this dilemma is a combination of the VI strategy and AD strategy. That is to say, the objective is to encourage new business development that can be done only by a general manufacturer through the AD strategy, while maintaining the superior competitiveness to the specialized manufacturer through the VI strategy.

2. AD Strategy Classification and Advanced Solutions

Figure 1 shows the classification of the VI strategy and AD strategy. The independent business type classified as the VI strategy pursues growth through each business unit making full use of its advantage. The AD strategy focusing on the linkage among business units is roughly classified into three types: customer-linked cross sales type, business-linked market development type, and new business development type.

The customer-linked cross sales type responds to the needs of our important customers with the collective strength, and mainly includes activities such as sales collaboration centered on the sales department in charge of the customer. The business-linked market development type offers a total proposal with the related product groups combined and strengthens business operations in the market across multiple business units such as security, energy conservation, display solutions, etc. as a project. The new business development type focuses on an advance activity for a business whose market has not yet materialized.

3. Introduction to Advanced Solutions

3.1 Total security solution

Mitsubishi Electric is highly regarded for each of its products in the physical security industry such as access control systems and surveillance cameras, and in the information security industry using its proprietary encryption and information management technologies.

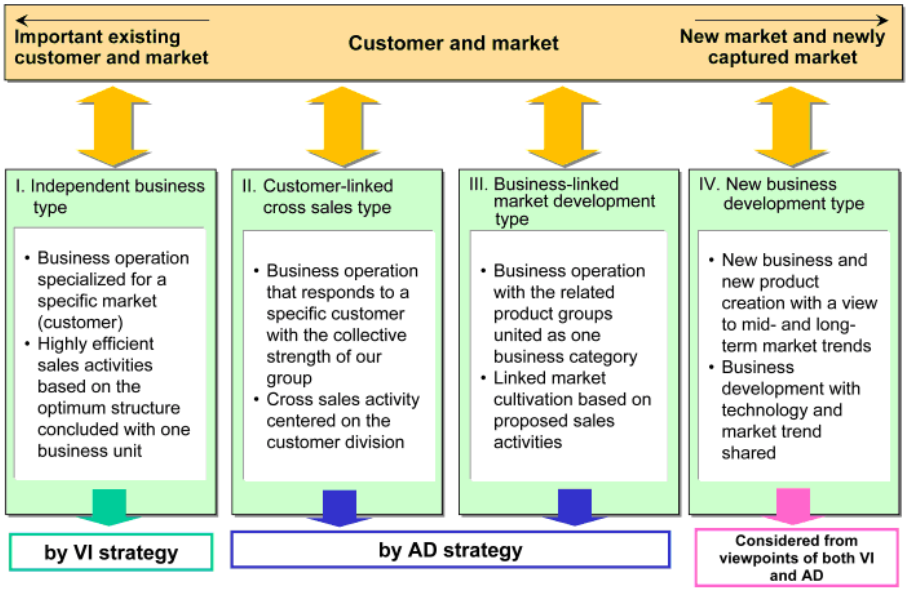


Fig. 1 Classification of VI strategy and AD strategy

*Corporate Marketing Group **Corporate Strategic Planning Division

Recently, security needs have become more diverse and advanced, and there has been a growing demand for combining multiple security systems and linking them with maintenance and service. We have therefore developed the "DIGUARD-NET" platform for operating multiple security appliances and systems in combination.

3.2 Display solution

Mitsubishi Electric is highly regarded for large type video display systems such as those for athletic facilities and large surveillance systems, etc.

Recently, the digital signage market has grown rapidly where various video display systems are connected via networks to transmit informations at large commercial facilities, etc. We have proposed a system that combines our outstanding large video display devices with liquid crystal monitors to deliver video contents in various formats collectively over high-speed IP networks.

3.3 Global warming countermeasures

As efforts to prevent global warming gather momentum worldwide, Mitsubishi Electric announced in October 2007 its "Environmental Vision 2021" which sets the target year of 2021, the 100th anniversary of the founding of the company.

To draw on this "Environmental Vision 2021" to both strengthen corporate management and gain business opportunities, we have launched a global warming countermeasure as a company-wide project. In addition to reinforcing the renewable energy business in the global market of photovoltaic generation business, etc., this project also includes activities conducted since 2004 to expand the sale of energy-saving equipment such as for factories and buildings in Japan.

3.4 City development solution

Mitsubishi Electric has long been involved in the city redevelopment business which has been our advantage, so far.

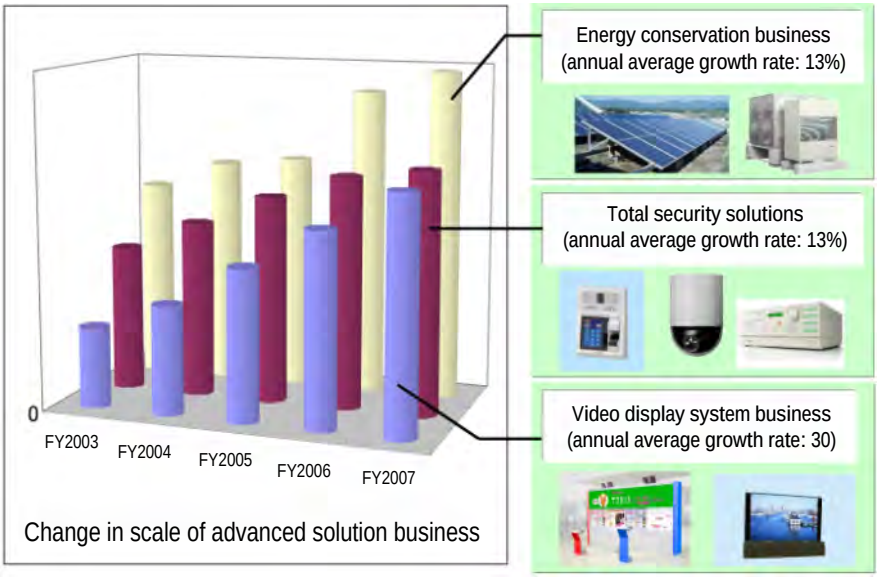


Fig. 2 Result of advanced solution business

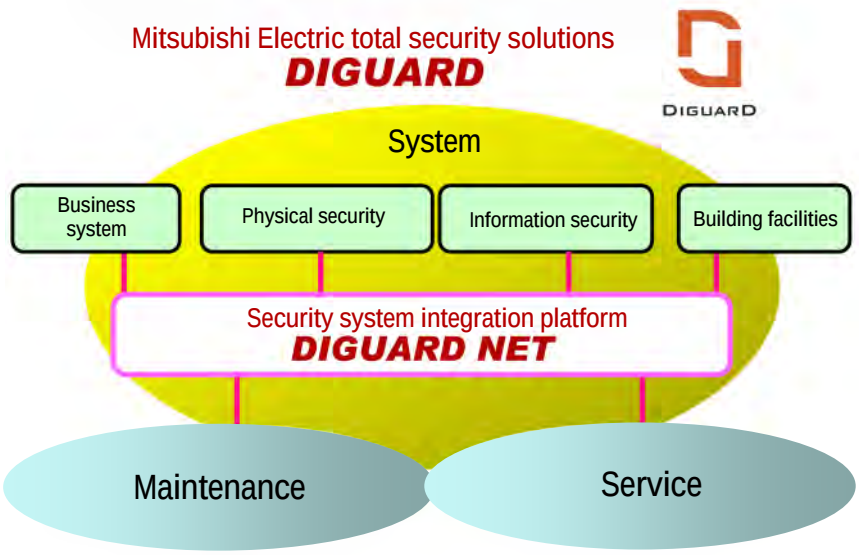


Fig. 3 Total security solution

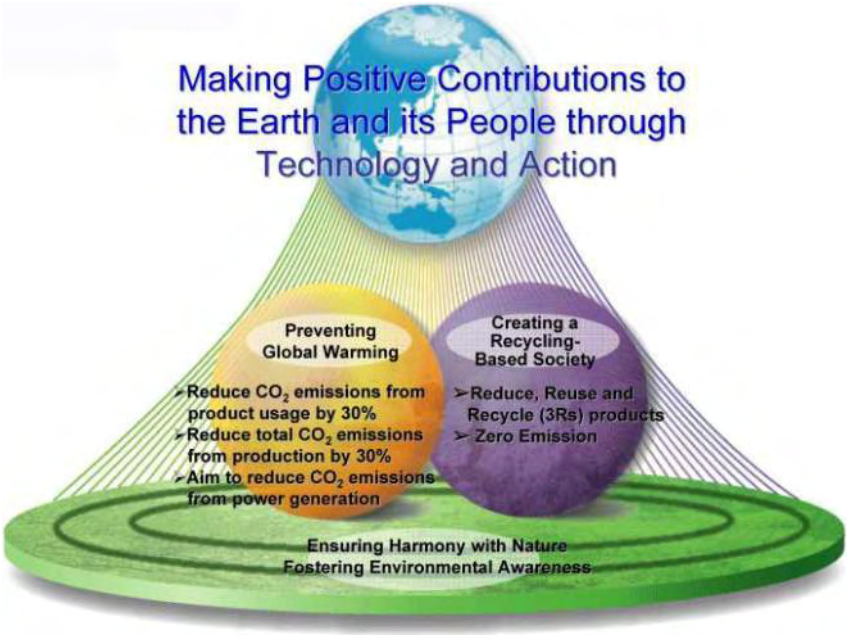


Fig. 4 Mitsubishi Electric Group "Environmental Vision 2021"

Fig. 5 City redevelopment platform AdvanCity

Our outstanding solutions have been further tied and linked to launch the business concept of "AdvanCity," a platform for developing more attractive cities and strengthening proposals for major projects throughout Japan.

4. Future Outlook of AD Strategy

General electric manufacturers have the know-how to manage many businesses that vary greatly over time, from development to commercialization, as well as business scale, profitability, investment scale, product and system life, quality criteria, sales channel, and maintenance concept. Mitsubishi Electric's AD strategy capitalizes on this know-how to integrate strong business areas and continue expanding new values.

5. Conclusion

In this "ADVANCE" Technical Report, feature articles enter into details about the specific technical aspects of individual solutions. We hope this paper clarifies the essential part of growth strategy of Mitsubishi Electric.

Total Security Solution "DIGUARD"

Authors: *Akihiro Takeda*, Masato Matsuoka** and *Koichi Sasakawa**

1. Introduction

Security measures tend to become more complicated and advanced in order to create a secure and safe society and maintain corporate competitiveness. The Mitsubishi Electric Group offers a higher level of security management such as integrated management with video surveillance and access control and analysis of multiple different security system logs, etc. by systematizing physical security such as access control and video surveillance and information security such as file encryption and network security, as well as sharing ID information, history information, etc. among systems.

2. Security Technology Trend and Needs

Since the 9/11 attacks in the US, work on crisis management has been accelerated worldwide. In Japan, security products are needed that include fast, accurate biometric authentication technology, image format for high-definition and long video recording, low-error detection image processing technology, and a system that integrates them all. However, security systems typically cost more to manage and maintain (approx. 80%) than the initial cost (approx. 17%) for design and construction in terms of ratio concerning its life cycle cost (LCC)(1). Therefore, an increasing number of users are requesting total support ranging from system construction to consultation for formulating operation policies and guidelines as well as maintenance and operation management.

3. Mitsubishi Electric Total Security Solution "DIGUARD"

3.1 Total Security Solution "DIGUARD" Achieved by "DIGUARD NET"

For constructing the "DIGUARD NET" security system integration platform, Mitsubishi Electric has done the following: (1) fixed Mitsubishi own communication protocol, (2) specified the data format such as ID information and history information, and (3) systematized the interface at which the system functions are invoked, to create a highly secure total system by combining an access control system, video surveillance system, file encryption and authorization management system, etc. to share ID information and history information among systems (Figure 1). This platform can also be linked with an attendance management system and building facilities such as elevators, air conditioners, lighting, etc. to achieve more efficient management and energy conservation. In addition, the platform can ensure remote monitoring and control of the status of each system through a wide-area network to provide rapid maintenance in case of faults and operation management service. The next report gives technical details of "DIGUARD NET."

3.2 Security Business Strategy Using "DIGUARD"

As described in Sec. 1 of the Chapter 3, urgent maintenance in case of a fault and an operation management system in which surveillance video is gathered by a network and the system operation status and log are analyzed statistically and reported, are effective for security maintenance and operation. The life cycle of the security system is divided into four phases: (1) design, (2) installation, (3) operation, and (4) renewal (Figure 2).

In the "DIGUARD" security solution, "DIGUARD NET" is used in the design, installation, and operation phases to:

- Speed up installation during construction and re-

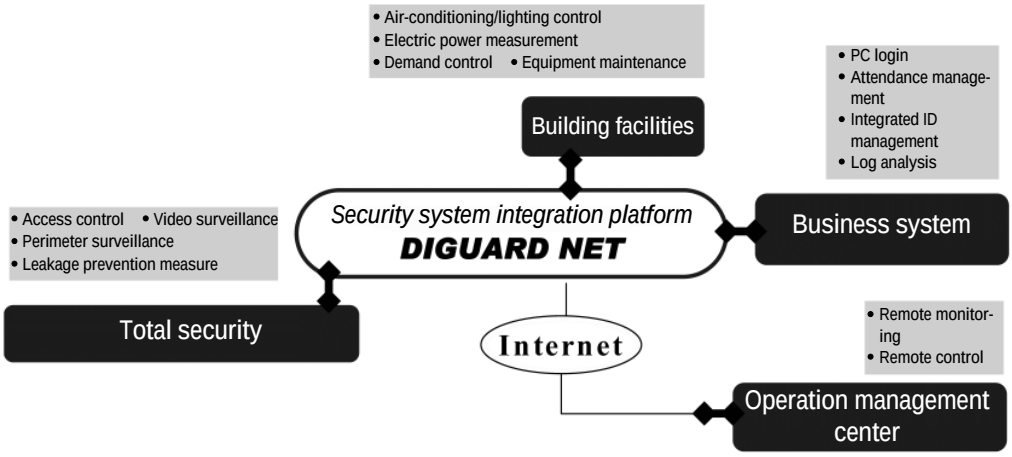


Fig. 1 Creation of a total system through DIGUARD NET

*Building Systems Group

newal, and maintain the reduction of work hours (SI cost)
- Extend the stable operation period and reduce the operating cost by providing operation management service.

In the life cycle from system construction to operation and management, it helps maintain the security level (Figure 3).

4. Example of Constructing Total Security Solution "DIGUARD" System

This section explains the typical patterns and their functions (Table 1).

(A) Easy-to-operate security through integrated management such as access control and video surveillance
- Access control history information and gathered videos are cross-checked to promptly detect accidents and incidents such as illegal access.

(B) Prevention of information leakage through linkage between the access control system and application terminal
- For the prevention of information leakage, only the person who has the access history in the access control system is permitted to log on to the PC.

(C) Optimum control of air conditioning and lighting using attribute information and number of people during entry/exit
- Optimum control of air conditioning and lighting is performed based on the attribute information and the number of persons who have entered the room to maximize security, comfort and energy conservation.

5. Conclusion

This paper described the concept of "DIGUARD," the new total security solution from the Mitsubishi Electric Group and its business strategy. In future, we intend to apply this solution to large-scale systems and system groups using a wide-area network, study the improvement of maintenance and operation management service, and commercialize this solution.

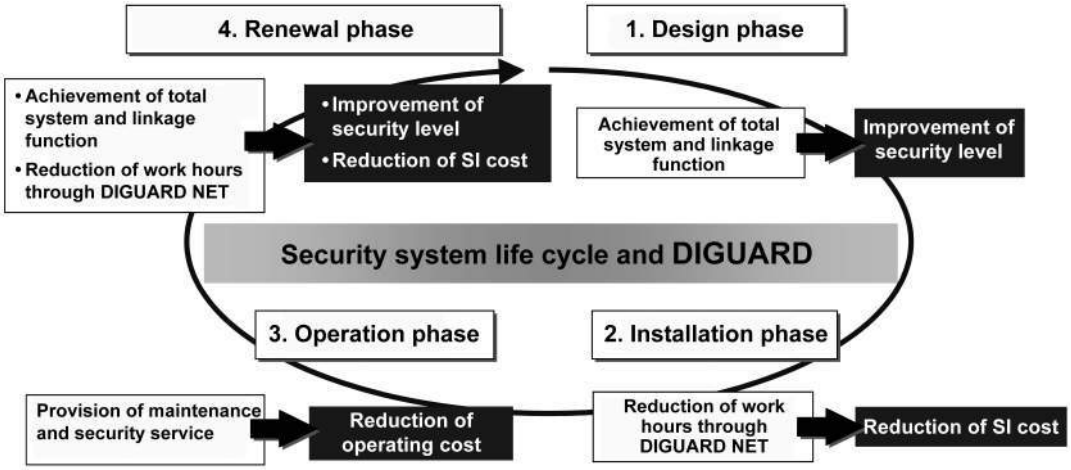


Fig. 2 Security system life cycle and DIGUARD

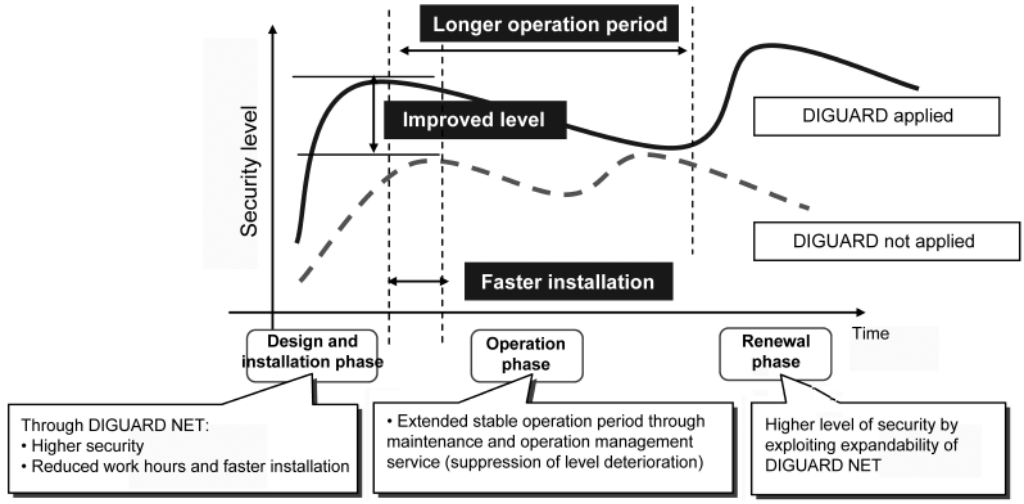


Fig. 3 Application and security level of DIGUARD

References

(1) "Life Cycle Costs-chart"
http://www.nikkenn-kann.com/pdf/lcc.pdf, 2001
(2) Mitsubishi Electric Technical Report Feature "Physical Security," Vol. 78, No. 8, August 2004

Table 1 Combination of systems and achieved functions

Linkage pattern/achieved function		A	B	C
System combination		Easy-to-operate integrated security management through linkage between access history and surveillance video	Prevention of information leakage through automatic log off from application terminal using access control information	Optimum control of air conditioning and lighting using ID and attribute information items and the number of persons during entry/exit
Security	Video surveillance	○		
	Access control	○	○	○
Business system	Integrated ID management, work management, and application PC		○	
Building facilities	Air conditioning, lighting, and elevator			○

"DIGUARD NET": Security System Integration Platform

Authors: *Masahito Matsushita** and *Shinji Kitagami***

1. Introduction

To ensure strict security control at lower cost in companies, we have developed "DIGUARD NET," a security system integration platform. DIGUARD NET seamlessly links security appliances (access control, video surveillance, etc.) and security governance systems, "internal control," (identity management, security log management, etc.) that have been installed individually.

2. Architecture of DIGUARD NET

DIGUARD NET provides the middleware and APIs (Application Programming Interfaces) which make it possible to cooperate with various security appliances, internal control systems and building facilities (Figure 1).

The architecture of DIGUARD NET consists of three layers: (1) the application layer, (2) the DIGUARD NET middleware layer, and (3) the security appliance layer (Figure 2).

In the application layer (1), we developed DIGUARD NET APIs to form cooperative security applications. The API features set in the application layer are abstractions for various security appliances and internal control systems. As the differences of individual security appliances and systems are eliminated by the APIs, DIGUARD applications become systematically more independent. And it is possible to reduce the cost of modifying program code when the new appliances are installed.

In the middleware layer (2), DIGUARD NET middleware is located. Its functions are to translate various security appliances' protocol and convert a customer's information system data to the DIGUARD data format.

In the security appliance layer (3), it has the appliances, such as access control units, surveillance cameras and recorders system, and so on. The interfaces and protocols for existing security appliances (no-DIGUARD) are translated by the DIGUARD NET middleware and APIs.

3. Access Control Solution

Managing the flow of people and products is a critical issue to strengthening physical security. Detection of illegal acts such as spoofing, tailgating, and illegal unlocking by an insider requires a complex system that closely integrates the video surveillance system, physical sensor, information system, etc.

DIGUARD NET provides a mechanism for uniform handling of varieties of Mitsubishi's security appliances. Particularly in the application layer, the APIs for controlling the appliances and systems are standardized and arranged by function, so the system can be constructed

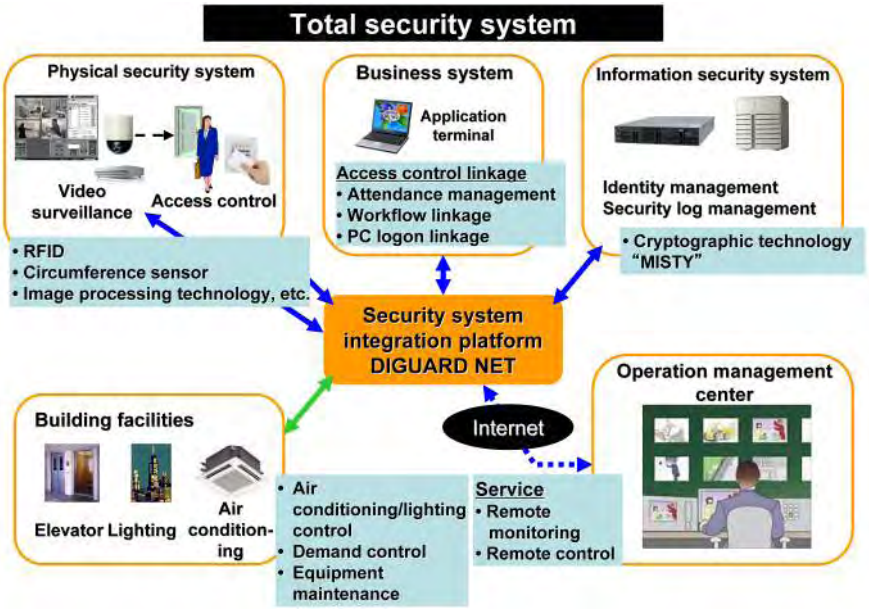


Fig.1 "DIGUARD NET", a security integration platform

*Advanced Technology R&D Center **Information Technology R&D Center

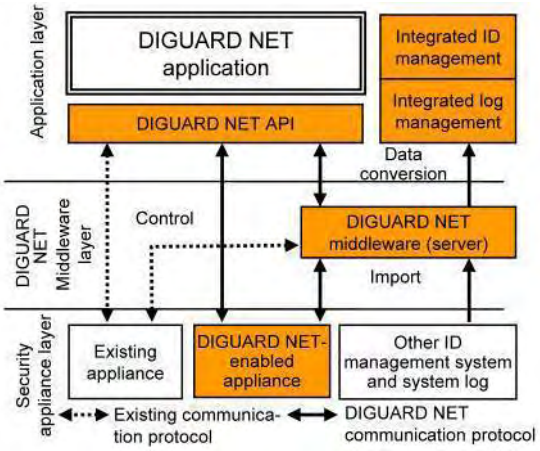


Fig.2 Basic architecture of DIGUARD NET

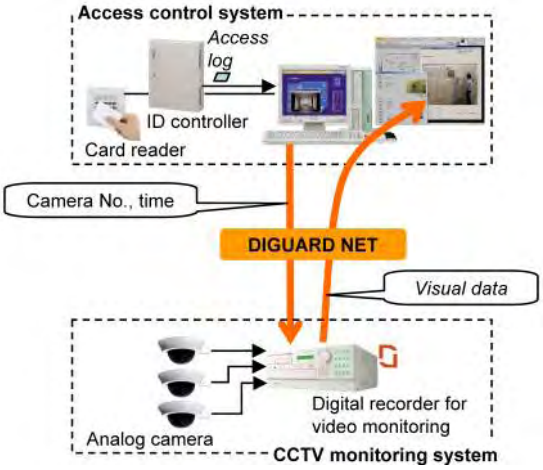


Fig.3 Linkage system focusing on access control system.

without considering the differences among appliances.

Figure 3 shows an example of the system configuration in which the access control system and video surveillance digital recorder are linked through DIGUARD NET. In this system, the digital recorder is DIGUARD NET-enabled and can be controlled from the application software of the access control system. Examples of linkage functions include: a function that links and plays back the video recorded in the recorder from the access history recorded in the access control system, and a function that displays the live video of the intruded area when illegal access is detected.

4. Video Surveillance Solution

In video surveillance systems, it is difficult to identify the required scene from the recordings although video recorders can effectively store evidence (recorded videos) for a long period.

To improve searching of a recorded video, the video surveillance system has to be linked with security systems such as access control, and uses information from other systems. Such cooperative system conventionally had to be developed for each project, but DIGUARD NET allows them to be developed efficiently.

Figure 4 shows a configuration example of DIGUARD NET-linked system focusing on video surveillance. In this example, the other system operates as an external event source for the video surveillance system. The video surveillance system obtains the events such as access operation and illegal operation that occur in the access control system and status changes such as locking&unlocking, long-time door open, and appliance errors, for example, via DIGUARD NET. It then saves these information items as external events together with time of occurrence, camera information, etc. and uses them for recalling the recorded videos.

Figure 5 shows the screen image of the integrated surveillance monitor terminal achieved based on the monitor terminal of the digital type video surveillance

5. Internal Control Solution for Security Governance

The Control Objectives for Information and Related Technology (COBIT) framework that achieves the internal control includes identity management that integrates and manages the user information and access privilege of each system and a mechanism that accumulates and audits system logs.

However, in order to continuously maintain and take measures to improve-governance against various threats, the entire company must unify its governance mechanism.

DIGUARD NET enables security-related management information to be safely exchanged between the security governance, internal control system and access control and video surveillance systems. In addition to the conventional information system, security governance (identity management and security log management) of the entire company including access control and video surveillance can be achieved.

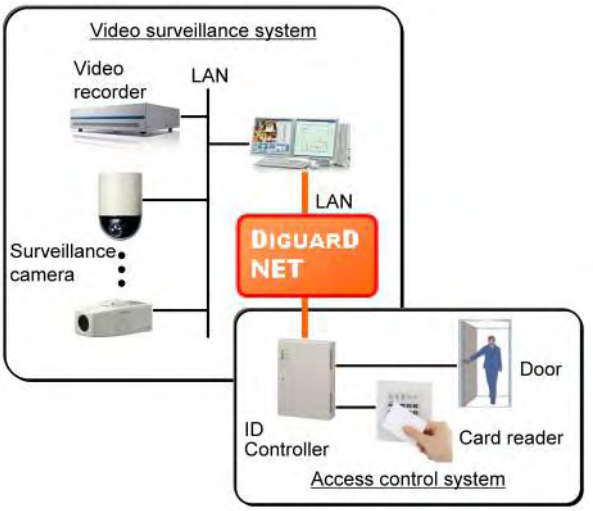


Fig.4 Linkage system focusing on video surveillance

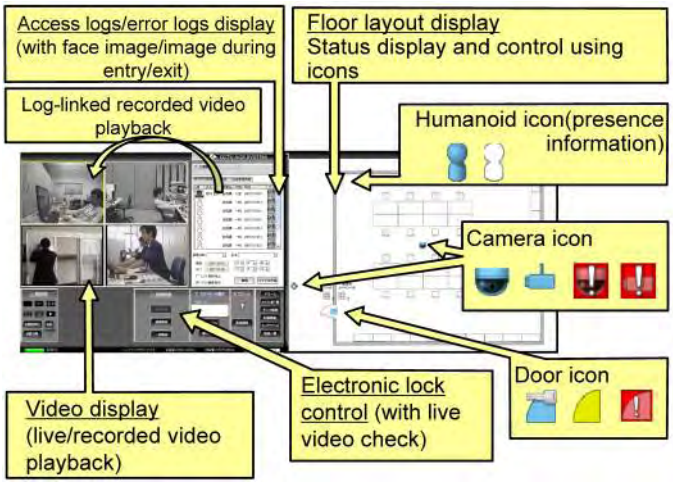


Fig.5 Screen example of the video surveillance/access control cooperative system

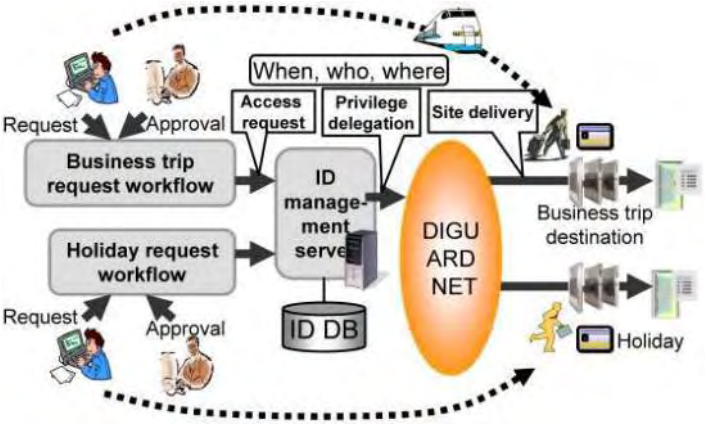


Fig.6 Workflow and access control linkage system

5.1 Identity management (ID management)

Examples of security governance through identity management include: promptly resetting privileges after a staff reorganization, temporary delegation of privileges to personnel on business trips and holiday, and the consistency check between access information and attendance information.

The identity management server imports information about privileges upon joining, retirement, personnel changes, reorganization, etc. from the human resource system, and delivers privilege information determined according to the access control policy governed by corporate rules, etc. to the site where the access control system is installed.

Figure 6 shows an example of the workflow linkage system that temporarily delegates privileges. The identity management server imports information about a user who is granted access as a result of a business trip request workflow, working overtime request workflow, etc., determines whether privilege delegation is valid, and delivers smart card authentication information, period, and accessible location to the access control system.

5.2 Security log management

Access control systems and various information systems recently output and store large amounts of security logs for the purpose of preserving evidence. These logs have conventionally been managed for each appliance and system. However, DIGUARD NET enables various logs to be collected from multiple security appliances and information systems in a unified procedure for integration and management. This reduces management costs and makes log analysis more efficient.

Figure 7 shows the configuration of the integrated security log management system using DIGUARD NET. The integrated log management server collects logs from access control and video surveillance systems and various information systems connected to DIGUARD NET for centralized management.

The server also saves access control and information system logs and snapshot images of video surveillance linked with the time and ID. This enables logs to be searched for a specific time, person, and appliance, and associated images to be displayed when investigating an incident.

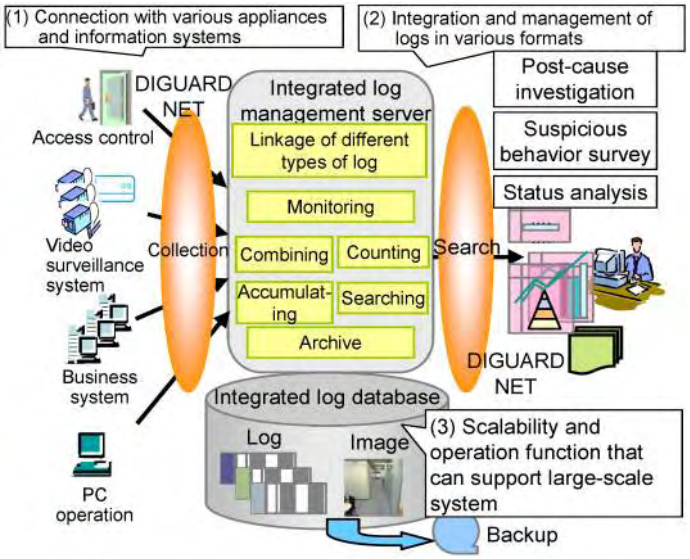


Fig.7 Integrated security log management system

The Display Solution of Mitsubishi Electric

Authors: *Toru Murozono** and *Takashi Iwatake***

1. Introduction

Since the beginning of development, Diamond Vision has focused on high-quality displays, advanced display functions, and system technology to suit various markets. Recently, Mitsubishi Electric has developed a stream delivery function for high-definition visual contents, and the market is being expanded by adding value to the visual information system.

2. Display Technology of Diamond Vision

Since 1980 when Mitsubishi Electric introduced Diamond Vision, the world's first full-color large-screen display system, the company has been offering high-quality displays with advanced functions.

2.1 High-quality displays

(1) Luminous uniformity

Before each Diamond Vision is shipped, the luminance of all R (red), G (green) and B (blue) light emitting diode (LED) devices is adjusted to ensure uniform luminance over the entire screen.

(2) Color reproducibility (Color conversion technology)

Colors produced by uncorrected LEDs look unnatural because their color reproduction range differs from those specified by the National Television System Committee (NTSC), Phase Alternating Line (PAL) and other standards. Diamond Vision can be tuned close to NTSC or PAL by independently adjusting each individual color point corresponding to R, G, B, in addition to Y (yellow), C (cyan), M (magenta) and W (white) on the chromaticity diagram.

(3) Full digital processing

In the video signal processing circuit, interlace-progressive (I/P) conversion, image size conversion and color conversion are performed on direct digital signals. Initial video data can also be received as direct digital signal, enabling full-digital high-quality pictures at every stage through to the final display.

(4) High definition

For events or other indoor applications, various screen sizes need to be constructed by combining multiple display modules which are high definition, compact, and easily transportable. Mitsubishi Electric has developed and released product lines with pixel pitches of 6, 4 and 3 mm (Figure 1).

2.2 Advanced functions

(1) Digital screen controller

(a) Compatibility with Various Video Formats

The digital screen controller simultaneously accepts four video source inputs, each of which can be compatible with either conventional analog video signal, high-definition video signal, or video signal from a PC (DVI: Digital Visual Interface).

(b) Reduction in frame delay

During live display at events, a long frame delay causes a problem with lip sync (synchronization of audio to video). Therefore, we have selected an I/P conversion method without any frame delay, providing a system configuration having less delay.

(2) Automatic power consumption control

The average power consumption of the next image frame, to be displayed is continuously monitored; if it exceeds the preset value. Then the automatic power consumption controller reduces overall luminance.

(3) Image creation technology

Mitsubishi Electric has developed a proprietary rendering function that displays animations, still images, text, etc. on the screen.

(a) Image transition effect function

Figure 2 shows an example of an image transition effect. Currently, about 60 effect components are

Fig. 1 High resolution type of diamond vision for indoor use

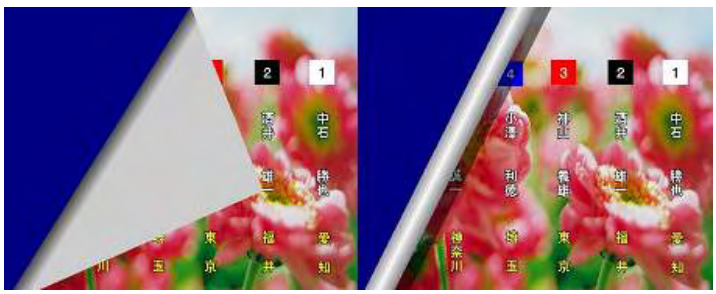


Fig. 2 An example of a transition effect

**Nagasaki Works* ***Mitsubishi Electric Control Software Corporation*

available. With our rendering function, parameters of the transition effects are specified in scripts, allowing additional effects to be easily produced to meet the user's needs.

(b) Super-long display

Mitsubishi Electric offers a horizontally super-long screen for use in sports stadiums and grounds. Mitsubishi Electric offers a range of screens approximately one meter in height and over 100 meters in length. As shown in Figure 3, a PC image is divided into multiple strips having the same pixel counts. Each strip of display area is sequentially transmitted by the display controller to reproduce a horizontally super-long video image.

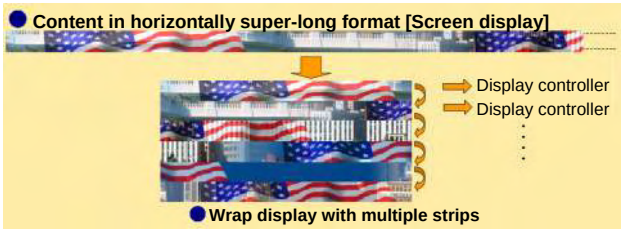


Fig. 3 Rendering function for super-long screen

3. Visual Contents Delivery System

As broadband networks have spread in recent years, the need has grown for a system that integrally controls multiple display units and delivers timely information over the Wide Area Network (WAN).

The features of Mitsubishi Electric's "High Definition Content Delivery System" are discussed in the following sections.

3.1 Hybrid delivery

This system supports the following three delivery methods. The most appropriate method can be selected depending on the application.

(1) Stored delivery method

This method is used for the images such as advertising or store promotion videos, which do not need frequent changes. These video images are delivered in advance when network traffic is low and stored as files in the display terminal.

(2) Stream delivery method

For immediate video images such as live coverage of an event and emergency broadcasting, input images are sequentially encoded, delivered in a stream, and displayed.

(3) Real time delivery

Video images of news and weather forecasts are generally created using text information. Such text information alone is delivered to each terminal as needed, and the image is created in real time by the terminal to display continually changing information without delay.

3.2 Distributed delivery method

With the conventional method, when high definition visual content was delivered to multiple terminals, the large file sizes made it difficult to deliver the data within a practical time.

To improve the system performance, the distributed delivery method has been developed as shown in Figure 4. With this method, when each terminal receives an image from the server, it re-delivers the image to other terminals, reducing the delivery time to just one-fifth upto one-tenth of the conventional method.

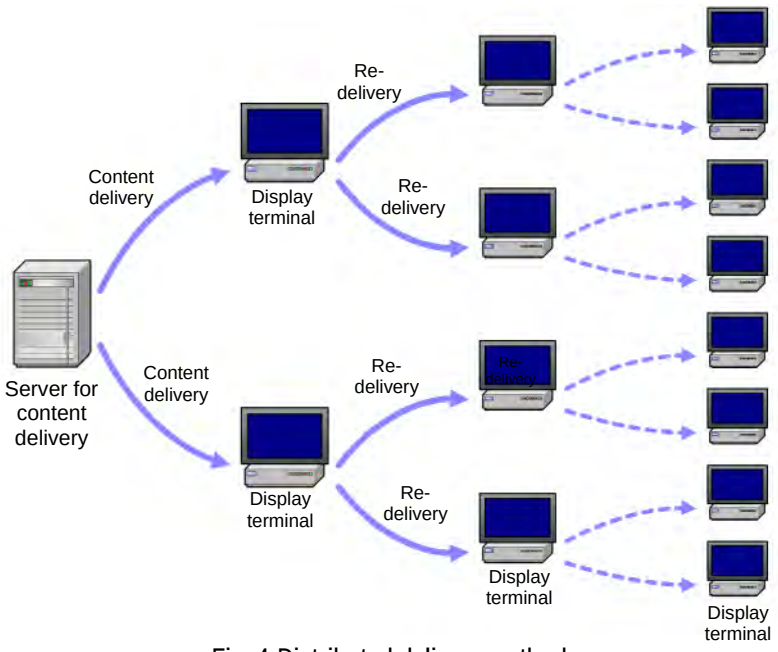


Fig. 4 Distributed delivery method

3.3 Example of system configuration

Figure 5 shows an example configuration of this system. The center system consists of a delivery control server, an editing terminal, a stream server and other devices. (The delivery control server performs overall system control, storage and delivery of contents, etc.; the editing terminal registers and edits contents; and the stream server performs the stream delivery of video images.) Concerning the display systems, Display terminals are connected over the network to the center system, and display the contents according to the schedule delivered from the center system.

Using the technologies introduced in this paper, Mitsubishi Electric will persistently provide better services in existing fields and develop new markets.

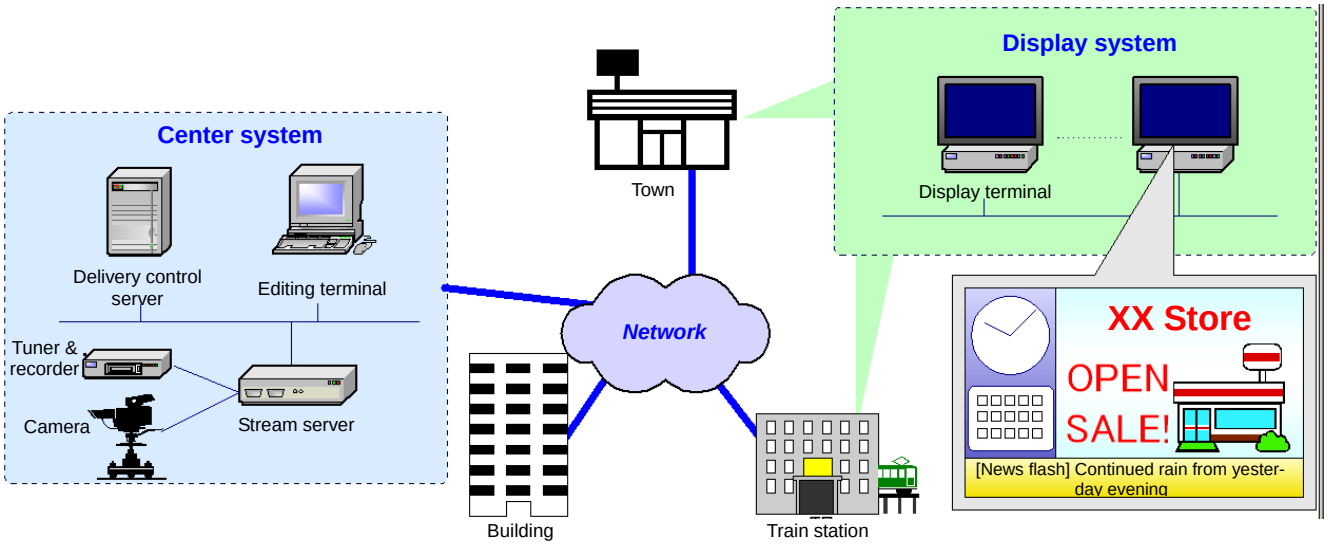


Fig. 5 Example of high-definition content delivery system

Resolia™, a Pre-packaged LED Display for Indoor Use

Author: *Shin'ya Iio**

1. Introduction

Resolia™ is a pre-packaged LED display system for indoor use, with a pixel pitch of 4 mm and standardized screen size of 140 inches. This product is designed and developed to take advantage of the LED system as well as offer versatile installation due to the thin structure, reduced labor by an integrated structure, and offer flexible styles of installation.

As high-definition television (HDTV) spreads, large LED video displays are being used for high-resolution high-definition screens. Even for a relatively small indoor screen of less than 150 inches, high-density arrangement of LED elements will soon result in high-resolution screens.

With this background, Mitsubishi Electric has developed a new large LED-type video display, the Resolia™ series, which has a narrow LED pixel pitch of 4 mm and fixed screen size of 140 inches (Figure 1).

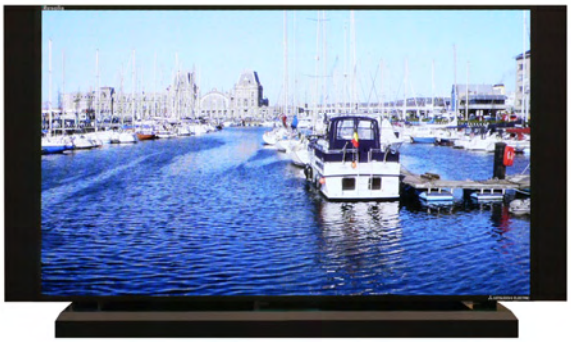
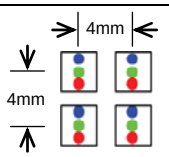


Fig. 1 Resolia™ screen outline

The key specifications of Resolia™ are listed in Table 1. Although the resolution is less than that of "true high vision," the LED elements are more densely packed than Mitsubishi Electric's conventional LED displays. As a result, even though the 140-inch screen is relatively small for an LED-type display, it appears to have a high-definition quality level. In addition, the appearance is excellent even when viewed from approx. 3 m, for the same reason. These features expand the potential applications and markets to include shopping malls, presentation rooms in company buildings, and information display panels for stockbrokers, where conventional LED displays were not competitive due to their size, resolution, or viewing distance.

Compared to other display systems (projection type multi-vision and large LCD/PDP systems), the advantages of the LED system include: (1) brightness with a high luminance, (2) high reliability and long service life, and (3) clear video images without reflection or burning, etc. In addition, the following three features were considered when designing the Resolia™ to make it competitive with other systems.

Table 1 Resolia™ specifications

Method	3 in 1 LED
Pixel configuration	
Pixel pitch	4.0 mm
Density	62,500 pixels/m^2
Maximum brightness	1,500 cd/m^2
Gray scale	4096 steps for each color
Brightness setting	64 levels
Maintenance	Front service
Viewing angle	H: 150 V: 120
Input power	200–240 VAC, 2 wire single phase +G, 50/60 Hz, 8.0 kVA
Life time	50,000 hrs (brightness reduced by half)
Screen size	W 3072 × H 1792 pixels
Resolution	W 768 × H 448 pixels
Outline	W 3550 × H 1872 × D 150 mm
Average power consumption	4.8 kW (when showing a video at 50% brightness)
Mass	380 kg (main body only)

2. Versatile Installation by Thin 150-mm Structure

By reviewing the layout of the internal components and optimizing their arrangement, the depth is reduced while maintaining the cooling efficiency (150 mm: half of the conventional Mitsubishi Electric product). In addition, all maintenance can be performed from the front. As a result, the display unit can now be installed within ex-

**Nagasaki Works*

isting structures where there is little rear space, in shallow show windows, and other places where installation was difficult.

3. Labor-saving by Integrated Structure

The display screen is integrated, making installation work much simpler: total setup time can be reduced by maximum of up to 50% from that of conventional products. For cases where an integrated unit cannot be installed such as due to narrow passageways, an option is available to deliver a display unit in two parts, divided into the left and right halves.

4. Flexible Installation Styles

The display can be inclined when installed at a high position, and can be installed in the following 3 styles depending on the place and application: (1) hung freely, (2) hung on a wall, or (3) self-standing. Mitsubishi Electric's Industrial Design Center created a cabinet design that is ideal anywhere and for any application (Figure 2). Moreover, optional brackets are available to assist each installation method, making the work a simple device.

Fig. 2 Resolia™ outline design

Mitsubishi Electric has long been developing, designing, and producing large-screen video systems under the brand name of Diamond Vision™. Through this experience, the company has developed proprietary control and signal processing technologies including element-by-element brightness adjustment/color conversion, and display control. These technologies are also implemented in Resolia™ to deliver high-quality video images.

As high-quality video sources are increasing with the spread of digital broadcasting, it is anticipated that the public display market will require large-screen display systems that are easy to operate like a PC monitor and high-video quality. We intend to expand our business by penetrating markets where other display systems have dominated because of bright ambient light, long time operation, etc.

Display Wall System

Authors: *Toshiya Iwanaga*, Shigenori Shibue** and *Toshiki Yamabe**

1. Introduction

We have been developing display units and systems to meet demands for higher resolutions, larger screens and more compact display wall systems. This paper introduces the state-of-the-art technologies of display units and display wall controllers for display systems

2. Features of the Product

2.1 Higher reliability

Surveillance systems must be easy to use and work reliably and incessantly for five to ten years.

(1) Image sticking resistance

We use Digital Light Processing (DLP®)[1)] as the imaging device to avoid burn-in effect. DLP® is a light modulation device that consists of just over 10 μm fine mirrors, which achieves high burn-in resistance throughout the operation in an appropriate temperature.

(2) Fast lamp changer

The industry's first automatic lamp changer system enables continuous operation with two lamps. The latest fast auto-lamp changer achieves fast image output just in a few seconds after a lamp blowout.

2.2 Higher performance

In a large surveillance and display system, uneven pictures tend to appear on the screens. Accurate adjustment of brightness and color in individual display units is necessary. The main technology to satisfy this requirement is Color Space Control (CSC).

Figure 1 shows video image before and after the CSC correction.

A) Before CSC correction B) After CSC correction

Fig. 1 Image before and after CSC correction

2.3 Smart lamp systems

The smart lamp system incorporates the following functions to suppress brightness deterioration on screens due to lamp aging and to facilitate maintenance:

(1) New brightness sensor feedback

(2) Automatic brightness and chromaticity correction at lamp and color wheel replacement

2.4 Space saving

We have commercialized front accessible display units that can be maintained from the front and be installed against the wall. It can consequently save spaces, in particular, in small surveillance systems.

2.5 Installation and adjustment properties

6-axis adjusters ensure accurate adjustment of the positional relationship between the optical engine and screen. Electrical 6-axis adjusters have enabled the adjustment with remote control, although conventional 6-axis adjustment was done manually.

2.6 Screen

As a diffusion material for screens, a rare-earth metal is used to improve the viewing angle and to reduce color shift. Figure 2 compares the color shift characteristics between our screen and general screens.

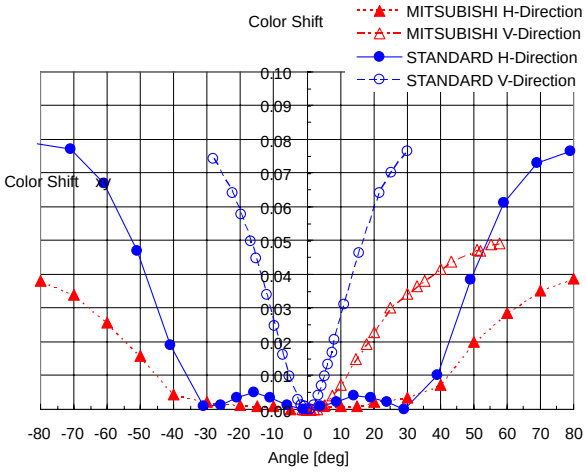


Fig. 2 Color shift characteristic

1) DLP (Digital Light Processing) is a registration symbol of Texas Instruments, Inc.

*Kyoto Works

3. Solution as System

In the display wall system, display wall controllers that process the display images is important as well as the display unit itself. This section describes VC-MK3000 and VC-X3000, which are currently commercially available.

3.1 VC-MK3000

The VC-MK3000 can take 32 RGB and video inputs to overlay 4 windows per screen on 16 screens in any sizes at any positions with high image quality in real time. Using multiple VC-MK3000s enable to output up to 80 screens.

3.2 VC-X3000

The VC-X3000 is a PC-based wall controller; it enables to display images on up to 24 screens, and can take 48 video inputs to overlay 16 windows per screen. It also has power, fans and hard drives (HDD) redundancy functions as well as a system monitoring function for improved reliability. Figure 3 shows an example of a display wall system configuration using the VC-MK3000 and VC-X3000.

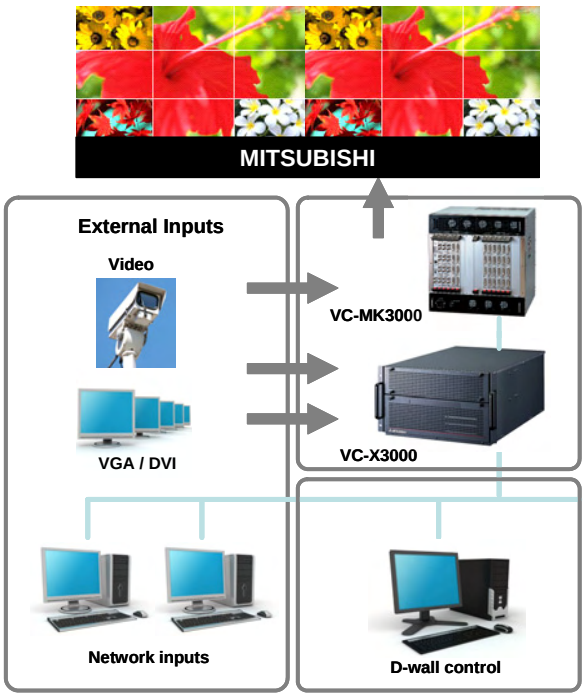


Fig. 3 Example of wall display system configuration

3.3 Integrated control software

In the display wall controllers, not only hardware but also the software is important. Figure 4 shows a screen image of the wall control software "D-WALL Control."

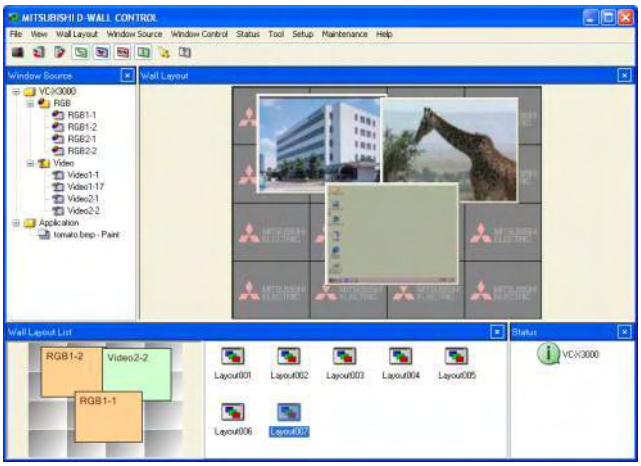


Fig. 4 Control software screen

This software is designed for ease of use and reliability, and can control the VC-MK3000 and VC-X3000 together; it is structured to eliminate the need to know the hardware. A tree structure lists show input image signals which can be dragged and dropped on the display screen area to be displayed. The image sizes, positions, quality, etc. can be adjusted in the control software.

4. Conclusion

We will continue developing user-oriented products to increase customer satisfaction by enhancing the performance, reliability and functionality.

Energy Solution Technologies for Energy-saving Society

Authors: *Yoshio Izui*, Kazuyuki Mori** and *Yasuhiro Kojima**

1. Introduction

The prevention of global warming is an urgent issue. This paper describes the development of energy solutions that fully utilize optimization technologies, that is, energy-saving technologies for large-, medium- and small-size buildings, energy-saving technologies for large factories, and optimum microgrid operation control technology.

2. Technologies for Energy-saving Solutions for Buildings

2.1 Energy-saving technology by optimizing air conditioning in large-size building

We are developing a building energy management system (BEMS) for a large-size building with a total floor space exceeding 10,000 m^2, which is equivalent to a designated energy management factory.

This section describes the air conditioner central control system[(1)] consisting of multiple facilities, and optimizing the total operation, connecting a central heat source to air conditioners respectively. The control system incorporates multiple local controls from a broader perspective to minimize the energy consumption of the entire air conditioner system. Figure 1 illustrates the central air conditioner system, featuring the above operation, and its constituent facilities managed by the central control system. It also shows the results of simulations performed on the actual building data. This system models the air conditioner system as shown in the figure, and then applies an optimization algorithm called PSO (Particle Swarm Optimization) to obtain setting values for the central control. The simulation results indicate that the central control system reduces the energy by about 28% compared with existing local controls.

2.2 Energy-saving Services for Medium- and Small-size Buildings

We are working on a system development of energy-saving service in the way of "remote monitoring system," for medium- and small-size buildings with a total floor space of less than approx. 7,000 m^2 where energy saving is not heavily promoted. As illustrated in Figure 2, this service is provided from the central information center to medium- and small-size buildings at remote locations. The center collects data on power consumption from the remote buildings and issues a monthly energy analysis report to assist energy-saving activities at those buildings. In the energy analysis report, energy consumption amount is analyzed from various aspects such as a comparison with other buildings, comparison with past data, and correlation with temperature, etc. Also in the report, electric power consumption is predicted for the next month based on the seasonal forecast. This service started in April 2008.

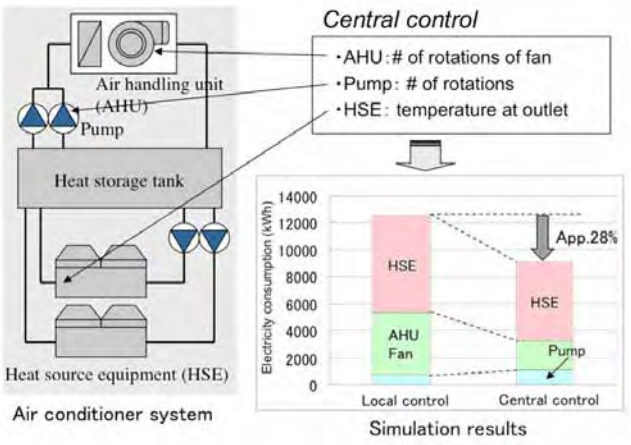


Fig. 1 Central control for air conditioner system

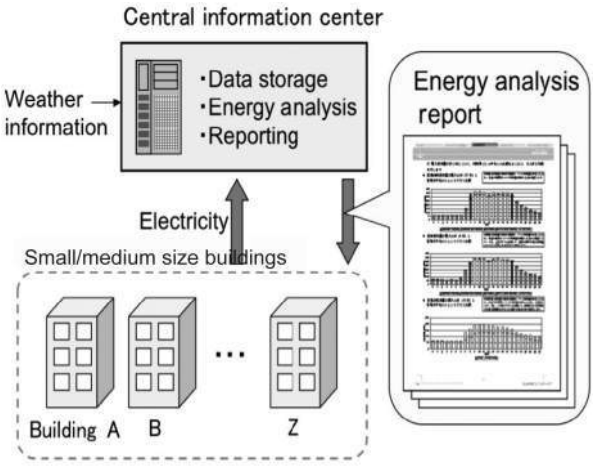


Fig. 2 Energy report service system

*Advanced Technology R&D Center

3. Technologies for Factory Energy-saving Solutions

3.1 Background of introducing FEMS

In factories' assembly lines such as paper mills and oil refineries where a large amount of thermal and electric energy is consumed, the annual energy cost (hereafter simply called "the cost") may exceed several billion yen. Thus, it is important to reduce this cost, which has led to the introduction of FEMS (Factory EMS) as illustrated in Figure 3.

3.2 Multi-objective optimization technology for factory energy management system

In addition to cost reduction, FEMS is recently required to simultaneously reduce the energy consumption and CO_2 emissions. In the daytime, although in-house power generation with coal is more cost effective than commercial electricity, it increases CO_2 emissions, so there is a conflict between the two objectives of reducing the cost and reducing energy consumption and CO_2 emissions (trade-off relation). It is very difficult to determine which objective should have higher priority.

Therefore, we have developed an improved version of Multi-Objective Particle Swarm Optimization (MOPSO)[2] that efficiently finds various optimum solution sets. With this method, various "Pareto" optimum points can be simultaneously obtained. The operation planner need not weigh up the objectives in advance, and thus MOPSO can easily be used for FEMS. We have also developed a method that predicts the effect of introducing FEMS, and have confirmed that the prediction error can be reduced below 1/10 of that of the conventional multi regression analysis.

4. Microgrid Solution Technology

4.1 Background of introducing microgrid

Recently, the introduction of renewable energy systems such as photovoltaic systems and wind farm systems is accelerating. However, these power sources are easily influenced by the weather, and so could have a negative impact on the grid operation if a large number of them are introduced. Consequently, attention is focused on the "microgrid," which consists of renewable energy systems, electricity and heat demands, and other multiple distributed energy resources (including cogeneration and storage facility systems).

4.2 Optimum Microgrid Operation Control Technology

Our target is to control the supply and demand balance within the microgrid, while considering the power quality and optimizing the economic and environmental metrics, such as the cost and CO_2 emissions. To achieve this target, we have to design each control function with an appropriate time resolution for the characteristics of the corresponding issue. We have been participating in the "Hachinohe City Micro-grid Project," which is one of the "Demonstration Projects for Regional Centralized Power Grids with Various New Energies," sponsored by the New Energy and Industrial Technology Development Organization (NEDO). In this project, we have developed and conducted a demonstration test of the four-levels of supply-demand control system shown in Figure 4, which achieves both optimum control and power quality[3].

We have analyzed the operational data from November 2005 to July 2007. The results show that the energy consumption and CO_2 emissions were reduced by 71.3% and 68.9%, respectively compared to those before the microgrid was introduced. Regarding the power quality in terms of the power fluctuation at the interconnection point between the microgrid and the commercial system, the 6-minute moving average error was controlled within 3% and the remaining rate was 99.98%. These results confirmed the effective use of renewable and other new energy sources. In addition, from November 3 to 10, 2007, we conducted an isolated operation control test on private distributed lines. In this test, the city hall and six other users successfully maintained normal operation after being isolated from the commercial system.

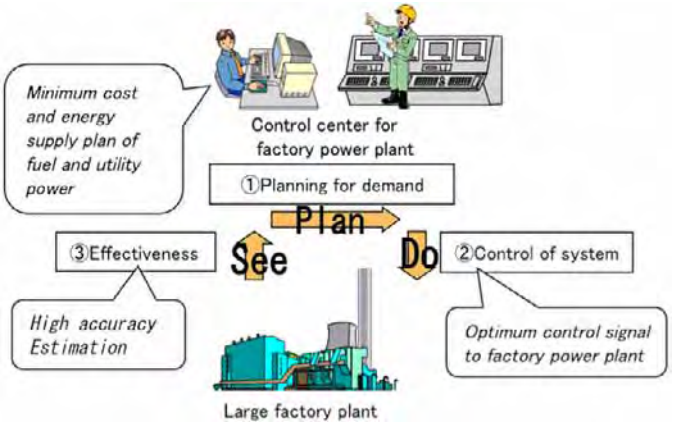


Fig. 3 PDS (Plan/Do/See) flowchart for FEMS

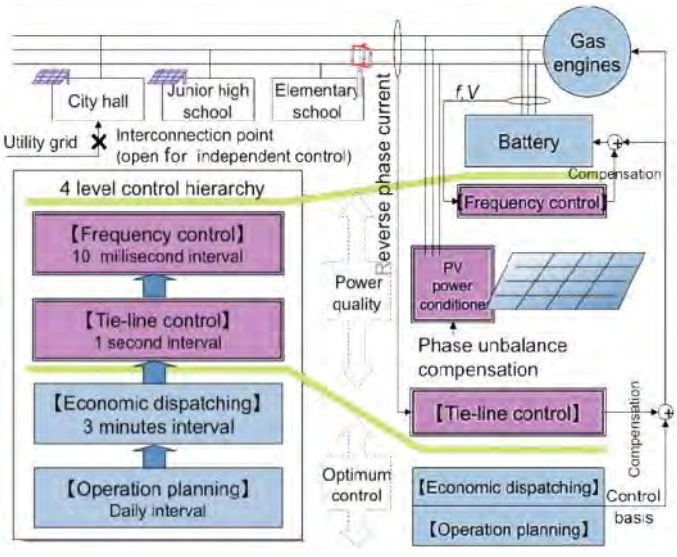


Fig. 4 Four-level control hierarchy with quality control

5. Conclusion

We will continue to improve our optimization technologies and system control technology embedded in high-efficiency energy equipment used in buildings, factories and microgrid systems.

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Power Electronics for Conserving Energy

Author: *Takeshi Oi* , Kenro Mitsuda** and *Masato Koyama***

1. Introduction

The main target of power electronics is energy conservation. When the motor driving method was changed from constant-speed operation using a commercial power source to variable-speed driving, mechanical and electric losses were significantly reduced. Power electronics were first introduced for power generation, transmission and transformation, and have since expanded to electric railroads, industrial use, home appliances, and now hybrid-electric vehicles (HEV).

Regarding using power electronics to conserve energy, this paper introduces power devices as the key components of power electronics equipment; the power capacitor which is expected as power storage device; and the energy-saving technologies for motor control.

2. Power Devices

Power devices have greatly contributed to the development of power electronics. For 600 V or higher class applications, the insulated gate bipolar transistor (IGBT) is the main device. Since it was first developed in the 1980s, IGBT has made remarkable progress. The power loss of the 5th generation IGBT inverter is just 33% of that of the first generation (Figure 1). The IGBT has accelerated the use of inverters in home appliances such as air conditioners and refrigerators, greatly contributing to energy conservation. Meanwhile, as the new IGBTs with a higher withstand voltage became available, they began to be used for electric railroad applications, rapidly replacing the gate turn-off (GTO) thyristors. As a result, "snubbers," which incur high power losses, were no longer needed. The elimination of snubbers and other improvements have significantly reduced the converter loss, and equipment size and weight.

As IGBTs have dramatically evolved, their features have gradually reached the upper limit of improvement, and thus silicon carbide (SiC) is expected to replace silicon (Si) as the new device material. SiC has an insulating breakdown strength about 10 times greater than Si. This feature allows, for example, a 1,200 V class MOSFET device having an on-voltage lower than that of the Si IGBT, significantly reducing a large switching loss intrinsic to bipolar devices such as IGBTs. Although the development of SiC devices is still at the research stage, an on-resistance of 5 mΩ cm^2 has been achieved with a MOSFET having a withstand voltage of 1,200 V. We have also experimentally made a 400 V range 3.7-kW class inverter (Figure 2) and demonstrated a 50% power loss reduction relative to Si-IGBT type inverters.

3. Power Capacitor

As shown in Figure 3, in terms of output power density (instantaneous force), the capacitor is superior to batteries but inferior to condensers. But in terms of energy density (enduring force), it is superior to condensers but inferior to batteries; that is, it has intermediate characteristics.

As shown in Figure 4, the instantaneous and enduring forces of the capacitor changes depending on the thickness of its electrode. If the electrode thickness is increased, the internal resistance during instantaneous charging or discharging increases, resulting in lower charging or discharging efficiency and higher heat generation. On the contrary, a thinner electrode increases the instantaneous force, resulting in higher charging or discharging efficiency; whereas the enduring force is low unless many layers are stacked, and

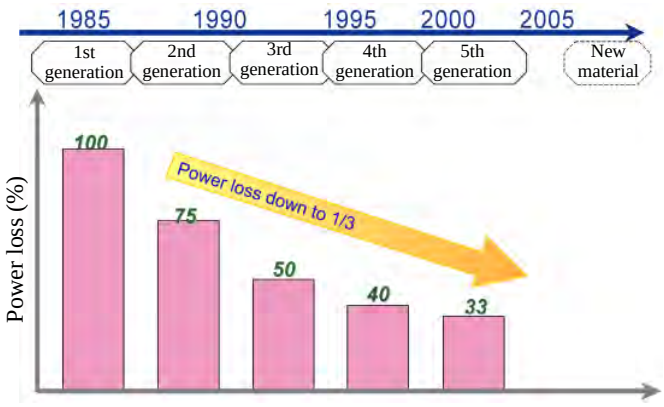

Fig. 1 Change in the power loss of IGBT

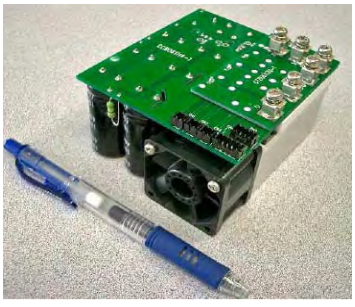

Fig. 2 3.7-kW class SiC inverter

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charging or discharging for a long time is not possible.

Consequently, we have examined the internal resistance of a hybrid capacitor, combining instantaneous type cells having an electrode thickness of 0.1 mm and enduring type cells of 0.4 mm (Figure 5), inside the same capacitor-cell. The internal resistance (of the hybrid capacitor), as shown in Figure 6, remains low for a short discharge time, indicating that the instantaneous type cells contribute to the output for a short charge & discharge time, and the enduring type cells to a long discharge time.

4. Energy Conservation Technologies for Motor Drive

Inverter controlled motor drive has been attracting attention as a key technology due to its high efficiency in the energy conservation. In recent years, as inverter control has become a technology of higher performance, more sophisticated, a more efficient motor driving technology has evolved.

A permanent magnet motor has high motor efficiency and generates almost no rotor loss, providing good energy conservation characteristics. An interior permanent magnet (IPM) motor, mounted in the interior rotor, uses a "reluctance torque" to improve the efficiency, furthermore.

Using above technology, Mitsubishi Electric has developed and produces the MM-EF series IPM motors along with their driver units, the FREQROL-FP series, for fan and pump applications[2]. Figure 7 shows the graphic comparison chart of Mitsubishi Electric's induction motors and the abovementioned IPM motors in terms of their motor efficiency at the rated output. For any motor capacity, the IPM motor provides better efficiency, more than 5%.

To drive a permanent magnet motor, information about the rotor's position is required. The "sensorless vector control method" drives a permanent magnet motor without using any position sensor. Figure 8 indicates the block diagram of this control method. Using an adaptive magnetic flux observer, the rotor's speed is estimated from the motor current and voltage. Vector control is then carried out based on this estimated speed.

Mitsubishi Electric has also developed and commercialized an optimum excitation controller for maximum efficiency control to improve the efficiency of induction motors. With this controller, the motor is always operated at the maximum efficiency point by controlling the excitation current loss and the torque

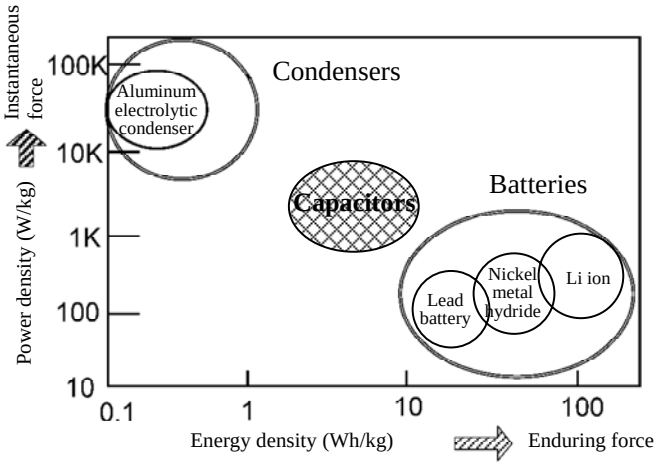

Fig. 3 Comparison of instantaneous force and enduring force

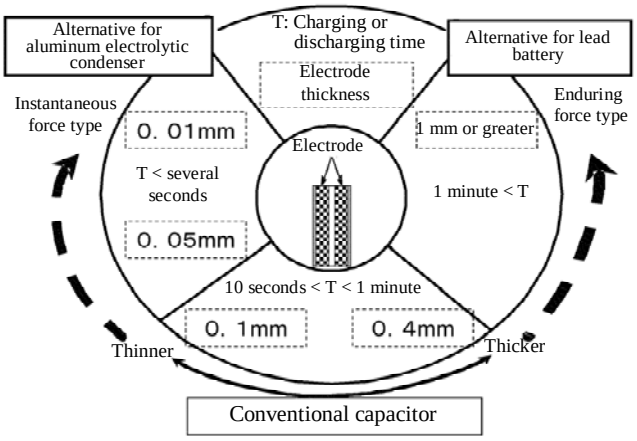

Fig. 4 Relationship between electrode thickness and instantaneous/enduring force of capacitors

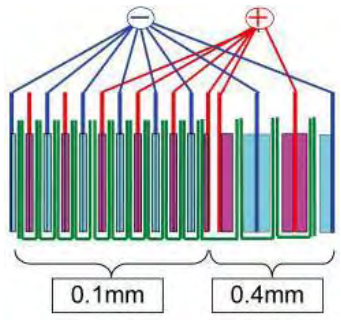

Fig. 5 Hybrid capacitors with multiple electrode thicknesses

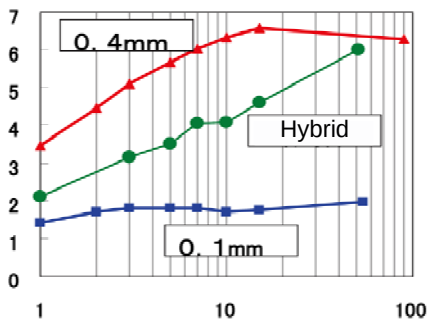

Fig. 6 Dependency of internal resistance on the discharge time and electrode thickness(1)

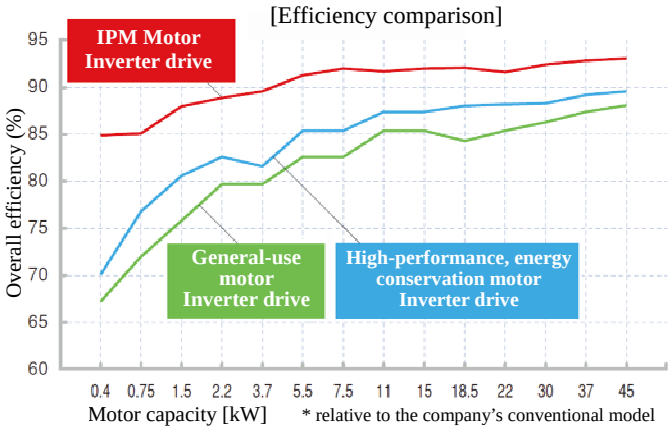

Fig. 7 Efficiency comparison between permanent magnet motors and induction motors

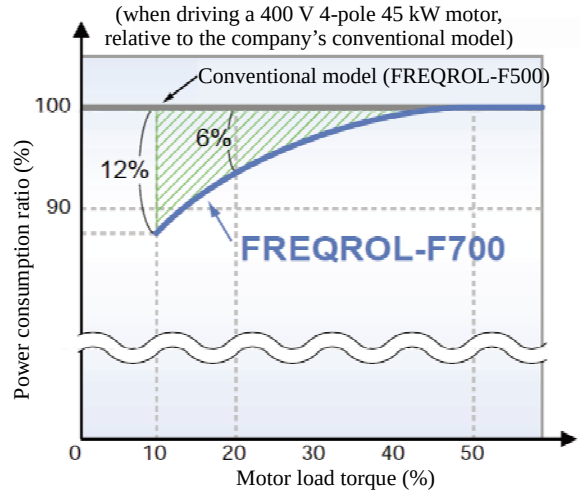

Fig. 9 Example of power consumption of motor during acceleration/deceleration

current loss, particularly during light load operation. With the new fan and pump inverter FR-F700, this control can be operated even during accelerating and decelerating operation, further improving the energy conservation effect (Figure 9).

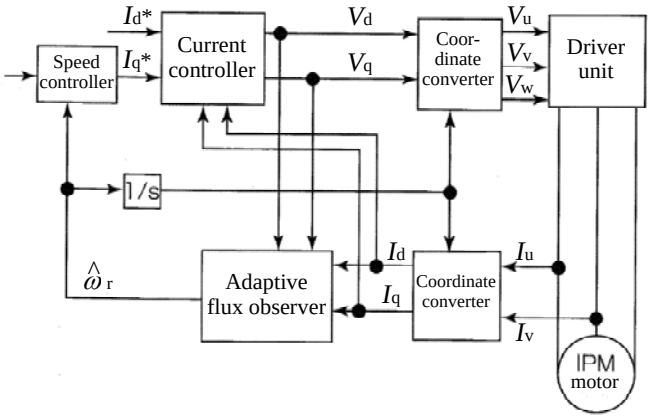

Fig. 8 Configuration of sensorless vector control for IPM motor

5. Conclusion

This paper discussed Mitsubishi Electric's work on power devices, power capacitors, and motor drive technologies. Since power electronics is an important energy conservation technology, the needs and applications are expected to expand.

In response, we will integrate our technologies to develop new technologies and products.

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Solutions for Advanced Cities by Mitsubishi Electric Corporation

Author: *Tsutomu Kayama**

1. Introduction

The Japanese government has drawn up a regional activation scenario and policies for reinvigorating cities such as a compact city initiative and central city revitalization. In addition, to counter global warming by reducing CO_2 emissions in a low-carbon society, renewable energies and energy conservation measures are needed to be taken for further promotion.

This paper describes "AdvanCity," a solution for redeveloping cities to address these social issues.

2. Creating Flows of People and Promoting Activity

2.1 Train & walk

Attracting people into a city is essential to make it active. Since train stations are central hubs of cities, providing train passengers with information is important. Advertisements and traffic information are now frequently displayed on video systems in trains, using Mitsubishi's train vision system. Passengers on the train can read information about events and bargain sales in the city, and when they get off the train at a station, interactive digital signage await them. This enables the search and acquisition of various information items such as visitor and map information inside/outside the station. Inside buildings and cities, the "video delivery system" can deliver multiple sources such as digital high-definition video to the multi-display units.

2.2 Park & ride

ITS technologies for the next-generation car-oriented society have yielded outcomes in pilot programs conducted by national agencies and various organizations. The time has come to deploy the technology in an actual city.

When we enter a city after automatic adjustment of expressway tolls with an Electronic Toll Collection (ETC)[1)]-equipped car, we can also make automatic payments at parking lots, filling stations and fast-food restaurants. To boost traffic safety, demonstration tests for the system of delivering safety-related information from the ground to vehicles are underway, such as the system for preventing accidents at intersections, that uses Dedicated Short Range Communication (DSRC)[2] system. By Mar., 2010, we intend to mass-produce and sell next-generation car-mounted extended ETC system (car-mounted ITS system), which enables information delivery in a city and various services such as detour guide information for relieving traffic congestion and providing visitor information and information about events at commercial facilities, etc.

The DSRC communication antennas as the ITS infrastructure are installed in a city to achieve a traffic "DSRC town" (Figure 1).

3. Safe Space for Anybody to Relax with Peace of Mind

3.1 Building security

Since people have recently tended to center on state-of-the-art large buildings, establishment of advanced safety by installing the integrated security system "DIGUARD" has been required. "DIGUARD NET," which uses the optical IP network in the building as its backbone, ensures integrated linkage by combining surveillance cameras, security gates, information security and access log management. In our head office building, the Suica[3)] card was introduced for employee ID cards for the first time in Japan and interlocked with access gates, access control on floors, information security at offices and office machines.

3.2 Town security

Safety of city areas and regions requires a system that transmits the signals from the various sensors that detect intruders and video signals with sensor functions by performing image processing of videos on the surveillance cameras to the security center at high speed via the optical IP network and monitors the areas and regions in real time.

1) ETC is a registered trademark of the Organization for Road System Enhancement.

2) DSRC is the bi-directional radio communication technology which achieves high-speed communication of about 4 megabits per second within a specific spot at a communication distance of several tens of meters to few hundred meters.

3) Suica is a registered trademark of East Japan Railway Company.

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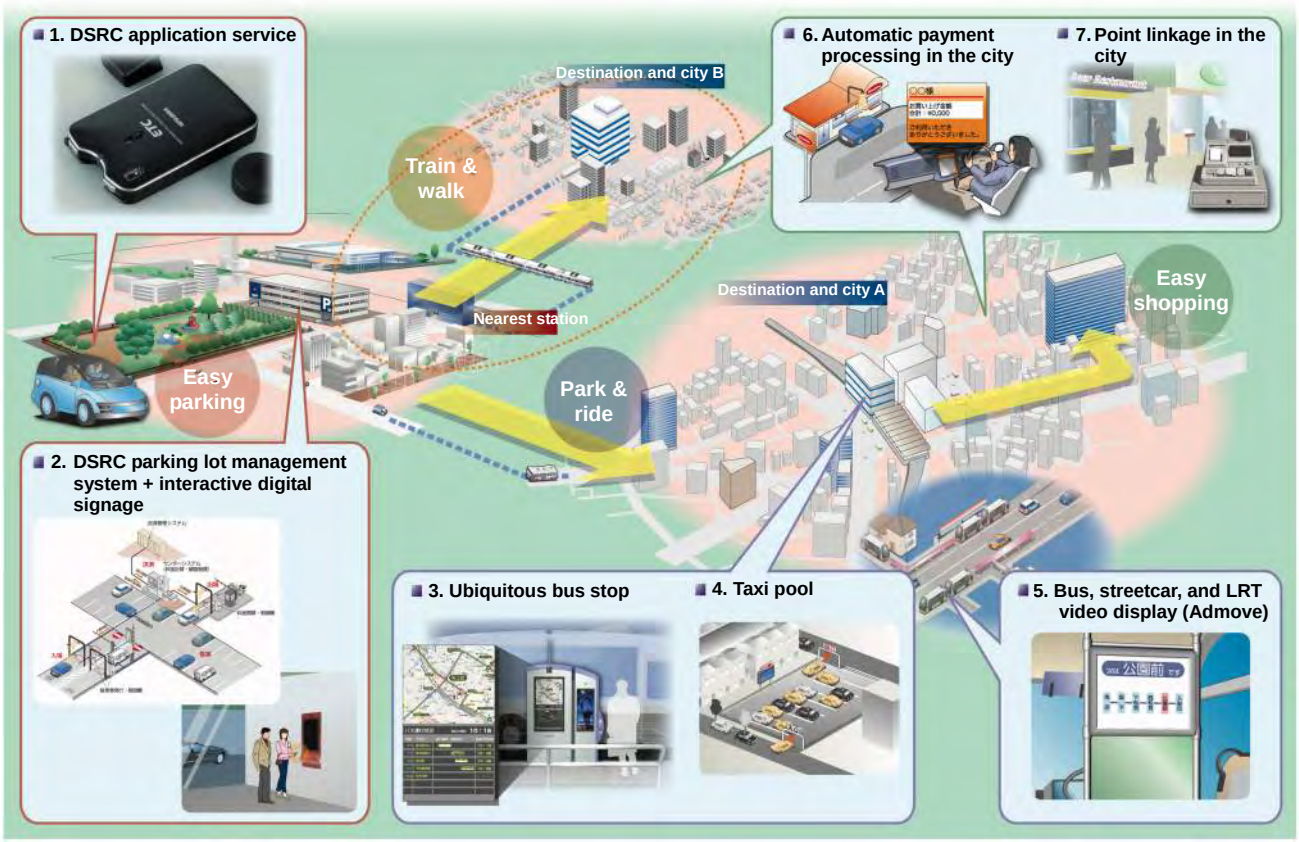

Fig. 1 DSRC Town

4. Environmentally-friendly, Sustainable City Development (Eco Town)

Technologies to achieve environmental friendliness and energy saving are essential themes to address social issues. To achieve a low-carbon society, the following measures has to be taken as needed, when constructing new buildings:

(1) To adopt the industry's leading energy-saving equipment
(2) To accomplish energy-saving management using the Building Energy Management System (BEMS)
(3) To achieve Town Energy Management System (TEMS) in buildings
(4) To apply renewable energy (photovoltaic generation system, etc.)

These measures reduce CO_2 emissions in the entire city. The leading energy-saving devices are connected via the IP network in the buildings to achieve BEMS. For energy management, functions are used to "visualize" the values measured by various sensors and air-conditioning and lighting control status of rooms where people stay (making the current use status easier to understand) and enable employees to prolong facility operation and change the temperature, etc. from the web page on their office personal computers; and then, these functions come into wide use.

5. Infrastructure to Support Social Ubiquitousness

5.1 Network infrastructure

The core component of the network infrastructure for AdvanCity is an optical IP network.

We recommend using the Gigabit Ethernet-Passive Optical Network (GE-PON) adopted by communication carriers and access terminals for the physical layer of the optical IP network to configure a high-speed network.

The IP telephony and mobile environments are provided by combining a wireless local area network (LAN) with this network to allow information communication for multiple uses.

5.2 Town management center

In this system, information about security, video, air conditioning, etc. in buildings is collectively operated and managed in the integrated range of buildings and areas.

The main management center in the range is referred to as the town management center. Its functions include:

(1) Video & voice information contents delivery
(2) Security monitoring
(3) Traffic/electronic money smart card management (automatic adjustment, etc.)
(4) Town Energy Management System (TEMS)

(5) Map-based facility and information management/maintenance operation management

Server groups to process these functions and a data center to accommodate the server groups are necessary. A consortium of regional and private developers is expected to manage the data center.

6. Conclusion

This paper has described that new technological themes covered by each report of this special issue are used for city redevelopment, regional and city revitalization, etc. to create a modern Japan for next generation.

We will ensure that our “city development solutions” meet the expectations as a one-stop contact for customers engaged in city development.


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