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HITACHI
Inspire the Next

Public-sector IT Solutions Supporting Social Infrastructure

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Volume 65 Number 1 March 2016

From the Editor

The use of information technology (IT) has spread to all corners of modern society, having been incorporated into the infrastructure that ensures the reliable functioning of that society. There are growing expectations for the potential of IT to help overcome the challenges facing Japan. Meanwhile, with the increasing quantity of digital information, the handling of this information is giving rise to concerns about the safety and stability of society as a whole. Amid these changing circumstances, public-sector IT solutions support the IT infrastructure of society and encourage ongoing growth.

This issue of *Hitachi Review* describes the role that Hitachi envisages for public-sector IT solutions; the technologies, products, and solutions for achieving this; and examples of work in this field by Hitachi's information and telecommunications divisions. This issue's Expert Insights is an article contributed by Saw Sanda Aye, a Rector at the University of Information Technology, Yangon, about the training of IT staff to facilitate the development of Myanmar. In Technotalk, we invited Hideo Hamashima, a past Counsellor in the Cabinet Secretariat and Kazuo Yoshida, Senior Manager, Industrial Technology Bureau, Japan Business Federation (Keidanren) to discuss the "Declaration to be the World's Most Advanced IT Nation" that was approved by the Cabinet in June 2015 and to provide an overview of the policy on the use of IT as a public management resource and the hopes for the future.

Other articles consider two sought-after aspects in public-sector IT, namely, how IT can be used to put Japan's national policy into practice in initiatives aimed at encouraging Social Innovation, and how systems are being made more convenient and reliable in initiatives aimed at contributing to social stability.

I hope that this issue of *Hitachi Review* will prove useful to you in your work by giving you an appreciation of our activities in the field of public-sector IT solutions.

Editorial Coordinator,
"Public-sector IT Solutions Supporting Social Infrastructure" Issue

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Vice President
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Public-sector IT Solutions Supporting Social Infrastructure

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Public-sector IT Solutions Supporting Social Infrastructure

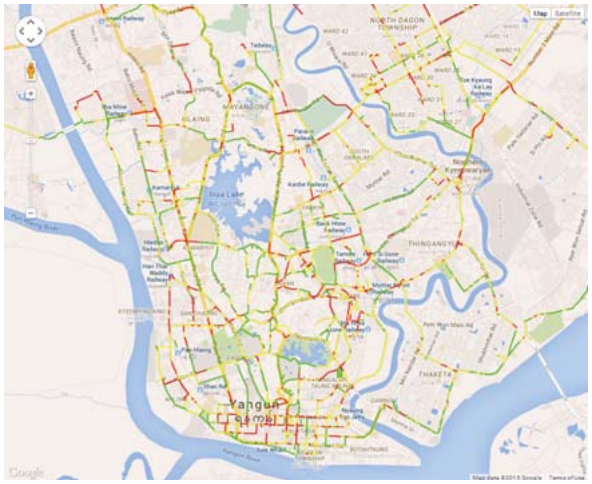
From social infrastructure to the various devices that surround us, information technology (IT) has become an important part of our world.
IT is steadily finding its way into all corners of public and private life, including the provision of IT services that incorporate wearable devices and other such technologies.
On the other hand, this spread of IT is also giving rise to issues with major social consequences, such as problems with security and privacy.
Hitachi's public-sector IT solutions seek to use IT to further enhance the quality of the public services that underpin the functioning of society.
By supporting the realization of a society that combines security and safety with convenience and efficiency, Hitachi is contributing to Social Innovation.


Providing public services based on the use of data (image)

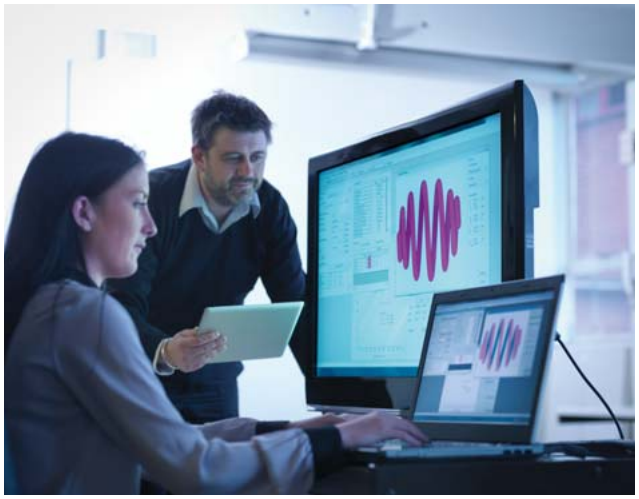

Action to facilitate the utilization of the information infrastructure through coordination of information (image)

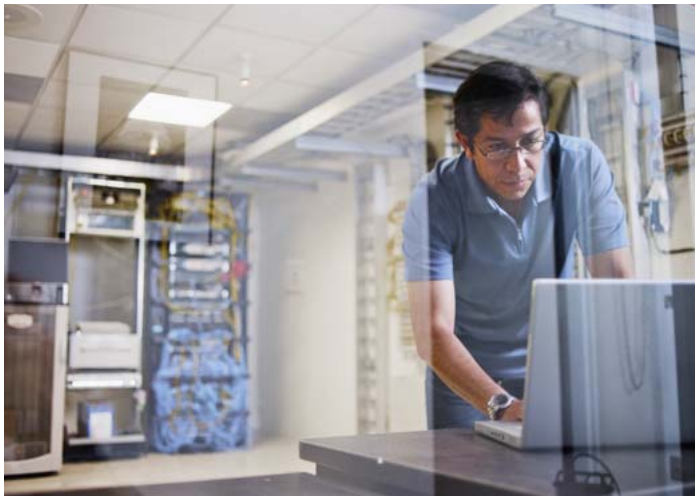
Services to support long-term and stable system operation [image (right)]

Initiatives that promote the use of digital technology in education [image (left)]



Solutions to solve the problems of social infrastructure, such as road transportation [image (right)]





Security measures and services for sharing information between organizations (image)

Expert Insights

Social Infrastructure and ICT Development for e-Government

Saw Sanda Aye, Ph.D.
Rector
University of Information Technology, Yangon, Myanmar

Graduated with Bachelor of Computer Science (B.C.Sc) degree at University of Computer Studies, Yangon (UCSY) in 1994, and gained a Master of Computer Science degree from the same institute in 1997. Gained her Ph.D. from Japan Advanced Institute of Science and Technology (JAIST), Japan in 2008, majoring in Software Engineering.
Graduating, in 1997, worked at the University of Computer Studies, Yangon (UCSY). After finishing her Ph.D. at JAIST, continued working as a professor at UCSY teaching undergraduate and post-graduate students, and supervising Master's and Ph.D. candidates.
Appointed Deputy Director General of the Department of Advanced Science and Technology in May 2012, and took up her current position as Rector of the University of Information Technology, Yangon, Myanmar in May 2015.
In addition to attending as JAIST a Ph.D. candidate, other international experience includes positions as conference organizing committee member of the International Conference on Computer Applications (ICCA), International Conference on Energy, Environment and Human Engineering (ICEEHE).
Her research interests are in Software Engineering, especially Software Development Models, Software Process, and Software Development Environments for Distributed Cooperative Work; and Database Management Systems.

Myanmar started an e-government project as a part of ASEAN's (ASEAN: Association of Southeast Asian Nations) 1999-2004 action plan focused on services to help businesses connect online in the public sector, and to promote electronic government, or e-government. Through the collaboration of Korea International Cooperation Agency (KOICA), Korea Information Society Development Institute (KISDI) and the e-National Task force (Myanmar), the "Myanmar ICT development Master Plan" was launched in 2005, but it was not endorsed by the government.

On the occasion of the Republic of Union Myanmar's 65th Anniversary of the Union Day, 12 February 2012, President Thein Sein stated that his government is focusing on clean government and good governance in building the nation. To build a successful establishment of a modern developed and democratic new nation, the government called for the combination of democracy with good governance. In order to enable joint cooperation to boost the modernization of the nation and the socio-economic improvement of the Myanmar people, information and communication technology (ICT) infrastructure is especially important and a driving force to reduce the digital divide, and a prerequisite for e-Government, e-Commerce, e-Education and other fields. The potential for the ICT sector will greatly support the development of other sectors as well. In the 2014-2015 fiscal year, Ministry of Communications and Information Technology (MCIT) has a plan to do a project on "Creating an e-Government Master Plan for the government" funded by Asian Development Bank (ADB). There is no proper structure for ICT departments in governance to support the Chief Information Officer (CIO). As a result, reforming the organization of ICT departments in every government agency and capacity building for human resources is currently critical.

One of the key political priorities of the Myanmar government under the Framework for Economic and Social Reforms is to focus on people-centered development, particularly in the areas of improving education and health, and year by year, the government has increased expenditures on education and health. For ICT education in Myanmar, Computer Universities mainly produce human resources for the ICT sector. Until 1998, there had been only two universities, University of Computer Studies, Yangon (UCSY) and University

of Computer Studies, Mandalay (UCSM). There were 25 computer universities across the country in 2003. This rapid growth caused the sharing of faculty members among those universities, recruiting many faculty members without a strict screening process, and insufficient budget, which are vital problems for human resource development in the ICT sector.

To nurture qualified IT engineers, in 2012, the government promoted UCSY and UCSM as COEs (Centers of Excellence) with the aims of recruiting outstanding students and giving them a better learning environment. UCSY (Bahan Campus) has been opened as a COE in Bahan Township, Yangon and starting from 1 April 2015, UCSY (Bahan Campus) was renamed as University of Information Technology (UIT). The Myanmar Institute of Information Technology (MIIT) has also been established in Mandalay as a 5-year collaboration project agreement between India and the Myanmar government. There are now 27 ICT specialized Universities in 2015.

The objectives of the two COEs, UIT and UCSM, are to generate highly qualified ICT graduates, to conduct research in the ICT sector by promoting international collaboration. UIT has a strong collaboration with local and foreign industries and universities. For the Human Resource Development program, UIT also conducts a diploma program in order to nurture IT knowledge for the staff members who are working in the public and private IT sectors. Besides this, a Training the Trainer program is needed at the Universities to become skillful faculties. The “Hitachi COE 2-week Scholarship program” has been offered by Hitachi, Ltd. since 2013. This program supports the five COE faculties to study Hitachi ICT work, ICT policies, management and advanced technologies of Japan, and to visit and study at Japanese universities and software companies. The program helps the faculties with capacity building to meet the objectives of the COEs.

As a latecomer, I hope Myanmar can leap forth over other countries in development by learning from other developed countries. By establishing such kind of HRD program for the ICT sector, successful e-government initiatives in all sectors can have a demonstrable and tangible impact on improving citizen participation and quality of life for the socio-economic development of Myanmar.

Technotalk

Seeking "True Affluence" through Solution-based IT

Hideo Hamashima Former Counsellor of the National Strategy Office of Information and Communications Technology, Cabinet Secretariat

Kazuo Yoshida Senior Manager, Industrial Technology Bureau, Japan Business Federation (Keidanren)

Yoshinori Hosoya Vice President of Government & Public Corporation Information Systems Division, Information & Telecommunication Systems Company, Hitachi, Ltd.

Toshinori Kajiura Senior Researcher, Information & Telecommunication Systems Company, Hitachi, Ltd. and Visiting Professor, University of Tsukuba

The emergence of challenges associated with such social trends as the super-aging of the population has also been accompanied by the rapid advance of digital technology, such that great potential is seen for the use of IT to overcome these challenges and achieve ongoing growth. Prompted by the formulation of a new national IT strategy in 2013, Japan is expediting the establishment of infrastructure for the use of IT in ways that facilitate social reforms. As an active participant in the national IT strategy, Hitachi is working to implement e-government through the supply of a wide variety of IT solutions that support the operation of the public sector. Along with responding to new challenges such as cybersecurity, Hitachi intends to utilize IT to support the creation of a "truly affluent" society.

Underlying Concept of "Declaration to be the World's Most Advanced IT Nation" and e-Government Initiatives

Kajiura: Japan's first national information technology (IT) strategy was the 2001 e-Japan Strategy. In addition to its participation in strategy formulation on a number of occasions through membership of expert examination committees, Hitachi has a deep commitment to national IT strategy that includes such activities as lobbying from an industry standpoint. The new national IT strategy of 2013, the "Declaration to be the World's Most Advanced IT Nation," has now been revised. I would like to start by asking Hideo Hamashima, a Counsellor in the Cabinet Secretariat, to explain the key points of the new national IT strategy.

Hamashima: I will start by speaking about past activities. The "Declaration to be the World's Most Advanced IT Nation" aims to make Japan a world leader in the use of IT and forms part of our growth strategy, the "third arrow" of Prime Minister Shinzo Abe's economic policy known as Abenomics. Drawing on considerations such as a review of the previous national IT strategies, a Government CIO* was appointed in 2013 to coordinate implementation of government

* Government Chief Information Officer (CIO): Responsibilities cover managing investment in IT in all areas of government, funding IT investment by government agencies, and providing strategy and management planning, execution, and coordination in relation to e-government. The National Strategy Office of Information and Communications Technology that supports the Government CIO is staffed by CIO aides from various agencies.

Hideo Hamashima

Former Counsellor of the National Strategy Office of Information and Communications Technology, Cabinet Secretariat

Mr. Hamashima joined the Ministry of Internal Affairs and Communications in 1990. Following positions that included head of the Regional Information Policy Office, he was Counsellor of the National Strategy Office of Information and Communications Technology, Cabinet Secretariat until July 2015 where he was involved in revising the 2015 "Declaration to be the World's Most Advanced IT Nation."

Kazuo Yoshida

Senior Manager Industrial Technology Bureau Japan Business Federation (Keidanren)

Mr. Yoshida joined the Keidanren Secretariat in 1994. He is currently in charge of information and telecommunications policy.

IT policy. The proposed revision, which draws on the results of work done over the two years since then and rapid advances in digital technology, was approved by the 68th session of the Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society on June 30, 2015, and the Cabinet decision was issued on the same day. The session of the Strategic Headquarters was attended in person by almost all Cabinet Ministers, with those Ministers who made submissions expressing their active participation in IT strategy from the perspectives of their respective administrations. I was able to see firsthand that expectations and interest in IT strategy are rising within the government.

Japan is facing the super-aging of its population, with challenges that include a shrinking workforce, rising social security expenses, and the need to deal with the aging of social infrastructure. To achieve ongoing growth in such an environment, it is necessary both to establish IT as an engine for growth and to utilize it as a tool for overcoming these challenges. In practice, during these two years, we were able to build a platform for utilizing IT under the leadership of the Government CIO and with the cooperation of all parties. For example, thanks to measures such as the consolidation of government information systems with reference to operational reforms and their migration to the cloud, we expect to be able to reduce the number of systems by 60% by FY2018. We are also stepping up measures aimed at achieving our target of a 30% cut in operating costs by FY2021.

In the case of the identification (ID) number system, meanwhile, we have concentrated on initiatives that contribute to the use of the system, including collation of the functions and requirements for the My Portal system for providing users with records such as the information they have disclosed. Work is also progressing on establishing the infrastructure for utilizing personal data through amendments to the Act on the Protection of Personal Information. We have also made good progress on open data, expanding data catalogs such that more than 13,000 datasets are now available. These activities have also received international recognition, with Japan having risen from 18th place in 2012 to 6th in 2014 (out of the 193 members of the United Nations) in the e-government rankings of the United Nations Department of Economic and Social Affairs.

The new “Declaration to be the World’s Most Advanced IT Nation” recognizes as one of its core concepts the establishment of a solution-based model of IT use that will set an example for the world through the pursuit of “true affluence.” With the aim of solving problems by utilizing new technologies such as the Internet of things (IoT), we intend to undertake initiatives based on four core policies with a view to utilizing standardization of IT use to make it more general-purpose and enhance its sustainability, and also to encourage innovation in all areas.

The first of these policies seeks to become “a society that grows toward the future through more intensive by utilizing IT” by pressing ahead with e-government, the use of personal data, open data, and establishing the institutional framework for encouraging the adoption of IT at both the national and regional level. To facilitate this new institution-building, we have formulated a basic plan for use of IT that sets out five principles and implementation policies, including making it a prerequisite that electronic processing be used for government data. The second policy seeks to become “a dynamic society that invigorates communities, people, and jobs by utilizing IT.” It aims to promote regional job creation and economic revitalization by sending IT personnel, such as the Government CIO and

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Mr. Hosoya joined Hitachi, Ltd. in 1988 and is currently engaged in business management for public sector IT.

Toshinori Kajiura

Senior Researcher, Information & Telecommunication Systems Company, Hitachi, Ltd. and Visiting Professor, University of Tsukuba

Mr. Kajiura joined Hitachi, Ltd. in 1981 and is currently engaged in IT policy lobbying and business incubation. He is a director of The Japan Society of Information and Communication Research, a director of the Japan Project-Industry Council, and head of the Internet Economy Private Sector Working Group of the Committee on Information and Telecommunication Policy of the Japan Business Federation (Keidanren).

successful practitioners, out to the regions to support information system reform and industrial development as part of a plan to encourage the use of IT for regional development. The third policy seeks to become "a society where people experience safety, security, and prosperity by utilizing IT," including the use of information such as healthcare and medical data for preventive medicine and other forms of health promotion, the use of data to enable sophisticated agricultural practices, and the successful development of fully self-driving vehicles. The fourth policy seeks to become "a society where one-stop public services are available by utilizing IT" through ongoing measures that include the use of the ID number system and the reform of government information systems.

Among the elements underpinning these policies, we are working to develop and train human resources, establish world-leading IT infrastructure, and strengthen cybersecurity at government institutions. The National Center of Incident Readiness and Strategy for Cybersecurity (NISC) is playing a central role in this latter objective. Specifically we are looking at ways of utilizing the savings achieved through improved system efficiency to fund the cost of security countermeasures.

Necessity for Using IT to Build an Affluent and Vibrant Nation that Enjoys Ongoing Growth

Yoshida: In January 2015, the Japan Business Federation (Keidanren) published a new vision document entitled "Toward the Creation of a More Affluent and Vibrant Japan." Under the leadership of Sadayuki Sakakibara, Chairman of the Keidanren, the document looks ahead 15 years to consider what sort of country Japan wants to be in 2030, and the challenges and policies associated with achieving such a vision. Four examples of the nation's aspirations for 2030 are: (1) affluent and vibrant national life, (2) a population of not less than 100 million living in attractive cities and localities, (3) a solid foundation enabling the economy to grow strongly, and (4) contributing to the prosperity of the world by providing solutions to global problems. We believe that the use of IT is essential to achieving a safe, secure, and convenient way of life.

The ID number system is a valuable platform for e-government and social security reform and along with forming part of the infrastructure of a growing nation, we also believe there is a need to come up with ideas for how the private sector can use the system to improve convenience for the public.

Hosoya: Hitachi is involved in developing the information systems that underpin e-government and, as we work with customers on the system implementation of the ID number system in preparation for its launch in January 2016, we are striving to find ways to combine appropriate safeguards for ID numbers with faster interchange of information. We are also supplying not only a solution for supporting the adoption of the ID number system that utilizes encryption and other security techniques to achieve high reliability and security and that covers everything from consulting to system installation, modification, and operation, but also business process outsourcing (BPO) services for ID number system that handle the processes associated with operating the system, from the collection and registration of ID numbers to the printing of official documents such as certificates of income and withholding tax.

For e-government, we are helping to reduce operating costs by adopting solutions that incorporate new technologies such as the cloud and virtualization to enhance both convenience and efficiency without interrupting existing work processes. We see our mission at Hitachi as being to provide support that ensures the continuity of government services while also responding to new challenges, such as cybersecurity, even as the IT infrastructure evolves.

Hamashima: The Keidanren's Sakakibara Vision corresponds to the challenges facing Japan as a whole and to the directions set by the government. Among the initiatives aimed at the use of IT is one for strengthening cybersecurity. We are extremely grateful to see the private sector adding its voice to this issue.

The roles played by local government in government services will likely become much more diverse in the future. Activities such as surveillance that were once the realm of local communities are now being transformed into government services. The use of IT has a lot to offer when considering how to cope with rising workloads amid constrained finances. For this reason, I look forward to an increasing number of IT vendors offering solutions in the field, such as shared use of systems on the cloud, and to local governments engaging in operational reforms in sympathy with this.

Public and Private Infrastructure Building for Use of IT and Data

Kajiura: What sort of contributions can IT make to future growth strategies?

Yoshida: One important area is how to deal with the aging of the population. Examples include automation to make society function more efficiently, implementation of advanced driver assistance systems that are safer and

easier to use, and uses for IT such as telemedicine and other forms of telework that overcome the barriers of distance and time. Another priority is encouragement of the use of public-sector data by industry as highly reliable basic data. There is scope for using big data to enhance society, with an urgent need to provide the frameworks that this will require and to build a national consensus on the subject.

In relation to use of data, the Keidanren is particularly interested in large cross-border flows of data. As skill in the use of data has a direct impact on competitiveness, there is a need to establish international rules and free and fair markets that can lay the foundations for this activity based on an adequate appreciation by both the public and private sectors of the importance of cross-border data flows so that the collection and use of data can take place at a global level to boost innovation.

There is growing interest in the use of personal data and expectations for regulation and rule-making in regard to this that include consideration of factors such as encouraging private-sector use of data, an agile response to technical innovation, and minimizing social costs. On the other hand, companies also need to propose voluntary rules that can overcome the concerns of consumers and achieve a consensus within society.

Given the prospect of further rapid advances in the digital society in the future, there is a need to deepen the discussion of overall system design, including redesigning paper-based practices.

Hosoya: Hitachi's involvement in the solution-based use of IT includes utilizing healthcare data to prevent the worsening of lifestyle disease symptoms, more advanced and efficient agricultural practices utilizing data and remote management, and telework support solutions. We are also working on the development of systems that use technologies such as artificial intelligence and robotics to support the customer-facing activities of local government offices and financial institutions. We see potential for the use of open data in relation to these initiatives. We also hope to see progress on establishing the legal framework to allow the bundling together of useful data from across different institutions, including data such as population statistics or evacuation routes that can be used to overcome challenges.

As we expand our work on social infrastructure overseas through our Social Innovation Business, we are involved not only in the sale of equipment, but also in working with customers to build the institutions of society and the systems that support them, particularly in emerging nations that have yet to fully establish such institutional infrastructure as social security and postal services. Through this business, we are seeking to help overcome societal challenges overseas as well as in Japan.

Hamashima: In regard to the importance of cross-border data flows mentioned by Mr. Yoshida, we are also working on this based on a common understanding of the issues. In the case of open data meanwhile realistic data based on the actual situation is crucial to both the identification of policy issues and the choice of policy, and I believe it is essential that open data plays a part in future policy-making processes.

The ability to offer a package that combines institution-building with the use of IT in markets such as emerging nations is a notable initiative. Just as Japan learned from other countries about the infrastructure of a modern nation, providing assistance that includes institution-building is likely to have a major impact on overseas nations. Moreover, I hope that, by marketing this in conjunction with Japanese industrial technology, we can achieve win-win relationships that benefit both Japan and the nations of the world.

Kajiura: What interested me most of all in the "Declaration to be the World's Most Advanced IT Nation" was the inclusion in a national strategy of the idea of information being a fourth type of business resource along with people, goods, and money. Solid progress has been made on establishing the infrastructure for utilizing information in the activities of Japan during the two years or so following the Declaration, and this has reaffirmed how important close coordination between the public and private sectors is to achieving further progress in the future. Hitachi intends to contribute to society as a whole by further developing its IT solutions for the public sector. Thank you for your time today.

This Technotalk discussion took place during July 2015.

Overview

Public-sector IT Solutions Supporting Progress of Society

Yoshinori Hosoya
Minoru Arai
Yoshito Okawa
Naoko Izumi
Hisashi Toyoshima

HOW TO USE IT FOR PUBLIC SECTOR

ONE after another, various different concepts and forms of data are being digitized and used throughout society in conjunction with information technology (IT).

With information considered an integral part of the social infrastructure, the public sector is among those asking questions about what form its use should take, including how to apply IT so that it is integrated into society; what the adoption of IT will change and how; and whether the application of IT will be beneficial, safe, and sound.

The introduction of the identification (ID) number system, for example, will re-define social attitudes about what is important and where priorities lie.

IMPACT OF IT UTILIZATION ON SOCIETY

The use of IT influences the functioning of society in the following three ways:
(1) Maintaining stability: IT can be used to implement rule-based practices and manage them reliably to ensure the smooth and proper functioning of society.
(2) Raising awareness: The expanding scope of digitization gives people a broader view of the world.
(3) Encouraging innovation: The new insights prompted by raising awareness give rise to innovation.

These influences correspond to the series of processes by which society functions, and among the innovations prompted by raising awareness, those that gain consensus support from a public perspective become incorporated into stable public institutions.

The use of IT contributes to this process through the following two mechanisms.
(1) Efficiency improvement: Ongoing process improvements to all sorts of societal systems boost their operational efficiency.
(2) Problem solving: Identifying problems and attainment targets leads to solutions through the collaborative creation of new value.

While the relative emphasis on these two mechanisms will vary depending on the needs of the time, ultimately what they both have in common is that they lead to social progress in terms of "stability" (see Fig. 1).

CHANGING PERSPECTIVES AND TOPICS FOR IT UTILIZATION

With the use of IT being extended into areas that cross the boundaries within organizations in an effort to improve the overall efficiency of societal systems,

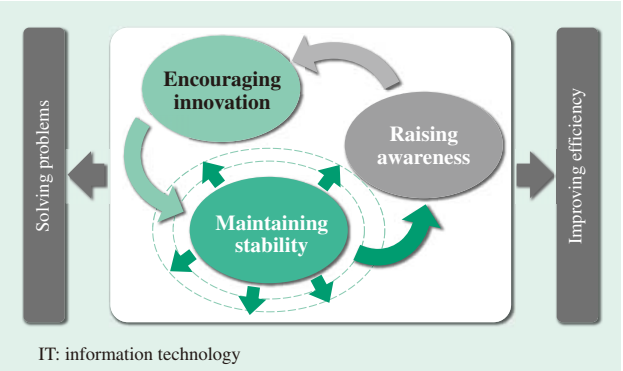

Fig. 1—Impact of IT on Society.
Raising public awareness and encouraging innovation play major roles in promoting the adoption of digital technology and IT systems. The public sector seeks to achieve a steady expansion of society by both solving problems and improving efficiency.

changes are evident in the perspectives and topics associated with the use of IT in the public sector.

Societal Value as a Criterion for Using IT

Growing integration between systems in the public sector is creating a need to use societal value as a criterion for choosing the type of system to use and how to handle data. A shift has taken place away from assessing the value of systems in isolation when considering the suitability of particular systems and toward making decisions based on the value of systems to society.

Risks of Relying on IT

IT already plays an essential role in the operation of public infrastructure such as electric power, water, and healthcare. If IT functions became unavailable, going back to running such infrastructure manually would be difficult.

In addition to the strengthening of security and the expansion of maintenance requirements commensurate with this growing reliance on IT, the recruitment and training of the staff needed to keep all of these systems running are also major challenges.

Pursuing New Opportunities Made Possible by IT

On the other hand, a wide variety of work is underway seeking to use IT to create new value. Among those initiatives that are attracting attention are the following.
(1) Big data initiatives involving the analysis of high-volume data flows to generate added value
(2) Initiatives such as the Internet of things (IoT) aimed at bringing various goods into the digital world
(3) Initiatives for augmenting human activity through the use of knowledge-based functions that combine artificial intelligence with information collected from sources such as the IoT

Among the activities associated with societal systems is Germany's Industrie 4.0 concept, which seeks to bring about a fourth industrial revolution by promoting the integration of physical objects with the Internet[1].

TABLE 1. Japan's International Competitiveness in IT
While Japan is evaluated highly for individual uses, there is scope for improvement in social environment.
Source: The World Economic Forum, "The Global Information Technology Report 2015"

	Category				Lowly ranked indicators	Highly ranked indicators
	Subindex	Ranking	Indicator	Ranking		
Overall 10th out of 143 nations	Environment	18	Political and regulatory environment	8	Efficiency of legal system in challenging regulations (19/143) Number of procedures to enforce a contract (27/143)	Intellectual property protection (7/143) Software piracy rate, % software installed (2/143)
			Business and innovation environment	35	Total tax rate, % profits (116/143) Number of procedures to start a business (94/143)	Availability of latest technologies (11/143) Intensity of local competition (2/143)
	Readiness	15	Infrastructure	17	Mobile network coverage, % population (39/143) International Internet bandwidth (63/143)	Secure Internet servers (20/143) Electricity production (23/143)
			Affordability	43	Prepaid mobile cellular tariffs (102/143)	Fixed broadband Internet tariffs (23/143) Internet and telephony sectors competition index (1/143)
			Skills	15	Quality of educational system (33/143)	Quality of math and science education (21/143)
	Usage	4	Individual usage	13	Mobile phone subscriptions (60/143) Use of virtual social networks (61/143)	Percentage of individuals using the Internet (12/143) Mobile broadband Internet subscriptions (3/143)
			Business usage	2	Capacity for innovation (7/143)	PCT patent applications (1/143) Firm-level technology absorption (2/143) Extent of staff training (2/143)
			Government usage	7	Importance of ICTs to government vision of the future (20/143) Government success in ICT promotion (27/143)	Government Online Service Index (9/143)
	Impact	11	Economic impacts	12	Employment in knowledge-intensive activities, % workforce (63/143)	Impact of ICTs on new services and products (14/143) PCT ICT patent applications (3/143)
			Social impacts	13	Internet access in schools (37/143) ICT use and government efficiency (25/143)	E-Participation Index (4/143)

ICT: information and communication technology PCT: Patent Cooperation Treaty

CHANGES IN CRITERIA FOR VALUE IN IT

International Competitiveness Indicators and Assessments

Table 1 lists the World Economic Forum (WEF) criteria for international competitiveness in IT[2]. In the 2015 survey, Japan placed 10th overall out of 143 nations (compared to 16th in 2014). The criteria are divided into the categories of "Environment," "Readiness," "Usage," and "Impact" and include the extent of IT use in public activity as well as the IT environment.

While Japan is ranked highly for business and other individual uses, it has a relatively poor rating in terms of criteria that consider the social environment, such as business innovation. Taking this assessment on its own, IT competitiveness can be thought of as an area in which different societies are in competition with each other. In other words, the challenge can be thought of as how to improve the value of the nation's society amid a global society that adopts this attitude.

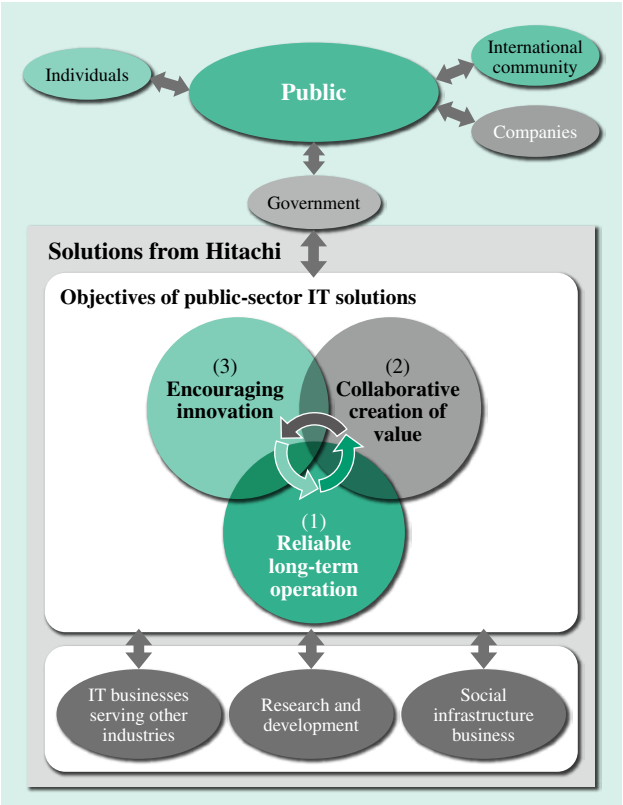

Fig. 2—Objectives of Public-sector IT Solutions.
The objectives of public-sector IT solutions are reliable long-term operation, collaborative creation of value, and encouraging innovation. Research and development at Hitachi support these solutions. Public-sector IT solutions deal with a wide variety of public challenges, primarily through the issues facing government agencies.

Declaration to be the World's Most Advanced IT Nation

In an effort to improve its IT performance, Japan has been publishing a "Declaration to be the World's Most Advanced IT Nation"[3] since 2013.

The 2015 version identifies the following four policies with the aim of achieving "true affluence."
(1) A society that grows toward the future
(2) A dynamic society that invigorates communities, people, and jobs
(3) A society where people experience safety, security, and prosperity
(4) A society where one-stop public services are available

The declaration identifies the use of solution-based IT as the way to make the public aware of the growth of society and the revitalization of the places where people live.

INVOLVEMENT IN PUBLIC-SECTOR IT SOLUTIONS

Hitachi supplies public-sector IT solutions in order to use IT to contribute to the smooth functioning of society.

The following sections describe the objectives for public-sector IT solutions in terms of three different considerations (see Fig. 2).

Reliable Long-term Operation

Information systems based on regulatory requirements that provide the infrastructure of public life need to remain in continuous operation over periods of decades. Furthermore, infrastructure that remains in ongoing use is achieved by keeping pace with changes in society.

Collaborative Creation of Value Using Information Infrastructure

The coverage of the infrastructure that supports the distribution of information is expanding along with advances in digital technology. To take advantage of this, there is a need for new rules and guidelines on the distribution of information that are based on use of the information infrastructure. The establishment of these through cooperation between stakeholders leads to the collaborative creation of value.

Encouraging Social Innovation

Social Innovation seeks to adopt new approaches to solving societal challenges, with the use of IT serving as an important tool for this work.

ACTIVITIES BY HITACHI

The following sections describe what Hitachi is doing in relation to these three objectives.

Reliable Long-term Operation

The information systems used by national and local government agencies for activities such as social security, resident information, and taxation are part of the infrastructure that supports the public's way of life.

For these public sector activities, Hitachi is contributing to the reliable operation of government services by supplying municipality solutions and solutions for central government agencies that include business application development and the outsourcing of operation and maintenance.

These business applications include systems that need to remain in operation for many years while also undergoing modifications required to comply with changes in the law. In response, Hitachi is developing technology that is specific to the requirements of this sector, including, for example, the development of a technique for producing a system requirements definition from the relevant statutes in order to comply with an amendment to a law. Hitachi also enables the ongoing use of business applications that represent important assets and incorporate operational know-how built up over time and the long-term reliable operation of these applications through activities that include the conversion of legacy systems[(a)] to open platforms and system migration[(b)].

Collaborative Creation of Value Using Information Infrastructure

(1) Promotion of standardization

Standardization is essential for making information infrastructure available to a larger numbers of users. For example, the use of consistent character sets and vocabularies is necessary for data from different sources to be treated as the same type of data. To achieve this Hitachi is drawing on know-how acquired through activities such as the development of systems for household registration administration by local government to participate in the establishment of the Japanese Character Data Platform[(c)] and the Infrastructure for Multilayer Interoperability[(d)]. Similarly, Hitachi is also actively pursuing the standardization required for information integration, including participation in the development of the Geospatial Information Platform[(e)] for sharing data on the location of goods and people.

(2) Use of ID number system

The social security and tax number system (ID number system) is being introduced with the aims of enabling the inter-departmental sharing of information for social security and taxation, providing efficiency and transparency in government, and greater convenience for the public.

By transforming government procedures from being paper-based to digital practices, comprehensive adoption of the ID number system will provide seamless interoperation between various different business systems. In response, Hitachi is actively involved in implementing and operating highly convenient and reliable systems that are designed with consideration for both public and private sector users. An article in this issue of *Hitachi Review* describes this work on the ID number system in detail.

(3) Dealing with system vulnerabilities

Along with advances in the distribution of information, cybersecurity for preventing data leaks, countering terrorism, and so on is growing in importance. Cyber-attacks deliberately target organizations and infrastructural functions that play important public roles with the aim of damaging them, and leaving the vulnerabilities of individual systems exposed leads to the inadequate functioning of public systems.

As cyber-attacks are growing in sophistication and ingenuity to the extent that actions taken by organizations on their own are unlikely to be adequate,

(a) Legacy system
An existing information system that has been in use for some time (as opposed to a newly installed information system). The term is mainly used to refer to application systems that have been built to run on mainframes and "office computers" (old-style mini-computers).

(b) System migration
The transfer of information system assets from an old system to a new one. It refers to the conversion of application programs built using obsolete programming languages and development environments to a different language and new environment.

(c) Character Data Platform
A data platform that provides a character set for government use, containing approximately 60,000 characters, including *kanji* characters used in names, and font data. It was established primarily by the National Strategy Office of Information and Communications Technology, Cabinet Secretariat, Ministry of Economy, Trade and Industry, and Information-technology Promotion Agency, Japan (IPA).

(d) Infrastructure for Multilayer Interoperability (IMI)
A platform available for use across different information systems that defines consistent notation, meaning, and data formats for words and other terms used in government. It is being set up in tandem with the character data platform.

(e) Geospatial Information Platform
An information platform that provides one-stop access for searching and browsing various types of geospatial information, including maps, weather, earthquake magnitudes, tsunamis, aerial and satellite photography, and location data for people and vehicles, so that users can obtain and use this information. The platform is being developed jointly by the National Institute of Information and Communications Technology (NICT), The University of Tokyo, and Hitachi, Ltd.

it is important to adopt a collaborative approach in the form of a defensive network for sharing information between organizations about such matters as security incidents, vulnerabilities, and attack warning signs. An article in this edition of *Hitachi Review* describes such an initiative.

Encouraging Social Innovation

(1) Use of data

Big data techniques, such as statistical processing or the extraction of highly reliable information from which the noise has been eliminated, are needed to obtain useful results from the analysis of information that flows in large quantities. Hitachi is actively engaged in encouraging Social Innovation by supplying big data and other solutions.

Among the issues associated with big data that have attracted widespread attention is the need to ensure the privacy of personal data. Hitachi is working actively on the development and application of technologies that allow this data to be used safely, including *k*-anonymization(f) and privacy-preserving analysis techniques(g).

OUTLOOK FOR THE FUTURE

Orientation toward Solutions

A growing number of initiatives are underway in the field of "open data," which means making public data held by government institutions available for other uses to improve industrial competitiveness. Hitachi is contributing to progress on open data by supporting the stocktaking of data held by government institutions as well as through the development and operation of the government's DATA.GO.JP data catalog.

Leading local governments are working on utilizing this public data to provide information on local characteristics, assess the state of activities and services, and benchmark against other regions, heightening expectations for use in such activities as business process re-engineering (BPR) or regional development planning.

With regard to the challenges facing the adoption of IT in education, developments include the full-scale introduction of digital textbooks starting from this academic year.

As part of this, Hitachi is participating in the consortium along with 12 textbook publishers to provide a common platform for digital textbooks. This has the potential to enable new forms of teaching. One example is the use of flexible cross-referencing between textbooks for different subjects to provide pupils with a deeper understanding, such as the use of social studies textbooks to learn about the settings in the texts used to teach Japanese.

Through the supply of public-sector IT solutions, Hitachi is actively involved in initiatives like this that are oriented toward the solution of societal challenges.

Further Advances in Adoption of Digital Technology

With the revised Japan Revitalization Strategy (Growth Strategy) 2015(h) having referred to shifting away from practices that are based on interviews and paperwork and instead adopting IT-based practices, the design of institutional practices under Japan's new legal system will be based on the use of information systems in the future.

The development of information systems in accordance with statutes requires expertise in both administrative practices and information systems. Furthermore, ensuring adequate time for the investigation and implementation of system requirements is a challenge for providing system interoperation with other processes.

In response to these challenges, Hitachi is contributing to high-quality public-sector IT systems by advising the relevant institutions as well as by improving development techniques and transferring skills.

Using Social Innovation to Solve Problems

Japan is recognized as a pioneer in confronting certain challenges, including numerous societal issues that have not been successfully dealt with by existing frameworks such as its low birth rate, aging population, and frequent natural disasters. Facing up to these challenges and acting boldly will lead to Social Innovation.

(f) *k*-anonymization
A technique for modifying data to make it difficult for individuals to be identified. It reduces the probability of identifying a particular individual in a dataset to 1/*k* or less by modifying the data so as to guarantee that it will contain a certain number (*k*) of instances with the same attributes.

(g) Privacy-preserving analysis technique
A technique for analyzing encrypted data without having to decrypt it. It uses a high-speed searchable encryption technique that can perform searches with both search key and database in encrypted form. This reduces the risk of information leaks in applications such as big data analytics.

(h) Revised Japan Revitalization Strategy (Growth Strategy) 2015
The second revision to the growth strategy that forms the "third arrow" of Abenomics, the economic policy of the Abe Cabinet. The Cabinet decision was made on June 30, 2015. The Japan Revitalization Strategy has achieved results by specifying policies for economic growth, including strengthening corporate governance. The 2015 Revitalization Strategy represents Abenomics as having now entered its second stage and includes policies for ensuring the elimination of deflation.

As noted on the Ministry of Internal Affairs and Communications website promoting information and communication technology (ICT) use in regions[4], while numerous demonstration projects and other trials aimed at overcoming challenges have been conducted around the country, few of them have gone on to nationwide deployment. On the other hand, there are many successful examples of localized initiatives that are tailored to the specific conditions of their community.

This has prompted one proposal for the use of IT that takes advantage of the characteristics of central and regional areas that involves a division of responsibility under which regions develop those systems that utilize regional characteristics and central areas are responsible for the mechanisms for loosely coupled interoperation between central and regional areas and between different regions.

Hitachi intends to continue proposing a variety of ideas for how to achieve prosperity in Japan based on its extensive experience and technologies built up over time, including contributing to regional revitalization through the implementation of systems and services that suit local conditions, and fostering Social Innovation by providing information integration platforms that link individual systems together and using the information exchanged. Furthermore, Hitachi also intends to supply solutions overseas that solve the problems faced by different countries and regions.

CONTRIBUTING TO SOCIETY THROUGH PUBLIC-SECTOR IT SOLUTIONS

IT and its applications continue to evolve in step with changes in social processes. From a public interest perspective, this can be thought of as a long-term process that requires stable operation.

Hitachi is contributing to the building of social processes through public-sector IT solutions by developing technologies from a long-term perspective and transforming them into dependable solutions.

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Featured Articles

Future Outlook for Japan's ID Number System

Daisuke Miyamoto
Shinji Nakamura
Misa Hara

OVERVIEW: Japan's ID number system is a social platform that improves administrative efficiency, provides greater convenience for the public, and establishes a fairer and more just society. Issuing of individual and corporate ID numbers commenced in October 2015, marking the launch not only of support for ID numbers in tax and social security procedures and the associated internal processes of private businesses, but also the use of information by national and local government and new administrative services based around My Portal. This article describes what Hitachi is doing in relation to the ID number system and considers how the scope of application of the system will expand in the future.

INTRODUCTION

THE social security and tax number system [identification (ID) number system] is a social platform that improves administrative efficiency, provides greater convenience for the public, and establishes a fairer and more just society. The system was established in Japan by the 2013 "Act on the Use of Numbers to Identify a Specific Individual in the Administrative Procedure" (Number Use Act). Its implementation is broadly divided into three stages. Issuing of individual and corporate ID numbers began in October 2015; use of the individual ID numbers in taxation, social security, and disaster response is to be introduced progressively from January 2016; and use of information sharing within national and local government to improve the efficiency of administrative procedures and the introduction of convenient online services based on My Portal* are to commence from 2017[(1)].

In the My Number Subcommittee of the Expert Evaluation Committee for New Strategy of the IT Strategic Headquarters, the Government Chief Information Officer (CIO) plays a central role in investigations into expanding the scope of uses for individual ID numbers from the perspective of encouraging the use of information technology (IT), and debate on the implementation of My Portal with a view toward future public-private collaboration. Work is also proceeding at other government agencies on things like conducting trials and investigating what forms systems should take.

With reference to these circumstances, this article describes what Hitachi is doing in relation to the ID number system and considers the various issues associated with how the system will develop in the future.

OVERVIEW OF ID NUMBER SYSTEM

The ID number system combines individual and corporate ID numbers with mechanisms for verifying identity and for sharing information between different agencies.

Mechanisms for Verifying Identity

The mechanisms for verifying identity include individual ID number cards and the Public Certification Service for Individuals. Individual ID number cards serve as documentary proof of a person's ID number and as a public means of verifying identity. The Public Certification Service for Individuals uses the electronic signature stored in the integrated circuit (IC) chip in each individual ID number card to enable administrative procedures to be conducted online as well as through private-sector online transactions such as Internet banking. This mechanism for verifying identity whether online or offline is part of the social infrastructure for both the public and private sectors.

Mechanism for Sharing Information between Different Agencies

This mechanism enables national and local government agencies to share information on income, for

* My Portal: A portal site open to public access. Its uses include viewing when and where government agencies have handled a person's personal information tagged with their ID number, checking for notifications, and viewing personal information held by government agencies.

example, over an information-sharing network system. It eliminates the need to supply supporting documentation such as the income certificates issued by government agencies that are required for administrative procedures.

Use of Individual ID Numbers

The use of individual ID numbers is restricted to certain administrative activities stipulated by law (taxation, social security, disaster response, and activities specified by local government bylaws). Private businesses collect individual ID numbers from employees, for example, and submit documents for taxation and social security with the ID numbers attached. While the initial launch in January 2016 will be limited to documents relating to withholding payments by retiring workers, it will be extended from January 2017 to also include procedures relating to employee pensions and health insurance. Private businesses are obligated to manage these individual ID numbers properly, with penalties for leaking information (up to four years' imprisonment or a fine of up to two million yen) applying to senior management as well as to the staff responsible for the leak. This makes it essential that private businesses implement appropriate security management for individual ID numbers.

HITACHI'S INVOLVEMENT

This section describes what Hitachi is doing in relation to the ID number system.

Work on Introducing the ID Number System

While private businesses are making progress on preparing for the launch of the ID number system from January 2016, a survey conducted in June 2015 found that approximately 70% of companies have yet to make preparations. The survey questioned applicants who attended the "Seminar for Companies on How to Administer the ID Number System" run jointly by the Japan Institute for Promotion of Digital Economy and Community (JIPDEC) and the Japan Chamber of Commerce and Industry[(2)].

First of all, preparations by private businesses relate to the attachment of the individual ID numbers of employees and others to documents submitted to government agencies or health insurers for tax or social security procedures. Based on government-issued guidelines and other information, private businesses need to clarify requirements such as which procedures need to have individual ID numbers attached and which staff will handle the work; clarify when new practices need to be introduced with reference to the timing of the requirement for individual ID numbers to be attached to documents; and investigate security management measures for individual ID numbers, specific personal information, and other data based on human resource, organizational, physical, and technological considerations. The main steps in the workflow are the collection and registration of individual ID numbers from employees and others; storage and management, including security management measures that also cover cancellation; preparation of documents with individual ID numbers attached at the same time as taxation or social security procedures; and submission of the documents to the government agency or other party. It is necessary to collate implementation plans that also specify how systems are to adapt to the changes in accordance with this workflow, and to proceed with the associated actions.

The potential ways in which systems can be adapted to the changes are: (1) upgrade payroll or other packages, (2) outsource work associated with the ID number system, and (3) install new secure systems for managing the ID number system. Private businesses need to decide which approach to adopt based on considerations such as security, workload, and cost. For the outsourcing option, Hitachi supplies business process outsourcing (BPO) services for handling ID numbers that cover the integrated management from ID number collection and registration to cancellation and the contract printing of statutory forms (see Fig. 1). This BPO service is available as an option in cases where it is difficult for a company to upgrade its own systems or establish its own dedicated administrative practices for dealing with individual ID numbers in a short timeframe. Hitachi anticipates it will often be selected for organizational or financial reasons.

Local government, meanwhile, will start issuing individual ID numbers from October 2015, start using individual and corporate ID numbers from January 2016, and start sharing information with national government agencies and other local governments from July 2017. For the various activities undertaken by prefectures, municipalities, and other local government entities, including the planning, system installation, and post-installation operation work associated with the adoption of the ID number system, Hitachi supplies total solutions that encompass various services and products such as its solution for local government.

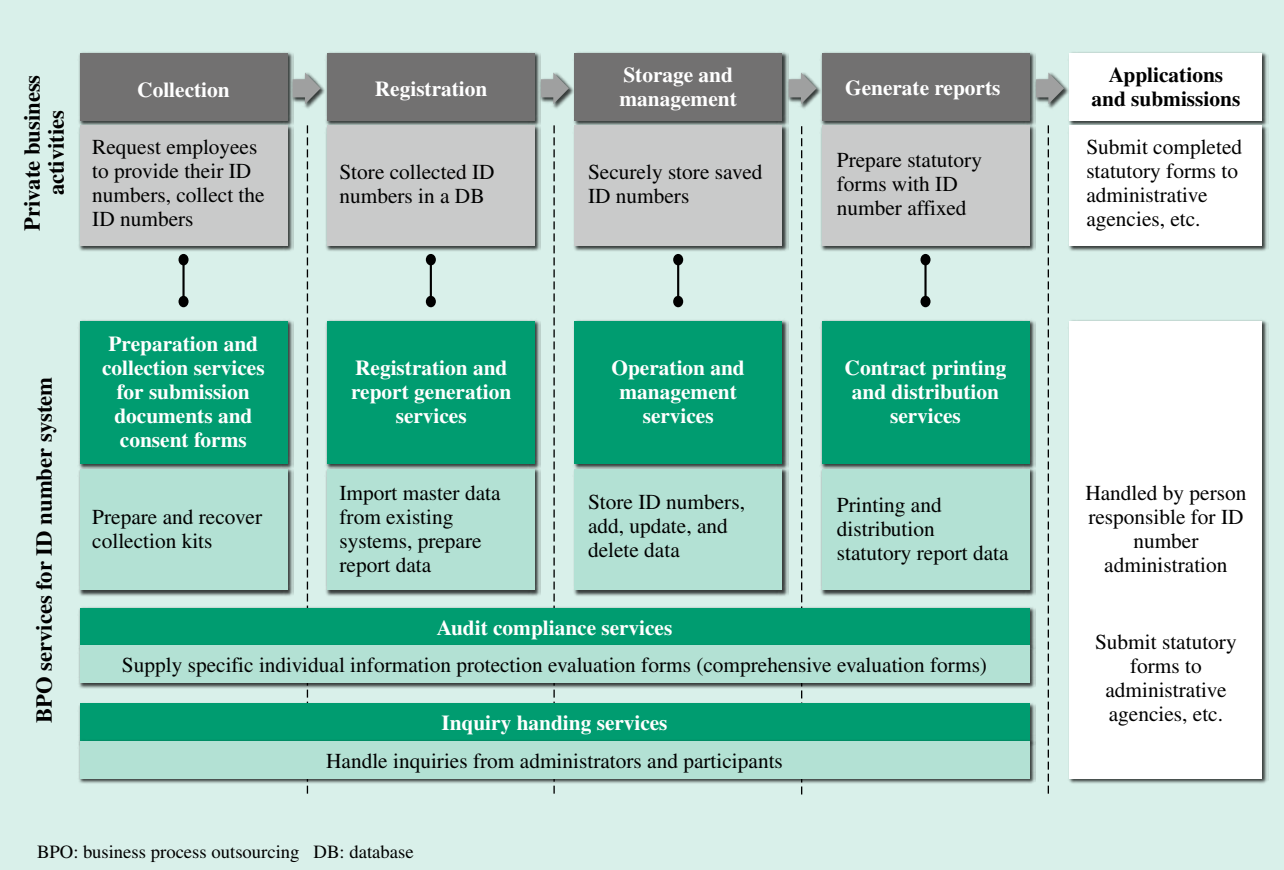

Fig. 1—Outline of BPO Services.
The figure shows an overview of BPO services for activities that private businesses are required to perform for the ID number system.

Work on Future Applications

The Ministry of Internal Affairs and Communications has established a working group and sub-working group for use of shared IDs[3] to investigate matters such as how the Public Certification Service for Individuals (which is expected to become a widely used part of the shared infrastructure for private-sector services) could be used in telecommunications and broadcasting. Hitachi has participated in the investigation as a group member. The groups have been set up as sub-committees under the Conference on Promotion of Information and Communication Technology (ICT) Urban Development, which studies common platforms and other methods for urban development that make use of ICT. The use cases for the Public Certification Service for Individuals have been grouped under the headings, "personal identification," "certification of qualifications," and "certification of changes," and the issues have been investigated based on technical aspects, rules, and operational considerations using as examples a variety of proposed applications, such as use in My Portal or use of cable television.

Along with conventional digital certificates for use as signatures, electronic certificates for user certification have also been established for the Public Certification Service for Individuals. Digital certificates for use as signatures provide a way for people and organizations to affix an electronic signature when making online applications or submissions to government agencies, private institutions, or other entities (applications or submissions, or in other words when uploading information). Electronic certificates for user certification provide a way for people and organizations to identify themselves electronically in situations such as when browsing online or accessing information that they have provided to government agencies or private institutions (browsing or access, or in other words when downloading information). The scope of services such as signature verification using the Public Certification Service for Individuals, which have been limited to administrative and other agencies, will be expanded to include private-sector businesses approved by the Minister of Internal Affairs and Communications. This will allow a larger number of public and private organizations to make use of

the Public Certification Service for Individuals and help improve the convenience of services that involve collaboration between the public and private sector. Hitachi will continue to participate in investigations aimed at the even wider use of the Public Certification Service for Individuals.

CONSIDERATIONS RELATING TO FUTURE USE

The government is studying the use of the ID number system from a variety of perspectives. The following section considers the issues being considered and the directions for the future.

Developments Facilitating Wider Use of Individual ID Numbers

As the Number Use Act uses a white list approach toward specifying permitted uses, which are specified in terms of uses (Number Use Act Attached Table 1) and sharing information (Number Use Act Attached Table 2), expanding the scope of applications for individual ID numbers will require changes to the law.

Proposed amendments to the Number Use Act (Draft Amendments to the Act on the Protection of Personal Information and the Act on the Use of Numbers to Identify a Specific Individual in the Administrative Procedure) were debated during the 189th ordinary session of the Diet (as of June 2015, the measure had passed the House of Representatives and was being debated in the House of Councillors). In addition to attaching the individual ID number to bank accounts, the proposed amendments include expanding applications for individual ID numbers to include their use by health insurers for insurance purposes, and permitting the sharing of information between local governments for purposes that local governments have mandated themselves through bylaws (see Fig. 2).

The My Number Subcommittee of the IT Strategic Headquarters, meanwhile, is deliberating on wider applications for individual ID numbers with the potential for additional benefits, including household registration, passports, and the management and sharing of medical, healthcare, and welfare information[4]. Similarly, the Fiscal System Subcommittee of the Ministry of Finance is undertaking investigations with a view to means testing in ways that take account of financial assets as well as income[5].

These discussions can be divided into three stages. The first stage involves expanding the scope of uses within the taxation, social security, and disaster response fields specified by the current law. The second stage involves expanding into other similar fields where public benefits can be anticipated. The third stage involves revising the current system based on the assumption that the scope of applications will be expanded. While it is anticipated that these discussions will lead to an acceleration of the investigations, an important factor is how well the benefits can be presented to the public in clearly intelligible terms.

Considerations Relating to Expansion of Applications for Using Individual ID Number Cards

The individual ID number cards will be progressively distributed to the public from January 2016, free of charge. The card functions are separated into those that involve use as a public form of personal identification with which people can identify themselves in person using the information on the card (the front of the card generally contains the person's name, address, date of birth, gender, and a photograph), those that use information that only applies to permitted uses for the individual ID number (the rear of the card contains the person's individual ID number), and multi-

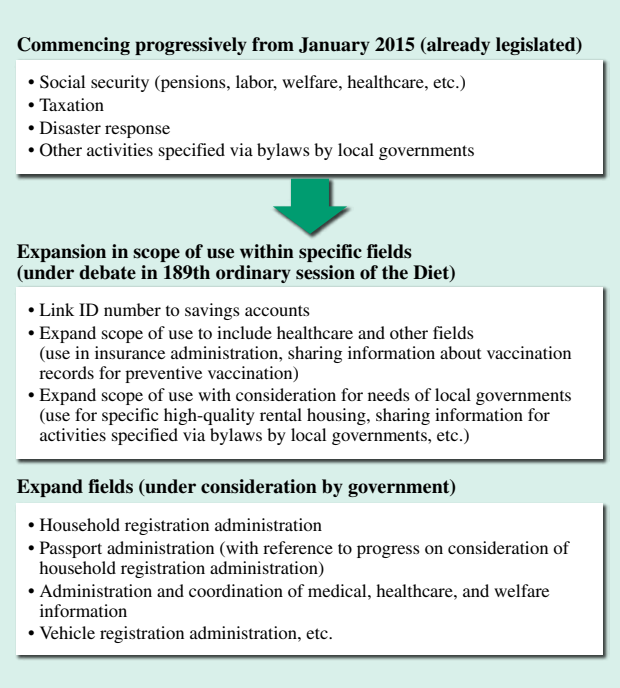

Fig. 2—Future Trends in Scope of Application of Individual ID Numbers.
The figure shows the matters being considered by the government with the aim of expanding the scope of application of individual ID numbers.

purpose services that use free space on the IC chip for things like library cards or providing certificates via convenience stores.

In the case of multi-purpose services, in particular, there are already services that use free space on the IC chips of basic resident registration cards. According to the Ministry of Internal Affairs and Communications' schedule of multi-purpose uses for basic resident registration cards (as of April 1, 2013), these include services provided by a wide variety of local governments, such as point services for shopping centers, reservation and availability-checking services for public facilities, services for requesting health checks or consultations and accessing the results, and community currency services(6). As the uptake of basic resident registration cards is currently low, the distribution of individual ID number cards to all citizens means that they can be used by a larger number of people, and this will help members of the public, even those who have not benefitted from these services, to experience higher levels of convenience than in the past.

The government is also considering incorporating functions such as proof of health insurance or IDs for government officials. It is anticipated that cards issued by national or local government will be incorporated into the individual ID number card. However, because only so much space is available on the IC chip, services clearly need to be chosen by the public based on the available capacity.

Furthermore, it is anticipated that making the free space on the IC chip available to private-sector businesses in the future will reduce their card issuing costs, leading to the inclusion of functions such as credit cards, membership point cards, and company or school IDs. Because use by the private-sector for its own purposes is not currently permitted, it is considered desirable that applications be extended to include uses that are linked to private services by using the individual ID number card for personal identification through the Public Certification Service for Individuals referred to below.

Considerations Relating to Expansion of Applications for Public Certification Service for Individuals

As noted above, a key feature of the Public Certification Service for Individuals is that it extends verification that the person concerned created a document (such as the verification of digital certificates used as signatures), previously the preserve of administrative agencies, to the private sector and enables both administrative agencies and the private sector to use online personal identification (electronic signatures for certifying users).

Administrative agencies can use the Public Certification Service for Individuals to implement services for the submission of online applications for administrative procedures and for browsing users' own personal information on My Portal. Private sector businesses can use the Public Certification Service for Individuals for personal identification in online transactions such as online banking, Internet shopping, ticket purchases, or opening insurance policies or bank accounts provided at places such as convenience stores, banks, supermarkets, or railway stations, which are closely tied to the public's daily lives. For private sector businesses, this helps reduce the cost associated with high-level electronic personal identification that they previously funded individually and also facilitates investment by the private sector in new service development. This use of the Public Certification Service for Individuals by both the public and private sector will lead to the creation of a variety of applications involving public-private collaboration. For example, it will lead to the development of one-stop public-private services in which these services work together, with documents prepared by the private sector being collected for use in government procedures or, alternately, using documents issued by government agencies in procedures directed at the private sector.

This service development has been studied in the "Study of Improvements to the Convenience of Pension Contributions and Taxation through Measures such as Use of the ID Number System" conducted by the Cabinet Secretariat, and service proposals have been considered. Specific examples that form part of an action program for improving the convenience of pension contributions and taxation through measures such as use of the ID number system include simplifying medical fee deductions using notifications of medical fees to My Portal and providing one-stop online services for things like taxation and pensions. In this way, work is proceeding on studying ways of using the ID number system and other mechanisms to improve things like convenience for the public and administrative efficiency(7).

Meanwhile, one of the challenges associated with encouraging greater use of the Public Certification Service for Individuals is the shift to multi-channel interfaces. With the recent dramatic growth in the

use of smartphones, many web services are available from smart devices such as smartphones as well as on personal computers and mobile phones, with applications often provided through or used by smartphone apps. Accordingly, to implement electronic personal identification, it is desirable for this electronic personal identification also be implemented through the conversion of individual ID number cards to multi-channel formats.

CONCLUSIONS

The matters considered in this article have extended from the current state of the ID number system to the future expansion in its scope of applications, including the relevant trends. The ID number system constitutes a Social Innovation in the move toward a society that utilizes IT, with a role in Social Innovation and the administrative layer in relation to things like social progress and enhancing social value initiated by system innovation, as described earlier in this article. In the move toward a society that utilizes IT, the Draft Amendment to the Act on the Protection of Personal Information submitted in the 189th session of the Diet includes measures relating to uses of personal data that encourage economic revitalization utilizing big data, and it is anticipated that progress will be made in the future on Social Innovations in which the public and private sectors will work together to utilize things like open data and big data. Hitachi intends to continue contributing to society through technology in relation to Social Innovations from the perspective of IT utilization.

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Featured Articles

Latest Trends and Future Outlook for Open Data: Making Public-sector Data Available to the Private Sector

Daisuke Hasegawa
Yu Asano, Ph.D.

OVERVIEW: There has been considerable activity in recent years in both Japan and elsewhere in open data initiatives, whereby public-sector data held by national, local, and other government agencies is made available for secondary use. In its strategy entitled, "Declaration to be the World's Most Advanced IT Nation," the Japanese government is also pursuing open data, setting a target of making available a level of data that is equal to other developed nations by the end of FY2015. Along with supplying an Open Data Solution that covers all of the processes needed to implement open data at public institutions and supports all activities from the planning associated with the introduction of open data to the preparation, publishing, and use of the data itself, Hitachi is also working on the research and development of the next generation of technologies for improving the usefulness of data.

INTRODUCTION

"OPEN data" means making data with a high level of public interest that is held by national, local, and other government agencies available on the Internet so that it can be accessed by the general public, and the activities associated with doing this. Unlike past information release practices, open data initiatives involve making data available in data formats and with licenses to use that facilitate its secondary use. Government initiatives in this area got underway with Japan's 2012 Open Government Data Strategy. The Japanese government is actively pursuing open data initiatives, including having identified such endeavors in the 2013 "Declaration to be the World's Most Advanced IT Nation" as being among activities that will help establish the type of society it aspires to realize, and a further expansion in activities is evident, facilitated by public interest.

This article describes trends in open data, in the public and private sectors, what Hitachi is doing to support progress on open data, advanced technologies for making data more useful, and the outlook for open data in the future.

TRENDS IN OPEN DATA AND INITIATIVES

Trends in Making Open Data Available

In the early 2000s, open data initiatives aimed at improving government transparency spread around the world, starting in the UK, with government data catalogs already available in 45 different countries[1]. With reference to the G8 Open Data Charter adopted in June 2013, Japan launched its DATA.GO.JP government data catalog in October 2014. Public-sector data that is in high demand such as statistical or geospatial information held by central government ministries and agencies was released as open data, with cross-agency searching and collation available through DATA.GO.JP.

In local governments of Japan, early-adopter local government agencies have preempted central government initiatives by providing open data, particularly data of relevance to dealing with local issues such as welfare, tourism, and political expenditures. In Fukui Prefecture, examples can be seen of work that aims to facilitate the use of data in ways that extend across all the municipalities in the prefecture, such as having municipalities release data in a common format. Already more than 100 local government entities are working on open data (as of the end of June 2015), and these are increasing at an accelerating rate, with the expectation of further expansion in the future prompted by government measures for encouraging wider adoption (see Fig. 1).

The USA and the UK, meanwhile, which are recognized as leaders in open data, have released 141,218 and 25,664 datasets respectively through their government data catalogs (as of the end of June

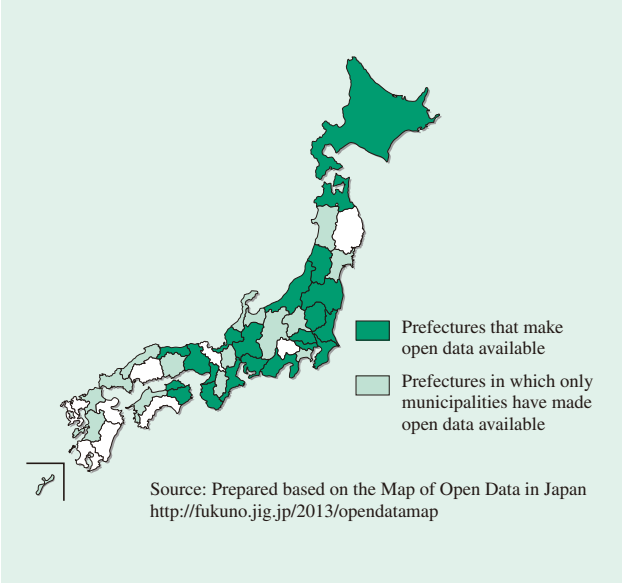

Fig. 1—Spread of Open Data Initiatives by Local Government. The map shows local governments that have already made open data available.

2015)[2), (3)]. Similarly, the Digital Accountability and Transparency Act of 2014 (Data Act) passed by the USA in May 2014 obliges the publication of financial and expenditure data for government agencies using specified formats and field names.

Benefits of Making Open Data Available

As noted above, considerable progress is being made on open data initiatives. The significance of work by national, local, and other government agencies on open data include the following benefits.

(1) Greater transparency in government

The benefits of national and local government agencies releasing budget and other data associated with administrative activities include fulfilling their obligation of accountability to the tax-paying public, raising public confidence in their administration, and raising public interest in participating in government.

(2) More efficient government services

National and local government agencies release observational data and other data relating to public activity in forms that make it easy to manipulate. Private sector service providers undertake certain governmental tasks associated with providing information, publicizing policies, and so on by using this data to develop and supply applications and other services that take account of things like public needs and usability.

(3) Economic revitalization

National and local government agencies release data that private sector service providers and other agencies would find difficult to obtain on their own, such as statistical and geographical data. This promotes economic activity through the use of the data by private sector service providers for things like developing new businesses, more efficient marketing, and enhancing productivity.

Furthermore, work on making open data available is not restricted to government agencies alone. In 2014, for example, Tokyo Metro Co., Ltd. made realtime information on railway services available as open data, and used it to stage an "Open Data Utilization Contest." By making its information publically available as open data, numerous developers participated in the contest, leading to the creation of 281 new applications[4].

Examples of Businesses that Use Open Data

Table 1 lists some of the numerous examples of new businesses that use open data in those nations that are leaders in the field. Uses include assessing real estate values and the trustworthiness of companies.

TABLE 1. Example Uses of Open Data
The table lists some open data practices adopted outside Japan.

Category	Summary of service or application	How open data is used	How it is funded
Real estate	Service providing real estate sales data to real estate intermediaries	Collects information relevant to real estate prices, such as local environment, employment, education, and weather	• Service fee
Company information	Database of approximately 85 million companies from 103 countries (registered address, financial information, etc.)	Collects company registration data in a database and also allows crawling of company websites	• Selling data • Service fee (API usage fee)
Finance	Mobile app for informing credit card holders of suspicious transactions	Derives algorithms that detect suspicious transactions from historical data on fraud and complaints	• Service fee
Transportation	Mobile app for identifying the quickest and easiest (least congested, etc.) route to a destination	Looks up details of transportation operator services when searching for routes, and app users submit congestion and other data	• Advertising

API: application programming interface

HITACHI'S OPEN DATA SOLUTION

Steps Leading up to Release of Open Data

Initiatives by public agencies such as national and local governments for making open data available require activities such as identifying the data they hold and establishing the infrastructure for releasing the data. The steps that need to be worked through to achieve this are described in detail in the Open Data Guide v1.0 published by the General Incorporated Association "Vitalizing Local Economy Organization by Open Data & Big Data" (see Fig. 2) and the "Introduction to Open Data: A Beginners' Guide for Local Government Agencies" published in February 2015 by the Cabinet Secretariat.

The Open Data Guide v1.0 specifies that the situational review step should include a data stocktake to determine things like the types and quantities of data held by the organization and to identify which departments manage it. Similarly, the preparation step involves establishing the data catalog and other infrastructure for making data available, and the publication and maintenance step involves ensuring the ongoing availability of the data.

However, having government agencies establish the services described above will likely increase the workloads associated with managing and publishing the large quantities of data held by each agency. To reduce this burden, they will need assistance with establishing the infrastructure for making open data available. Hitachi launched its Open Data Solution in July 2014 based on its past business experience and research and development work on open data. The following section describes this solution.

Features of Open Data Solution

The Open Data Solution supplied by Hitachi covers all of the processes needed to implement open data at public institutions and supports all activities from planning to the preparation, publishing, and use of open data. The Open Data Solution provides eight services (see Fig. 2). The following describes the main service options.

(1) Current situation review and analysis service

When getting started with open data, the first issue is to choose which data to make available. To make this decision, it is first necessary to undertake a quantitative assessment of things like the types and quantities of data held by the organization, its formats, and whether or not it can be released. On this basis, data that is in high demand from users (public and companies) needs to be made available in formats and via methods that are easy to use.

Along with conducting a stocktake of the data held by the organization to clarify these information assets, the current situation review and analysis service combines this stocktake with the results of a needs analysis to prioritize which data to release and formulate plans for how to do so. It also identifies the organizational and technological issues associated with doing this and investigates how to overcome them to formulate an action plan.

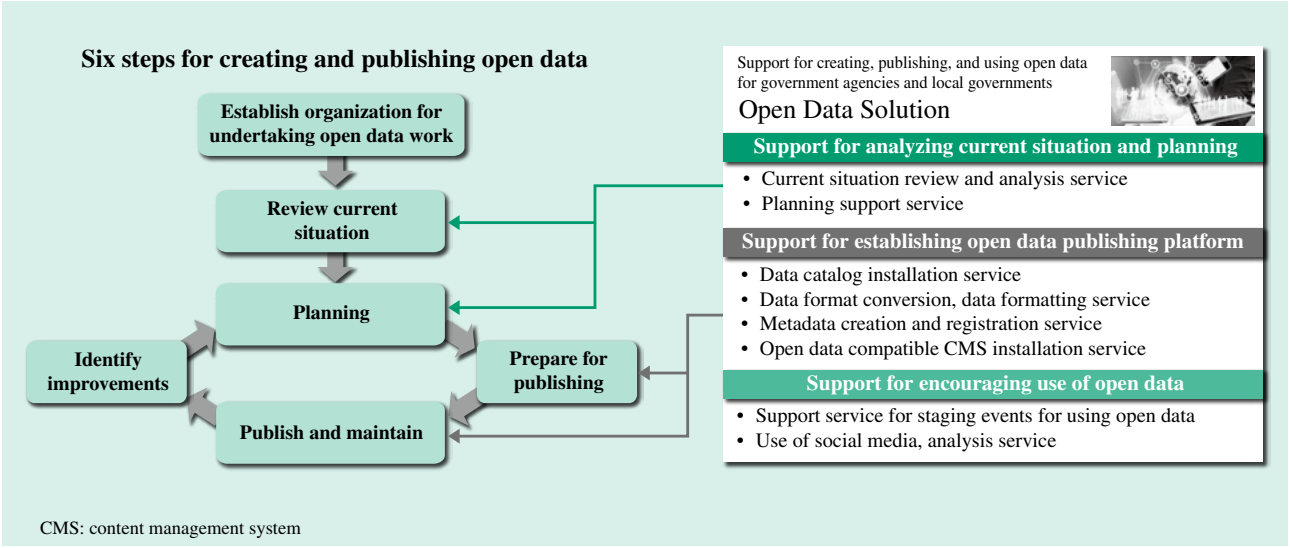

Fig. 2—Steps Associated with Making Open Data Available, and Hitachi's Solution.
The steps for making open data available are listed on the left and the options available through Hitachi's Open Data Solution are shown on the right. The figure also shows the interrelationships.

(2) Data catalog installation service

Standard practice when making open data available is to set up a data catalog to make it easy for users to find the information they require from among the large quantity of data offered. The data provider inserts metadata (bibliographic data) about the open data in the data catalog. Data users can access the data catalog to search the available data using key words or to check data summaries to determine whether the data is useful to them prior to downloading.

The data catalog installation service sets up and operates data catalogs using the CKAN open data software adopted by the US and UK government.

An example application at the Cabinet Secretariat is the implementation of the DATA.GO.JP data catalog of the Japanese government that commenced operation in October 2014. DATA.GO.JP currently makes available 13,038 data sets (as of the end of June 2015).

(3) Content management system (CMS) installation service for open data

Adding data to a data catalog requires that staff spend more time preparing and entering metadata. In considering staff workflow data, providers find it desirable that the entry of metadata into the data catalog be conducted in parallel with the adding of content to the website.

The CMS installation service for open data is able to update the data catalog at the same time as content is added to the website by using the automatic open data catalog integration function of the content management system that supports the maintenance of local government websites.

ADVANCED TECHNOLOGIES FOR OPEN DATA

Publication in Data Formats that Facilitate Secondary Uses

As in the examples described above, there is evidence of the growing use of open data in business. It is recognized that providing open data in formats that facilitate secondary uses is important for encouraging its use. To achieve this, steps are being taken in leading nations to provide linked open data (LOD), a format that facilitates machine processing (use by computer programs).

The properties that characterize LOD are use of the resource description framework (RDF), a data format that enables the meaning of data to be determined during machine processing, and the tagging of data with unique uniform resource identifiers (URIs) to define references to external data. The use of LOD facilitates things like searching across multiple datasets and integrated analysis of data regardless of whether it is sourced from inside or outside the organization.

Technique for Converting Statistical Tables to LOD

Statistics are one form of data held by government that is already used in a variety of different ways. This section describes a Hitachi technique for efficiently converting statistical tables to LOD.

The conversion of statistical tables to LOD requires that data in table formats such as comma-separated values (CSV) or XLS be converted to RDF and tagged with URIs. In RDF, data is represented by three elements (subject, predicate, and object) collectively called a “triple.” Data expressing that the population of Japan is 127.3 million, for example, is represented by a triple in which Japan is the subject, population is the predicate, and 127.3 million is the object. Here, the terms “Japan” and “population” are represented by unique URIs. The same URI is used to indicate a particular concept regardless of the label used. Using the same URI in different LOD allows those LOD to be linked. This enables efficient crossover search and use of the data by users.

As statistical tables may contain hundreds of thousands of values or more, manually converting them to LOD would be very labor-intensive. Accordingly, there is potential for using a tool to support conversion to LOD. However, past tools have only been able to convert data stored in specific structures, and as statistical tables have many different forms, this results in extra work for data structure conversion. This created the challenge of how to convert statistics to LOD without imposing extra work.

In response, Hitachi developed an LOD conversion support tool that is made up of templates for the efficient conversion of statistical tables to LOD and a program for performing the conversion automatically[5), 6)]. The templates reduce the amount of work involved in converting data structures because they are suitable for use with statistical tables that have a variety of different structures. The tool also enables compatibility with external LODs to be achieved efficiently because it includes a function for recommending the corresponding external URI for each term. The technique was used on six statistical tables published by the government as open data, which demonstrated that it could be used to convert tables with millions of values to LOD, making the data easy to search and interlink.

OUTLOOK FOR OPEN DATA IN THE FUTURE

As noted above, agencies such as national and local governments in Japan are working to establish an open data environment at a level equivalent to other developed nations. Nevertheless, progress to date has not been sufficient to achieve things like economic revitalization or more sophisticated public services through open data initiatives.

To create an environment in which greater use can be made of open data, Hitachi believes it is essential to make progress in a synergistic manner by working through a cycle of three steps: (1) providing data through public institutions, (2) providing services through private-sector service providers and others, and (3) providing feedback to public institutions from the public, companies, and others.

Based on the solution described above, Hitachi supports the provision and use of open data by public institutions seeking to engage in open data initiatives and by private-sector service providers who want to use open data, from identifying the challenges to formulating and implementing solutions. Hitachi is also developing the solution further and conducting research into technology with the aim of enhancing the efficiency of customers' existing operations and improving business services.

CONCLUSIONS

This article has described trends and initiatives in open data, Hitachi's solution and technology for overcoming the challenges faced by data providers, and the outlook for open data in the future. Hitachi aims to implement related products and services through Social Innovation with national, local, and other government agencies involving open data and through collaborative creation with private-sector companies involving business applications.

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Featured Articles

Infrastructure for Multilayer Interoperability to Encourage Use of Heterogeneous Data and Information Sharing between Government Systems

Kazuki Adachi
Ryosuke Takazawa
Hiroshige Shibata
Akifumi Yato
Dan Yamamoto

OVERVIEW: In recent years, the use of heterogeneous data with various different meanings and structures has become essential for sharing information between government systems and for promoting open data, an area of growing activity. Infrastructure for Multilayer Interoperability enables the combination of different types of data, the cross-platform use of data, and seamless information sharing between government systems that use different data formats. To enable the implementation of Infrastructure for Multilayer Interoperability, Hitachi has developed techniques for acquiring the vocabulary data needed for standardizing data formats, and for designing databases that manage vocabulary data. By utilizing these techniques in tasks such as data integration within organizations, application development, and open data creation, Hitachi is contributing to organizational process improvement and the development of new services that impact society.

INTRODUCTION

THERE has been growing activity in recent years, particularly in Europe and the USA, involving moves such as making public data held by government institutions available to the private sector (open data) and enabling information sharing between government systems (data integration and conversion). Japan's "Declaration to be the World's Most Advanced IT Nation" (initial Cabinet decision on June 14, 2013 and subsequent revision on June 30, 2015)[(1)] stipulated work on the establishment of standardized "vocabulary platforms" that facilitate the combination of data and the use of data from different sources with the aims of developing new businesses and improving the performance of existing industries as well as achieving efficiency and transparency in government through progress on open data and providing highly convenient electronic government services. In accordance with this declaration, the Ministry of Economy, Trade and Industry and the Information-technology Promotion Agency, Japan have embarked on a project to develop the Infrastructure for Multilayer Interoperability (IMI)[(2)] as a common vocabulary platform. Fig. 1 shows an overview of the IMI.

This article provides an overview of the IMI, describes what Hitachi is doing to implement such infrastructure, and considers the outlook for the future.

OVERVIEW OF THE IMI

Trends in Open Data and Information Sharing

Responding to the Open Data Charter agreement reached at a G8 summit, the Japanese government established the DATA.GO.JP[(3)] data catalog[*1] as a web portal that enables searches to be performed across all of the open data provided by various government institutions. As of July 2015, it held more than 13,000 datasets.

In the USA, the implementation and use of the National Information Exchange Model (NIEM)[(4)] as an information exchange platform has enabled information sharing between numerous government systems, particularly in the Department of Homeland Security, the Department of Justice, and the Department of Health and Human Services. In Japan, the social security and tax number system [identification (ID) number system] which entered use in January 2016

*1 Data catalog: A portal site that facilitates access to data with functions that include listing data, cross-agency searching of data items, and collation.

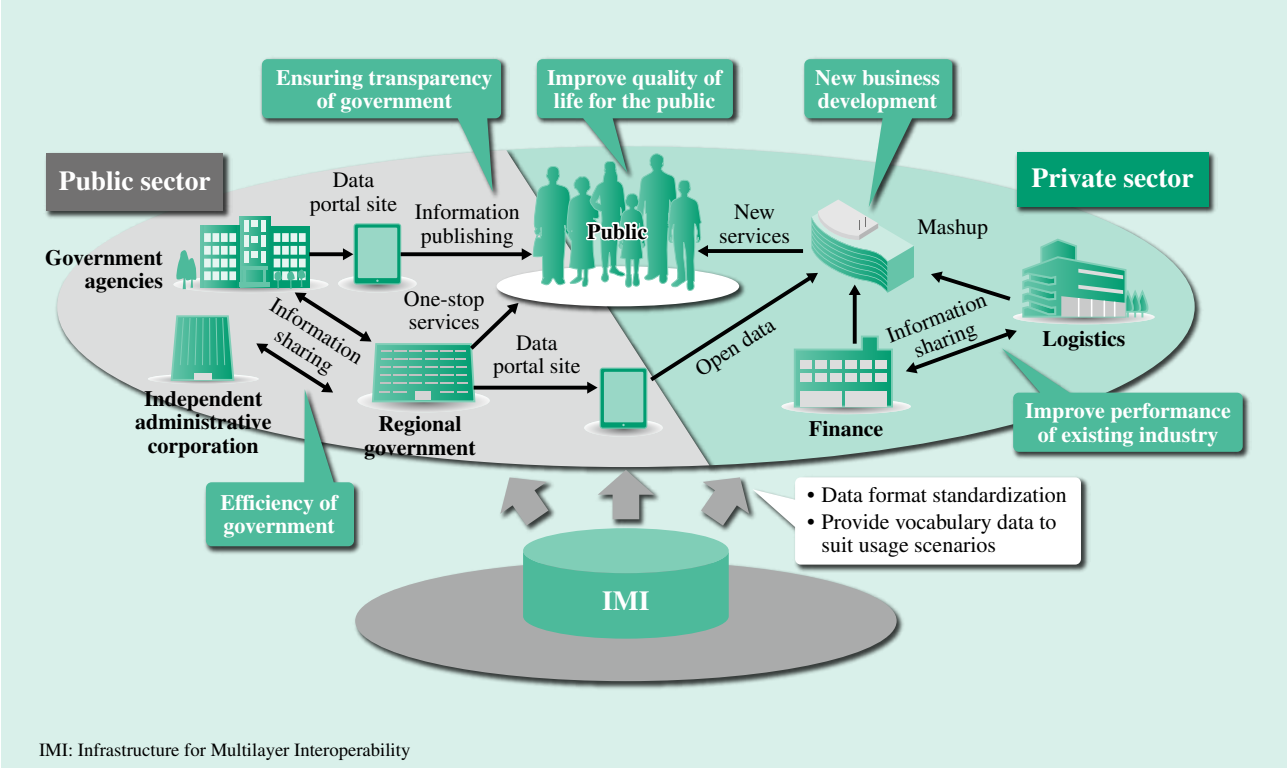

Fig. 1—Overview of the IMI.
The IMI enables the combination of different types of data, the cross-platform use of data, and seamless information sharing between government systems that use different data formats.

is expected to promote information sharing between government systems.

Difficulties of Using Data of Different Types

As government institutions that provide open data and government systems that share information become more numerous in these days, they are using data created in a wide variety of data formats (notation of terminology, data structures, etc.).

Using the automated external defibrillator (AED) data published by local governments as an example, different local governments list the names of facilities where AEDs are available under different titles, such as “facility name” or “name.”

Likewise with the addresses of facilities where AEDs are available: in some cases these are formatted as a single field containing everything from the postal code to the lot number, in others as different fields for the postal code, prefecture, municipality, and lot number.

In this way, even if data are conceptually the same, when data have different notations and structures, humans can understand that the meaning is the same, however computers interpret them as having different meanings. This complicates the integration of heterogeneous data (data of different types) published by numerous different government institutions, and the achievement of seamless information sharing across government systems.

Using the IMI to Enable Use of Heterogeneous Data and Seamless Information Sharing across Government Systems

To overcome the difficulties described above, it is necessary to standardize data formats by concentrating on terminology and collating vocabulary data that includes the notation, structure, and meaning of each term, notation constraints, and the relationship between different terms. As a means of achieving this, Hitachi is working on establishing the IMI to provide a database for managing vocabulary data and an application programming interface (API) for using this vocabulary database.

In the case of the AED example described above, an AED search application has been developed that uses the vocabulary data provided by the IMI to standardize the format of the AED data published by each local government and enable searches to be performed for AEDs that cover the entire country[5]. Fig. 2 uses AEDs as an example to show how the standardization of data formats works.

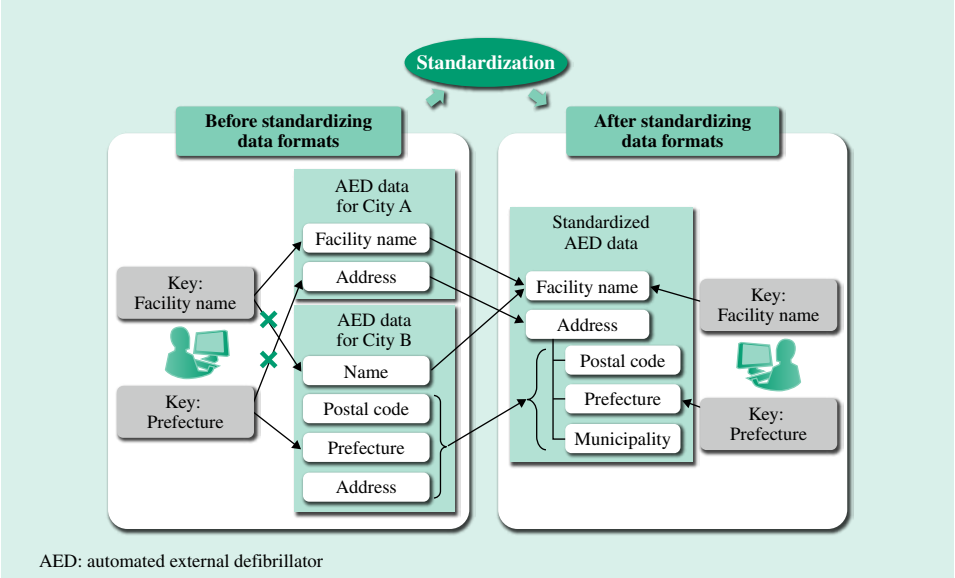

Fig. 2—Standardization of Data Formats.
Standardizing the notation and structure of data terms facilitates the use of different types of data (heterogeneous data).

Preparation for the use of heterogeneous data and seamless information sharing across government systems requires a phase in which the vocabulary data required for the standardization of data formats is collated and a phase in which data is produced in a standardized format from the data held by the data providers.

Fig. 3 shows how the use of heterogeneous data and seamless information sharing across government systems is achieved using the IMI.

WORK TOWARD IMPLEMENTING THE IMI

Challenges of Implementing the IMI

Hitachi participated in the Development of Conceptual Model of Vocabulary Database for Information Sharing and Implementation and Operation of Pilot System project of the Information-technology Promotion Agency, Japan, which involved the development of a conceptual model representing the form that the IMI should take and also identifying the

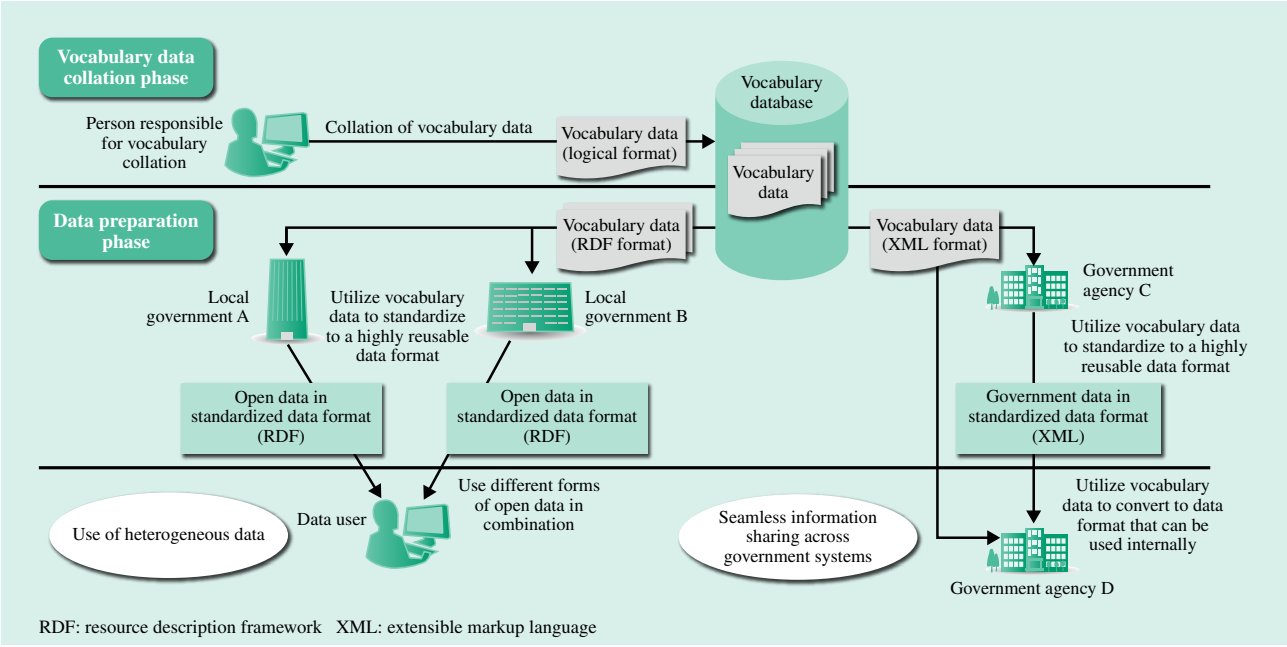

Fig. 3—How Use of Heterogeneous Data and Seamless Information Sharing across Government Systems is Achieved Using the IMI.
Using the IMI for heterogeneous data and seamless information sharing across government systems facilitates the use of data by standardizing the formats of heterogeneous data.

challenges associated with its implementation[6]. The two major challenges are as follows.

The first is that the vocabulary data collation phase requires using usage scenarios for information publishing and sharing in a variety of fields (transportation, finance, organizations, etc.) as a basis for the collation of information such as the structure and meaning of terms, notation constraints, and the relationship between different terms. The difficulty with this is that collating information such as the scope of usage scenarios or the meaning of terms used in a particular field requires someone with expertise in that field.

The second challenge is that, in the subsequent data preparation phase, because data needs to be prepared in a variety of formats to suit different users and usage scenarios, including the use of heterogeneous data and seamless information sharing across government systems, the vocabulary data must support all of these different data formats.

Vocabulary Data Collation Technique for Publishing and Sharing of Information

To overcome the challenges posed by the vocabulary data collation phase, Hitachi has developed a vocabulary data collation technique for publishing and sharing information.

This technique enables large quantities of high-quality vocabulary data to be collated efficiently for the purposes of information publishing and sharing, even by people who lack expertise, and ensures a certain level of quality even if adequate support from experts in the field is not available.

Hitachi participated in a project run by the Organization for Small & Medium Enterprises and Regional Innovation, Japan in which it used this technique to collate vocabulary data for information sharing between organizations over a period of approximately four months from November 2014 to February 2015.

Specifically, this identified three categories of usage scenarios (information about business systems at the Organization for Small & Medium Enterprises and Regional Innovation, Japan, application forms for small and medium-sized enterprises, and company data held by external company data sites and other sources), and collected and collated terms including corporate and joint-stock company terminology.

The following is a summary of the collated vocabulary data.

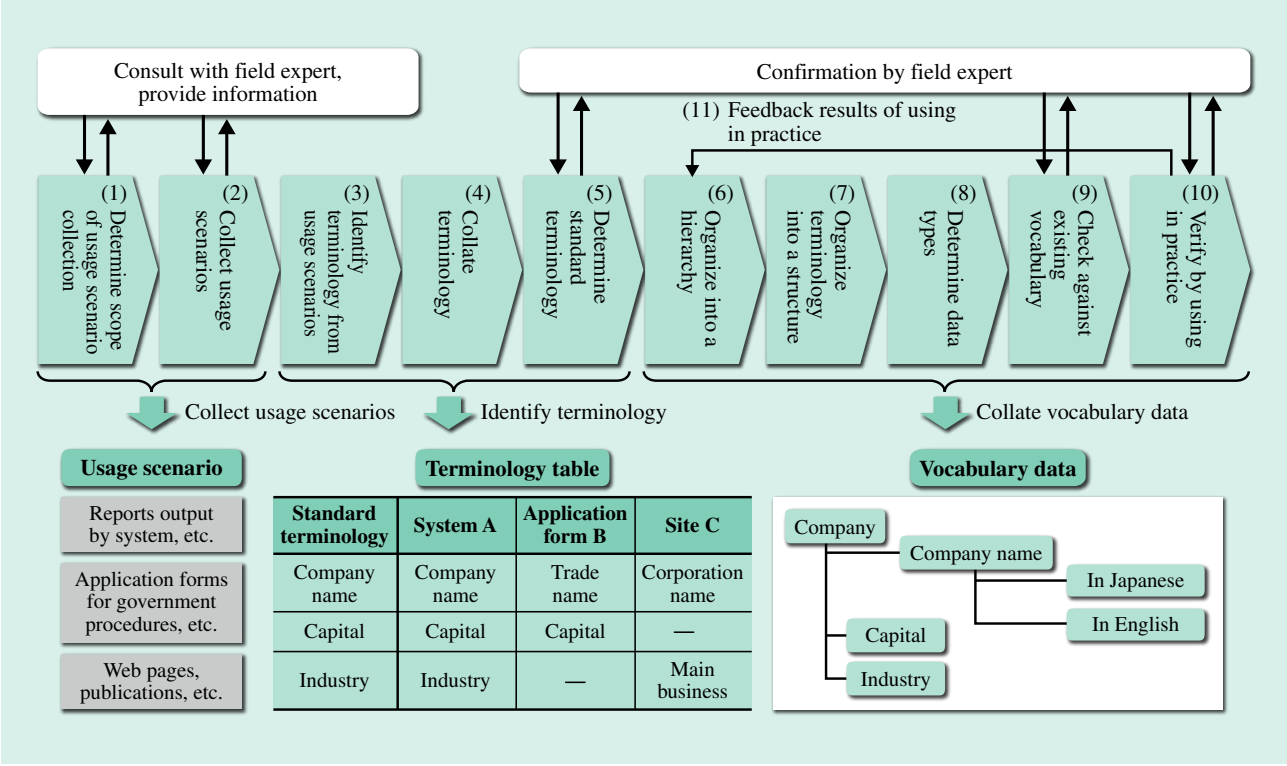

Fig. 4—Vocabulary Data Collation Process.
The steps in the process, which include collecting samples (usage scenarios) of actual data, such as web pages; identifying terminology; and collating vocabulary data, are performed with assistance from an expert in the field.

• 2,504 usage scenarios were collected.
• 61,337 terms were identified.
• 1,304 terms were included in vocabulary data.

Fig. 4 shows the process for using the vocabulary data collation technique for publishing and sharing information to collate vocabulary data for information sharing between organizations.

In collating vocabulary data, the core vocabulary[7] collated by the Development of Conceptual Model of Vocabulary Database for Information Sharing and Implementation and Operation of Pilot System project of the Information-technology Promotion Agency, Japan was used to reference common terms such as organization, name, and address to conduct the collation work more efficiently and to ensure compatibility with other vocabulary data.

Vocabulary Database Design Technique

To overcome the challenges posed by the data preparation phase, Hitachi has developed a vocabulary database design technique.

This technique stores vocabulary data that, in the vocabulary data collation phase, was collated in logical formats that are independent of the data format and provides it in physical formats that are suitable for users and associated applications, such as the resource description framework (RDF)*2 format, which facilitates the combination of data on the web and searches across multiple data sets, and the extensible markup language (XML) format, which can easily be checked to verify that linked data is free from errors and inconsistencies.

To trial the technique, Hitachi implemented and operated a pilot vocabulary database system that stores vocabulary data collated in logical formats and provides it in physical formats via an API. This work was part of the Development of Conceptual Model of Vocabulary Database for Information Sharing and Implementation and Operation of Pilot System project of the Information-technology Promotion Agency, Japan.

The pilot system was used to store vocabulary data provisionally collated into five fields (facilities and services, roads, tourism, events, and systems), and it was operated in conjunction with prototype tools for each field to verify the vocabulary data and its suitability for providing the vocabulary data obtained via the API in a physical format.

*2 RDF: A framework recommended by the World Wide Web Consortium (W3C) for using three elements (subject, predicate, and object), collectively called a "triple," to represent the relationships between data.

CONCLUSIONS

This article has provided an overview of the IMI, which facilitates the use of heterogeneous data and seamless information sharing across government systems, and described what Hitachi is doing to implement such infrastructure.

Hitachi intends to encourage the use of heterogeneous data and information sharing across government systems by continuing to develop technologies for providing and using the IMI. Through the use of these technologies, Hitachi intends to contribute to achieving Social Innovation by facilitating data integration, application development, uses for big data that include open data and Internet of things (IoT) data, and other such activities that are likely to be undertaken by organizations, particularly government agencies, so that it can encourage organizational process improvement and the development of new services that impact society.

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Featured Articles

Use of IoT by Government Institutions

Hiroyasu Takagi
Tadashi Mima

OVERVIEW: Use of the IoT and other sensor technologies by the public sector is an emerging field, with scope for a variety of operational uses in the areas of information collection, policy implementation, and business resources management. Along with improving the productivity of tasks that were previously conducted manually, it also opens up the potential for new operational practices by enabling the movements and other information about large numbers of people and objects to be monitored in ways that are impractical to perform manually. Nevertheless, there are a number of technological, systemic, and organizational challenges and considerations to bear in mind when introducing sensor technology in practice. Hitachi looks forward to the public and private sectors working together on ways of overcoming these challenges so that, by making steady progress toward practical implementation, further advances can be made in the use of the IoT by government institutions.

INTRODUCTION

THE Internet of things (IoT) involves the exchange of information between all sorts of different devices. Driven by advances in sensors, networks, and other information technologies (IT), it has emerged as a full-fledged trend in recent years.

While private-sector businesses are already looking at a wide variety of applications for the IoT, some of which have already been implemented, it has yet to be wholeheartedly adopted by the public sector, particularly government institutions.

In recognition of this, Hitachi was contracted by The Institute of Administrative Information Systems in FY2014 to conduct a study of the potential for sensor technology in the public sector. This article reports on the results of this work.

SENSOR TECHNOLOGIES USED FOR IOT

Scope of Sensor Technologies

The study defined the scope of sensor technologies with reference to the fact that use of the IoT and big data can create value in a variety of different ways. That is, it encompassed not only sensor devices[(1)] that collect information on the external environment, but also sensor modules that combine sensors with communication functions, data networks (telecommunication networks), storage devices, and the cloud for storing data, and analysis techniques for extracting useful knowledge from the data (see Fig. 1).

Trends in Sensor Technology

Sensor technology in recent years has been characterized by improvements in the function of sensor devices and modules and advances in techniques for their mass production, including more advanced functions, the integration of multiple functions, and better reliability. An effort has also been made to reduce their power consumption and cost and to make them smaller and lighter for use in commercial and consumer applications.

In the case of networks, along with reducing the power consumption and increasing the speed of wireless communication systems, wireless sensor network technologies have also included advances in network control techniques such as ad-hoc networking whereby sensors relay communications for each other.

Improvements to storage technology have included higher capacity and faster data retrieval speeds, while in the cloud, interest has focused on the emergence of the database-as-a-service (DBaaS) model for the collection and analysis of big data and the use of non-relational databases suitable for handling unstructured data such as the numeric, text, image, and audio data that frequently features in big data.

In the case of analysis techniques, progress is being made in the development of stream analysis techniques

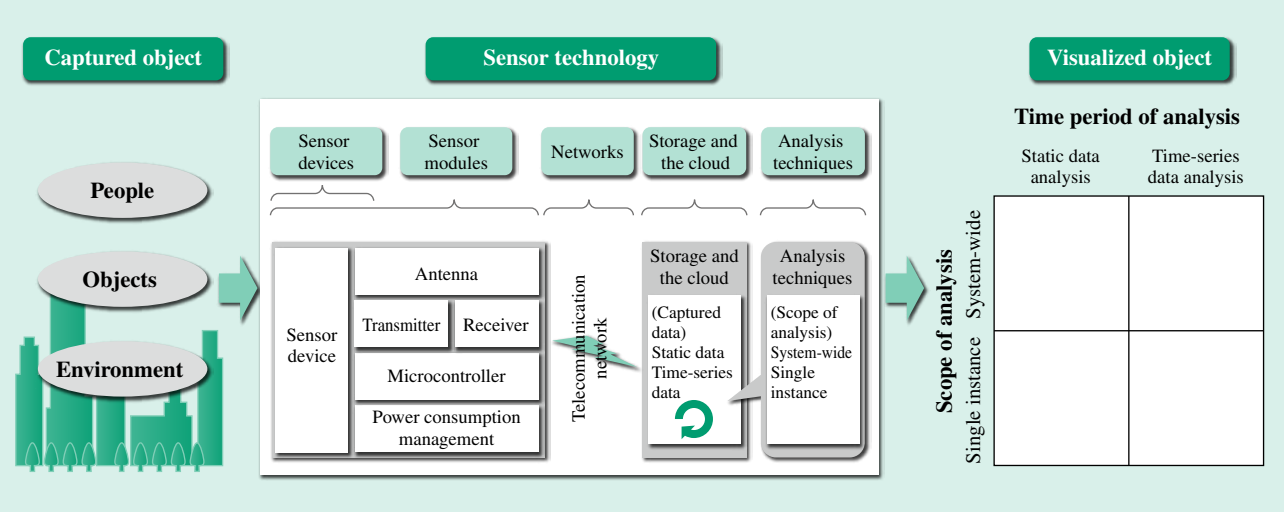

Fig. 1—Framework for Using Sensor Technology.
Hitachi developed a general-purpose framework that focuses on "captured objects" (the people, objects, or environment being monitored by the sensor) and "visualized objects," classified as the time period of analysis (the presentation of information from sensors using static or time-series data analysis) or the scope of analysis (whether considering a system-wide or a single instance).

such as complex event processing (CEP); stock analysis techniques that use technologies such as artificial intelligence (AI); and analysis platform technologies such as parallel distributed processing systems.

CASE STUDIES OF EARLY ADOPTION OF IOT

Collection of Early Adoption Case Studies and Consideration of Frameworks

To put these advances in sensor technology in context and understand how the technology is being put to practical use, Hitachi utilized websites and other published information to conduct a survey of examples of its early adoption by private-sector companies or local government agencies and other government institutions in Japan and elsewhere. The survey collected a total of 59 such case studies.

Hitachi also drew on the results of the survey to devise a general-purpose framework for the broad-based study of the potential for using sensor technology in the public sector, and used this in its appraisal of the case studies.

In devising the framework, Hitachi looked at the processes associated with the use of sensor technology and defined the terms "captured objects" for the inputs to sensor technology and "visualized objects" for the outputs, investigating these respective categories (see Fig. 1).

"Captured objects" are classified as either people (when monitoring the movements or other information about human beings), objects (when monitoring the movements or other information about animals or man-made objects), or the environment (when monitoring the weather, atmospheric conditions, forests, or other aspects of the external environment that are not covered by the above two categories). In contrast "visualized objects" are treated as classifiable in terms of the time period of analysis and scope of analysis respectively. The time period of analysis can be classified as either "static data analysis" when the analysis is performed on data taken from the captured object at a particular time, or "time-series data analysis" when the analysis is performed on data collected over time. Similarly, the scope of analysis can be classified as either "system-wide," indicating a fixed range or group in its entirety that is clearly defined by capturing data on a number of different people or objects, or a "single instance," indicating a particular person or object identified by capturing data about them.

Appraisal of Case Studies

Each of the collected case studies was assigned a position in a matrix based on their "captured object" and "visualized object" classifications, and an appraisal of these was conducted (see Table 1).

Looking at the distribution of the categorized case studies shows that examples involving the capture of data about people were the most common (37 examples), among which many examples involved the analysis of single-instance movements (time-series data analysis) or status (static data analysis) (28 examples). This was attributed to interest in things like

TABLE 1. Classifications for Sensor Technology Case Studies
The case studies of sensor technology use were classified in a matrix by "captured object" and "visualized object." The table lists a typical example from each category and the number of case studies for each.

	Static data analysis		Time-series data analysis	
	System-wide	Single instance	System-wide	Single instance
People	Use of image analysis to determine visitor attributes, etc. (2)	Transmission of video, audio, and location information for people or chairs to support telework, etc. (11)	Use of smartphone app and GPS to collect and analyze data on activities of foreign tourists, etc. (7)	Support for health by using wearable wristband sensors to monitor daily activity of staff, etc. (17)
Objects	Use of airborne drones with GPS, cameras, and other equipment to assess disaster sites, etc. (4)	Use of sensors to assess how full rubbish containers are, etc. (6)	Countermeasures for danger spots on roads utilizing data on locations where there is a high frequency of vehicles braking suddenly (1)	Use for taxation of driving distance and other data collected from vehicle-mounted systems with GPS, etc. (5)
Environment	Efficient monitoring of environmental pollution using chemical sensors on buses, etc. (4)	None	Providing and sharing information on weather situations by service users (2)	None

GPS: global positioning system

individual behavior analysis as being a trend in recent years. The results also showed a comparatively large number of examples involving the use of the portable sensors in smartphones to collect data on the system-wide movement of people ("people flow"). Specific examples included an initiative aimed at encouraging tourism by using smartphone apps and the global positioning system (GPS) to collect and analyze data on the activities of foreign tourists.

A total of 16 case studies involved the collection of data about objects. Specific examples included an initiative aimed at facilitating safety measures on prefectural roads by collecting location and other information from the car navigation systems of vehicles and analyzing it to identify sites where sudden braking occurs frequently.

Cases involving the collection of environmental data were few in number (6), with a feature being initiatives aimed at providing a more accurate "system-wide" view of the ever-changing environment. An initiative that has reached the implementation stage in one European city involves the detailed realtime monitoring of atmospheric pollution across a large urban area by attaching sensor modules fitted with GPS as well as chemical and other sensors to the roofs of buses to perform continuous air detection and measurement while in service, with data being collected via a wireless network.

POTENTIAL FOR USE OF IOT IN THE PUBLIC SECTOR

The operations of government institutions cover a wide range of activities. Considering the government management cycle[2], these areas of activity can be defined as information collection, policy making and budgeting, policy implementation, policy evaluation, policy improvement and institutional reform, disclosure of information, and business resources management. Hitachi has investigated the potential for use of sensor technology in each of these areas (see Fig. 2).

Specifically, Hitachi first looked at the characteristics of each area, the operations of entities such as central government agencies[3] and independent administrative corporations[4], and the role of sensor technology to investigate which areas have potential for using the IoT, narrowing down its focus to information collection, policy implementation, and business resources management (since policy improvement and institutional reform relates to the work done in policy implementation, it was included in that area). Next, an investigation into the potential for using sensor technology in these three areas based on the framework described above came up with a number of potential uses in each area.

Information collection includes activities such as statistical surveys and surveys of facility use, and Hitachi found that there is potential for using visible-light sensors (such as cameras), smartphones, vehicle-mounted sensors, and so on to collect movement and other status data on people, objects, and entire environments for tasks like these that to date have been undertaken manually by staff or others. Possible examples include the use of facial expression analysis to measure user satisfaction among people making inquiries at government offices, or using an analysis that can identify sites where there is a high frequency of vehicles braking suddenly to undertake safety improvements on roads managed by national or local government agencies.

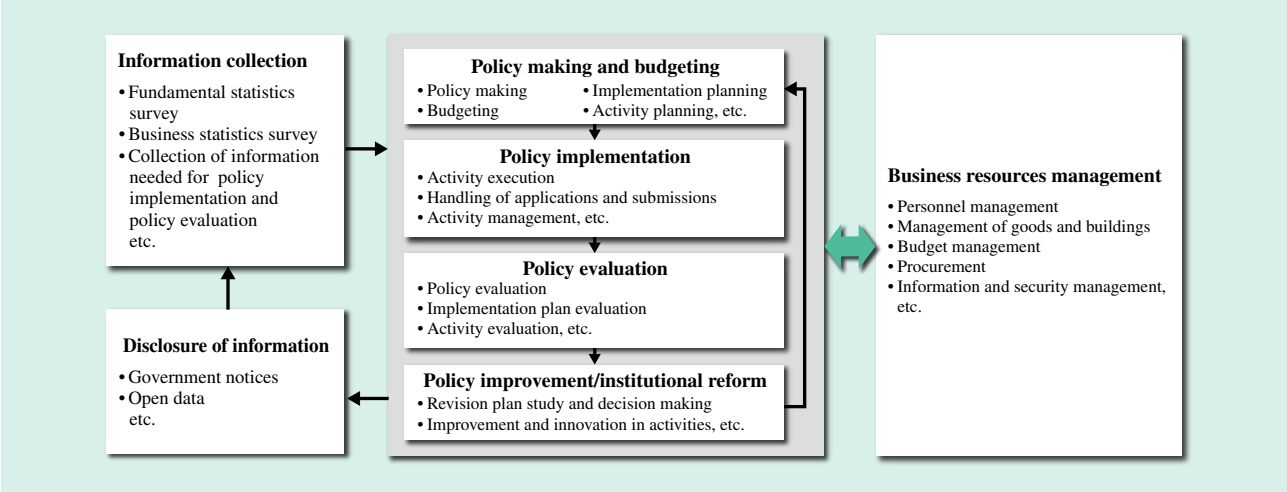

Fig. 2—Areas for Investigating Potential for Using Sensor Technology.
The areas of government activity were defined as being: information collection, policy making and budgeting, policy implementation, policy evaluation, policy improvement and institutional reform, disclosure of information, and business resources management.

Policy implementation includes activities such as over-the-counter services, border control procedures, taxation, and public works. These are areas in which progress has already been made on the use of sensor technology, but also with numerous possibilities for new uses. Possible uses for sensor technology include new methods of taxation based on parameters such as vehicle usage determined using automotive sensors, the use of GPS to obtain a situation overview during disaster and other emergency management, or the use of microwave sensors to identify people behaving suspiciously when passing through customs, for example.

Business resources management includes activities such as personnel management, management of goods and buildings, and budget management. Potential uses for sensor technology in this area include health monitoring for staff engaged in special duties that impose a high level of physical or mental stress, monitoring of staff movements or communications, and assessing the degree of aging of government buildings, for example.

In relation to the possibilities in these areas, the study also specifies some of these in more detail in preparation for their practical implementation, considering them in terms of how the work is currently done, the "captured objects," the sensor technologies to use, the "visualized objects," potential benefits, challenges, and issues to consider (see Table 2).

CHALLENGES AND ISSUES TO CONSIDER

There are a number of challenges and issues to consider in relation to advancing the use of the IoT by government institutions. In regard to technology, work is needed on things like the reliability and maintainability of sensor technology, data standardization, sensor network security, and measures for encouraging the switch to Internet Protocol version 6 (IPv6). Sensor technology reliability, in particular, is vital for avoiding false conclusions if the accuracy of collected data fails to satisfy requirements determined by factors such as the nature of the work for which it is intended. In relation to systemic matters, work is needed on things like privacy considerations, the provision and review of legal frameworks for government activities, and the review of frequencies used by networks and related matters. In the case of privacy considerations, it is important to clearly identify the data being collected and the reason for its collection, and to provide advance notification to the people being monitored (the "captured objects"). In cases such as using cameras to monitor visitors to public facilities and to classify them by attributes, for example, things that need to be considered include the use of signage or other methods to warn people that this is taking place, or the provision of alternative entrances that are not monitored by camera. Examples of organizational considerations include providing infrastructure designed to allow sharing between a wide range of entities that utilize sensors (including national or local government agencies), promoting the use of private-sector data, and training staff at government institutions so that they will be able to undertake data analysis. As noted above, given that sensor technology is likely to be used for a wide range

TABLE 2. Specific Examples of How Sensor Technology Can be Used

For typical examples of how sensor technology can be used in the information collection, policy implementation, and business resources management areas of government activity, Hitachi has devised more specific outlines of what form this use might take in practice.

Area	Activity	Basis of suggested use	Description
Information collection	Use facial expression analysis to survey user satisfaction among people visiting service counters at government offices	Current situation	As a means of determining how satisfied people who visit service counters at government offices are with the service they receive, Ministry of Health, Labour and Welfare or prefectural labor bureau staff, for example, stop people who have made employment inquiries at Public Employment Security Offices near the exit and interview them about their overall level of satisfaction with the service or their suggestions for improvement.
		"Captured object"	Capture the facial images of people who have visited service counters or other points of contact with the agency. There is also the potential to track changes in facial expression by collecting data from both the beginning and end of the consultation, rather than capturing it only once.
		Sensor technologies used	Use visible-light sensors or other types of camera to collect image data from service counter users and analysis techniques for detecting faces and interpreting facial expressions. Recognition of faces and parts of the body involves generating characteristics and rules from large quantities of image data and examples of correct recognition, and using machine learning algorithms to recognize faces and parts of the body using this data. The technique used to interpret facial expressions involves producing a shape model of faces from large numbers of image samples and then determining whether the shape resembles the model.
		"Visualized object"	Use time-series data to analyze changes in the facial expressions of a person visiting a service counter at a government office, and present information on their level of satisfaction based on the expression interpretation (happy, surprised, fearful, antagonistic, angry, sad, expressionless, etc.) and circumstances.
		Expected benefits	Whereas past methods have only surveyed a sample of users, this method can survey everyone. It also is less imposing on the staff who conduct the questioning and the service counter users who respond. There is also scope for presenting the obtained information on user satisfaction in ways that relate to different criteria, such as showing a low level of satisfaction among young males.
		Challenges and issues to consider	The accuracy of sensor technology is not such that achieving 100% accuracy in the detection of faces and face parts or interpretation of facial expressions is realistic. Furthermore, in the case of an exit survey at Public Employment Security Offices, the checking of desirable improvements other than satisfaction and the use of sensors to replace all current activities is also not practical. Meanwhile, privacy considerations are one of the issues to bear in mind in relation to systems (organizational practices). It is likely that many service counter users will be resistant to the idea of recording and analyzing their facial expressions. Accordingly, potential measures include using signage or other means to clearly indicate to service counter users that their images are being recorded and analyzed for satisfaction measurement, and offering counters that do not use cameras.
Policy implementation	Levying of vehicle tax based on actual mileage	Current situation	Income from taxes such as fuel taxes levied at the point of sale will likely fall as vehicles with low fuel consumption become more common. Given factors such as the rapid aging of roads and other infrastructure in the future, it is likely that a review will be needed of how to use taxation for user-funding of road maintenance.
		"Captured object"	Record vehicle location information and distance travelled to determine actual mileage
		Sensor technologies used	Use an onboard information system (such as a car navigation system with GPS) and the vehicle's odometer. The collected data is sent from the onboard information system to roadside base stations. It is anticipated that this will involve a communication method that is difficult to intercept like that used for toll payments on Japan's ETC system.
		"Visualized object"	Data (including driving location and time information held by the onboard information system and distance travelled data) tagged with a unique vehicle identifier will be collected and analyzed by a government institution (or by a private operator contracted by the government) to make driving records for individual vehicles available.
		Expected benefits	This should provide a mechanism whereby users fund part of the cost of road and other maintenance based on how much they use the roads, to ensure that those who benefit pay their fair share.
		Challenges and issues to consider	Because providing driving data to the government will lead the drivers who are taxed to feel that their vehicle use is being monitored by the government, possible measures include ensuring that the data cannot be used for any other purpose or offering alternative means of taxation. In the case when existing onboard information systems are not designed to prevent tampering with driving data, measures will also be needed to prevent falsification. Furthermore, consideration of the mechanism used to collect the tax payments needs to account for matters such as the tax system. In regard to user-pays, there is also scope for using sensors to measure vehicle weight as well as other driving parameters, and to use these as a basis for taxation also.
Business resources management	Health management for staff with special duties	Current situation	According to the National Personnel Authority, an increasing number of people are requiring long-term medical leave due to mental or behavioral disorders, with workplace stress seen as one cause. Along with other support measures for maintaining and promoting the mental health of staff, the military, firefighters, police, and others who respond to major disasters are said to experience as much stress in three months as ordinary people experience in a lifetime, and therefore there is a particular need for health management support for staff who have special duties that expose them to danger or excessive stress.
		"Captured object"	Measure the action current (biological signal) for the electromotive forces of the heart associated with the action of the heart to record data such as electrocardiographic waveforms and heart rates for staff engaged in duties that expose them to danger or high levels of stress, such as the military or air traffic controllers
		Sensor technologies used	Use a shirt (wearable electrode inner) made from fabric coated in electroconductive polymer as an electrode to measure biological signals. The measured waveform data is transmitted wirelessly via a small transmitter attached to the shirt to a smartphone, personal computer, or other similar device and then sent via the Internet to a server for waveform analysis.
		"Visualized object"	Manage workload and fatigue during working hours by analyzing and monitoring electrocardiographic waveforms of the employee to avoid assigning excessive work and to trigger an alarm if the person is at risk of becoming dehydrated or some other form of poor health. Because there is a close relationship between variability in changes in heart rate and things like autonomic nerve function and stress, it should be possible to estimate levels of stress and relaxation, and to intervene at an early stage if a tendency toward mental illness is indicated.
		Expected benefits	By encouraging staff to take a break when they show abnormalities such as excessive stress or fatigue during work, it should be possible to prevent them from continuing to work in a condition that is dangerous for their job. Furthermore, if early symptoms of mental health or other illness are identified, these can be prevented through early intervention.
		Challenges and issues to consider	While conventional electrocardiograph machines are attached to the skin using electrolyte paste to record heart rate, electrocardiographic waveforms, and other parameters, there is a need to verify in terms of the reliability of sensor technology that measurements can be made with the same level of accuracy as in the past. There is also a need to verify how much the environment in which the sensors are used influences their accuracy. In terms of privacy considerations, investigation is also needed into operational rules, such as measures for ensuring that biological information about staff is only available to industrial doctors. There is also a need for maintenance measures such as improving durability.

ETC: electronic toll collection

of different activities in the future, it is inefficient for each government institution to set up its own infrastructure for this purpose. Meanwhile, given that large amounts of data are now being generated and collected by private-sector companies and others, it is important to include consideration for utilizing this private-sector data when investigating what form the provision of infrastructure should take.

CONCLUSIONS

This study has demonstrated that a number of different government activities are potentially able to utilize the sensor technology that makes the IoT possible. This includes not only improving the productivity of tasks previously conducted manually, but also opens up the potential for new operational practices by monitoring the movement and other information about large numbers of people and objects in ways that would be impractical if performed manually.

Nevertheless, the study also identified a number of technological, systemic, and organizational challenges and considerations to bear in mind when introducing this sensor technology in practice. Hitachi looks forward to the public and private sectors working together on ways of overcoming these challenges so that, by making steady progress toward practical implementation, further advances can be made in the use of the IoT by government institutions.

ACKNOWLEDGMENTS

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Featured Articles

Development of Information Platform Service for Facilitating Reform of Work Practices and User Value Maximization

Atsushi Kawai
Yuuji Ikawa
Hiroaki Hiramatsu
Masahiko Inoue

OVERVIEW: The design of information platforms, an important part of the IT infrastructure that supports routine activities, needs to produce systems that are compatible with the work practices at the organization based on an understanding of developments in government that take account of changing real-world work practices and the associated technical trends. Given the documents published by the Fourth Joint Meeting of the Council on Economic and Fiscal Policy and the Industrial Competitiveness Council and a June 2014 Cabinet decision entitled, "Declaration to be the World's Most Advanced IT Nation," an important consideration in Japan relating to trends in work practices in recent years is that the designs of information platforms support the various measures being considered, including the establishment of new practices regarding work hours, promotion of "morning" work practices, and measures for the wider adoption of telework. Hitachi has developed information platform services that can make full use of the cloud to contribute to reforming work practices and that seek to maximize value for users, organizations, and others. Along with describing work on the development of information platform services, the benefits derived from application case studies, and the technologies and know-how used, this article also considers the outlook for the future.

INTRODUCTION

AMONG the issues associated with work practices in Japan are the difficulty of adopting more flexible work practices due to rigid forms of employment and employment systems, and the negative effect on productivity of the normalization of long work hours. The achievement of diverse work practices has become an urgent challenge for overcoming these issues.

CHANGES TO WORK PRACTICES

At public-sector organizations, information platform services are an important part of the information technology (IT) infrastructure that is used by all staff and supports their routine activities. Accordingly, the design of an information platform needs to be chosen so as to be compatible with the work practices of the organization and its staff based on an understanding of developments in government that take account of changing real-world work practices and the associated technical trends.

Table 1 lists trends in work practices in Japan under the categories "people," "time," and "place" based on sources such as documents published by the Fourth Joint Meeting of the Council on Economic and Fiscal Policy and the Industrial Competitiveness Council and the June 2014 Cabinet decision entitled entitled, "Declaration to be the World's Most Advanced IT Nation."

NEXT-GENERATION INFORMATION PLATFORMS

The concepts targeted by information platform services for reforming work practices are as follows.
(1) Improvement of user convenience
(2) Achievement of low-cost operation
(3) Improvement of operational efficiency
(4) Improvement of security

These initiatives are essential elements for supporting information platform services that are being required to become more advanced and efficient, and replacing conventional on-premises local-area network (LAN) and wide-area network

TABLE 1. Summary of Laws Relating to Work Practice Reforms Currently Under Consideration
This table was collated by Hitachi Consulting Co., Ltd. based on documents from the Fourth Joint Meeting of the Council on Economic and Fiscal Policy and the Industrial Competitiveness Council and the June 2014 Cabinet decision entitled entitled, "Declaration to be the World's Most Advanced IT Nation."

	Considered reform	Summary
People	Increasing the number of women in management positions	1. Ask companies to formulate action plans for increasing the number of women in management positions. However, a draft law on promoting women in the workplace lapsed due to dissolution of the Diet.
	Recruiting global staff with advanced skills	2. Establish a work hours system that enables flexible work practices under which people can demonstrate creativity based on clear job descriptions/levels of achievement and pay-for-performance
Time	Establishing a new work hours system	
	Facilitating "morning" work practices	3. Consider changes such as discretionary work systems for management staff or extension of flex-time systems, without waiting for a decision on a new work hours system
	Revising the flex-time system	
Place	Promoting wider use of telework	4. Establish awards system for recognizing early adopters and publish case studies of the practices of early adopters

IT: information technology

(WAN) systems or public clouds as the infrastructure platforms for service delivery (see Fig. 1).

Improvement of User Convenience

The aim is to improve convenience for users based on the concepts of work practice reforms and use of information "whenever (time), wherever (place), and in a way that enables them to work efficiently (pay-for-performance)."

Achievement of Low-cost Operation

The aim is to provide low-cost operation while taking account of the factors that satisfy requirements for improving user convenience, increasing interoperation between services, and optimizing the total cost of ownership (TCO) throughout the lifecycle of an information platform service.

Improvement of Operational Efficiency

The aim is to improve operational efficiency and establish standard practices that enable operation and maintenance to be performed in a consistent and trouble-free manner, and to reduce loss of time and operational errors due to one-off or other non-standard operations by establishing efficient system configurations and operating practices.

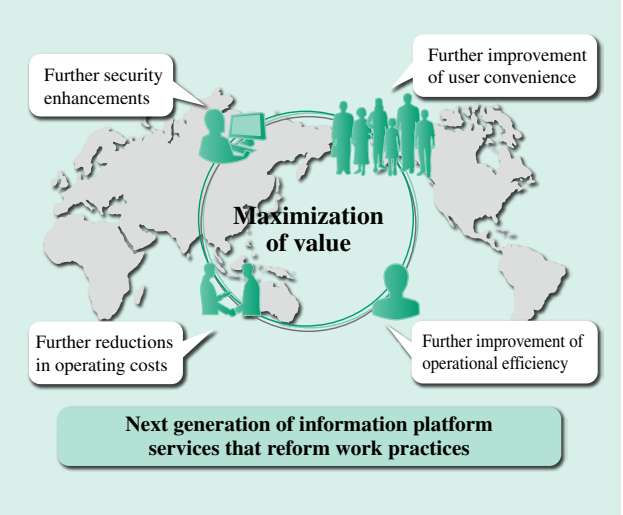

Fig. 1—Four Ways of Maximizing Value.
The aim is to reform work practices and maximize value by making full use of cloud services and selecting the best services for the work.

Improvement of Security

The aim is to improve security by establishing systematic measures for the security of each information platform service, including preventing loss of information such as through cyber-attack or error, and by determining the security level required by each service (see Fig. 2).

DEVELOPMENT OF SERVICES

In the development and selection of each set of information platform services, Hitachi has defined standards to ensure that they are as easy to use as possible for public-sector organizations.

Because information platform services are made up of a number of individual services and other products, combining services makes the overall architecture more complex and administration more difficult. Accordingly, they are at risk of higher TCO and lower return on investment (ROI) compared to currently operating LAN/WAN systems, being unable to take advantage of the benefits provided by the cloud.

In response, in the development and selection of services, Hitachi seeks to prevent this higher TCO and lower ROI by determining the factors that satisfy requirements for improving user convenience, increasing interoperation between services, and optimizing the TCO throughout the lifecycle of an information platform service in accordance with the concept of using a technical reference model (TRM) for information system procurement.

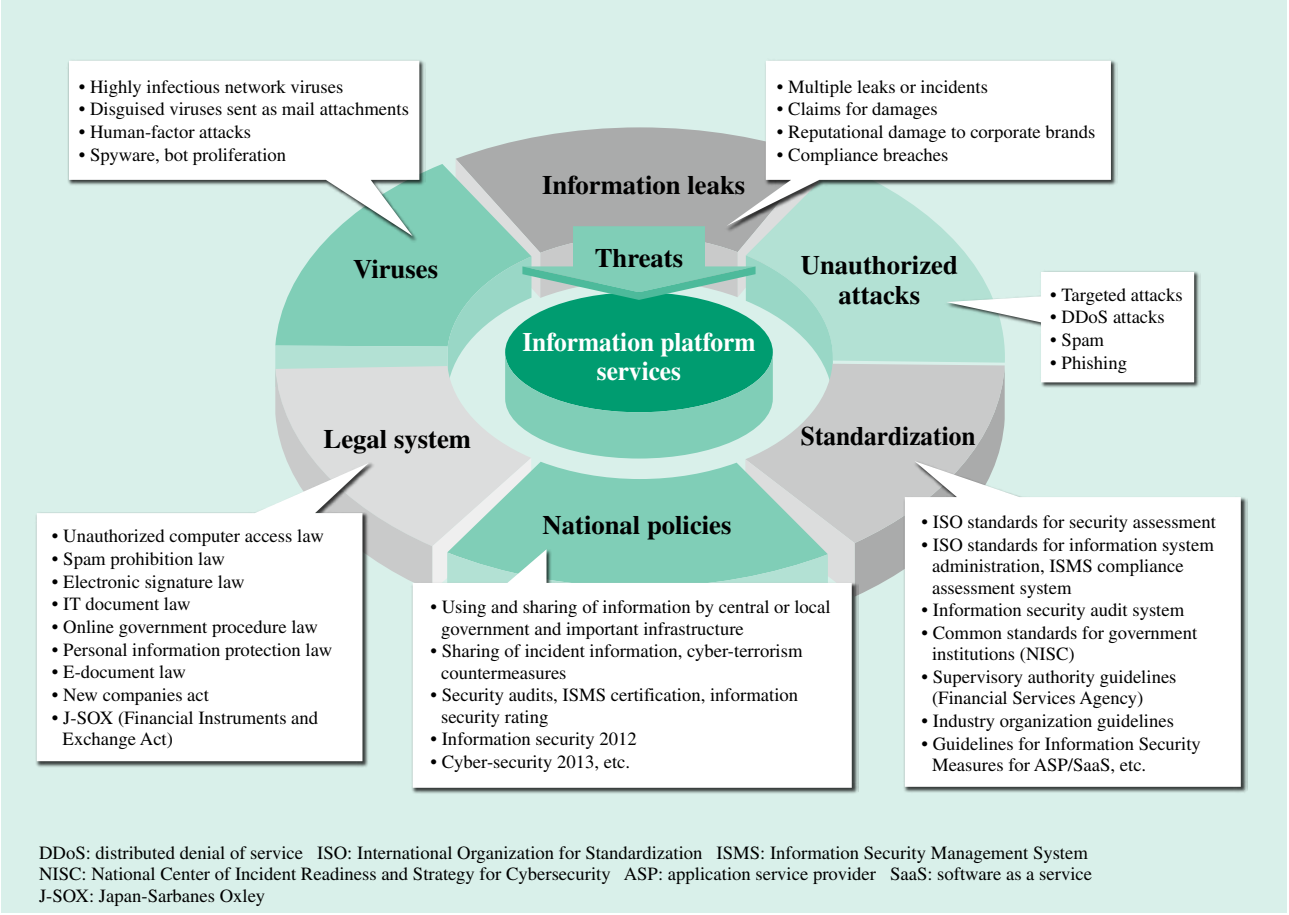

Fig. 2—Overview of Security as it Relates to Information Platform Services.
Hitachi will apply the information security philosophies and existing practices it has acquired as a provider of public IT solutions that support social infrastructure to information platform services.

The relevant factors for the development and selection of a set of information platform services are as described below (see Fig. 3).

More Efficient Administration

A TRM aims to improve user convenience, increase interoperation between government information systems, optimize total costs across the business or system lifecycle, and boost procurement efficiency. It provides a model that is intended to establish and expand an environment of healthy competition within the IT industry by reducing barriers to entry through the wider adoption of impartial specification practices that put a priority of open standards. Accordingly, because it enables standard operating practices to be established so that operation and maintenance can be performed in a consistent and trouble-free manner, and reduces the loss of time and operational errors due to the one-off or other non-standard operations that occurred in situations in which the overall architecture was complex, it is expected to contribute to the consolidation of administration work and a reduction in costs.

Selecting Services that are Easy to Use

With the spread of cloud services, there are an increasing number of examples in which information platform services have been implemented efficiently by combining other services such as those based on software-as-a-service (SaaS) and desktop-as-a-service (DaaS) models with aims that include improving the efficiency of operational administration, reducing operating costs, and improving user convenience. On the other hand, there are also many cases in which various issues have arisen and the anticipated benefits have failed to emerge. Security, in particular, is crucial when entrusting information assets to the cloud, yet when systems are put together with the security level as the sole criterion, the risk is that the resulting system will be expensive and difficult to use, such as an inability to integrate operation across different functions. When selecting which information platform

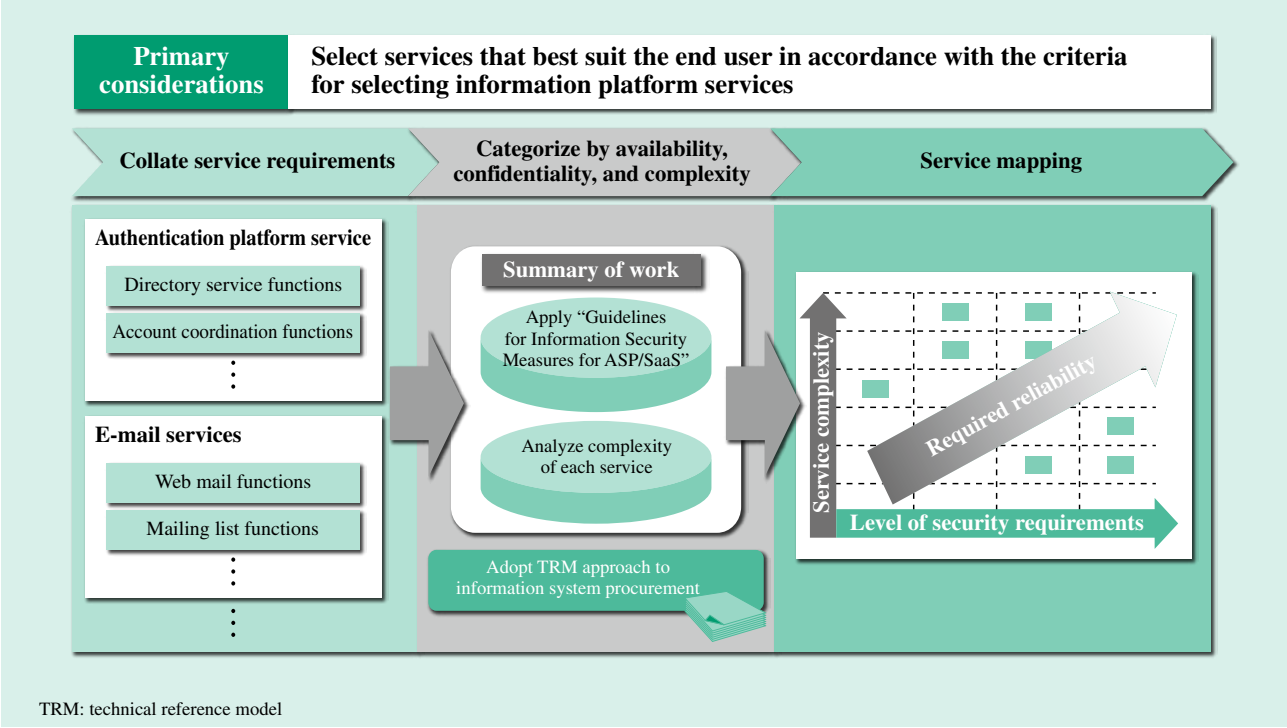

Fig. 3—Process for Selecting Suitable Information Platform Services.
Mapping of the required reliability is performed after categorizing and analyzing each service based on the functions it is required to provide.

services to include, Hitachi selects those services that are easiest for public-sector organizations to use, based on first clarifying the criteria with consideration for matters such as the security level required for each function and the complexity of interfaces between services (see Fig. 3).

(1) Analysis and collation of service complexities

As the individual information platform services need to work together and operate in an organic manner, the more functions are required to interoperate with a large number of other services the more consideration is required for things like interface consistency, meaning that these services can be treated as more complex. While services with sophisticated functions that work with a variety of different interfaces are typically expensive, services that feature excellent cost-performance without compromising ease-of-use can be supplied provided they have adequate functions even if the services have only a limited range of interfaces.

Examples of highly complex services include directory service functions for authentication platform services, thin client software services, mobile functions for rental services, and services for dealing with malware and other threats. Other comparatively complex services include single sign-on functions for authentication platform services and e-mail functions for mail services.

When selecting services, it is important to determine whether or not information platform services interoperate and the degree of complexity of each service.

(2) Systematic collation of security considerations

Information platform services include SaaS and other complex services or products, and while these provide various advantages such as lower TCO and the rationalization of administration, because service operators and affiliated organizations build up large quantities of user information assets, it is important that they also implement appropriate information security measures.

For cloud system security, the Ministry of Internal Affairs and Communications of Japan has published the "Guidelines for Information Security Measures for ASP/SaaS"[(1)]. These guidelines state that the services provided by cloud services need to satisfy different security levels depending on the information they handle, extending to authentication services and groupware. Normally, information security means maintaining the "confidentiality," "integrity," and "availability" of information, these being the terms defined in Chapter 3 of the ISO/IEC 27001:2005 standard.

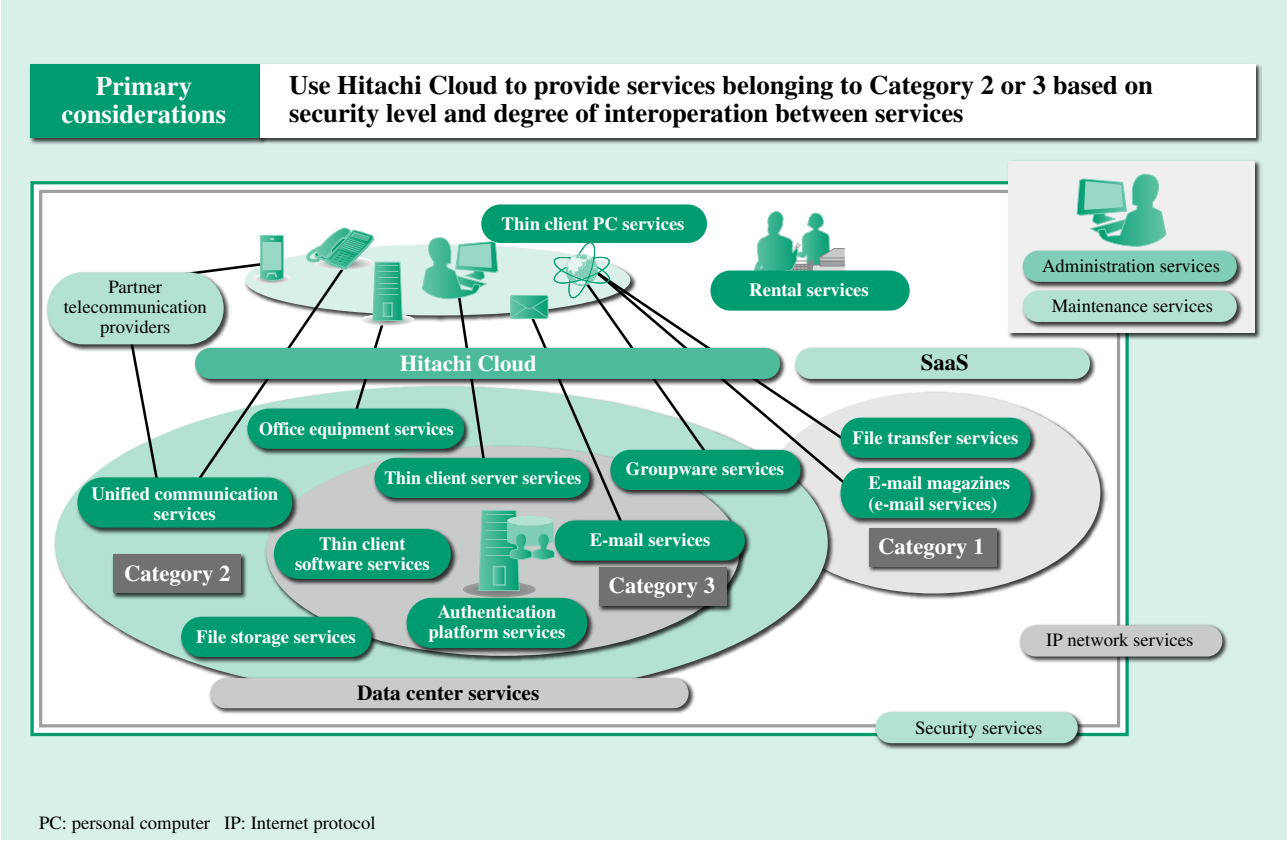

Fig. 4—Selecting Suitable Information Platform Services.
Along with utilizing Hitachi Cloud services, depending on security level, Hitachi also takes active steps to utilize services from other vendors as well as its own services.

Hitachi has systematically collated the individual information platform services based on these guidelines.

Service Selection

Information platform services can be grouped into three categories based on considerations of service complexity and security. The selection criteria for each category are as follows.

(1) Category 1: Group of services that can be selected as needed

The minimal interaction between services in this category means that services with adequate functions are selected. Hitachi takes active steps to select services with excellent cost-performance, including those from other vendors.

(2) Category 2: Group of services that need to be checked to confirm they provide the required functions

As these are services of mid-level complexity, selection involves confirming how well they satisfy customer requirements and, if satisfactory, checking the compatibility of interfaces. These are chosen from among the services provided by Hitachi Cloud because of their compatibility and ease-of-operation.

(3) Category 3: Group of services with potential for adoption of an on-premises implementation

These are services with a high level of complexity and high security requirements that are implemented by combining highly reliable services from a single service provider. Alternatively, an on-premises implementation may be used. Services are selected from those available on Hitachi Cloud or are provided via systems configured independently on Hitachi Cloud.

Fig. 4 shows the various information platform services and categories.

BENEFITS AND CHALLENGES IN PRACTICE

Customer confidence and trust can be earned by setting up a service management office (SMO) within Hitachi that undertakes integrated management and operation across different services so that they can link together in an organic manner, providing ongoing reliable operation of interoperating services, and acting as a point of contact for service inquiries that includes offering new services. The challenge for the

future is to establish mechanisms whereby the same consistent level of service can be provided regardless of which operation and maintenance staff perform the work.

FUTURE OUTLOOK

Hitachi is currently working on implementing information platform services that will serve as "open market trials." Here, "open market trial" refers to a system under which public and private sector entities can bid on equal terms for work on a public service that was previously the monopoly of a government agency, with the service contract being awarded to the bidder who offers the best in terms of both price and quality. Information platform services in the public sector are pioneers of the practice whereby government agencies focus on their core roles and contract out IT infrastructure, including service operation, to the private sector, and are significant in that they will be a subject of study by central and quasi-governmental agencies when they undertake future information platform upgrades. This is an area in which there will be more contracting out to the private sector in the future.

CONCLUSIONS

This article has described how Hitachi has sought to contribute to business performance by customers as well as raise staff activity levels by developing information platform services. In the future, Hitachi intends to share ideas with customers about undertaking ongoing improvement activities relating to the use of systems based on considerations of reforming staff work practices and increasing utilization while making them part of routine work practices, pursuing the enhancement of service value and value maximization by working through the plan, do, check, act (PDCA) cycle. Hitachi also intends to draw on its past successes, including overseas activities, and take maximum advantage of the experience and know-how it has built up through customer projects in a variety of industries.

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Featured Articles

Security Operation Management Initiatives in Cooperative Vehicle-Infrastructure Systems for Safe Driving

Akira Mizutani
Mai Kawamura
Eriko Ando
Toru Owada

OVERVIEW: There has been growing awareness in recent years of the potential for the implementation of self-driving vehicles to deliver benefits such as reducing traffic accidents and alleviating congestion. The techniques for obtaining the information about the surrounding environment that is required for autonomous driving include autonomous techniques, which obtain information from the vehicle's own sensors, and cooperative techniques, which obtain information from external sources via wireless communications. Japan has reserved the 700-MHz band for wireless communications using cooperative techniques, and work is progressing on implementing a 700-MHz CVIS to support safe driving using this band. This article describes Hitachi's work on the 700-MHz CVIS and its views on the future of ITS.

INTRODUCTION

THERE has been growing awareness in recent years of the potential for the implementation of self-driving vehicles to deliver benefits such as reducing traffic accidents and alleviating congestion. Autonomous driving involves onboard systems that perform the awareness, decision-making, and actuation functions that were previously performed by the human driver.

Progress is being made on the implementation of autonomous techniques for recognition by onboard systems that use cameras, radar, or other vehicle-mounted sensors. The problem with using autonomous techniques for autonomous driving is how to obtain, at an early stage, the sort of information that conventional sensors find difficult to acquire, such as what is happening out of sight, around a corner, or at an intersection, for example. In response, investigations are being conducted into cooperative techniques for obtaining information about what is happening outside the area that is visible from the vehicle by using wireless communications with roadside and other infrastructure, or with other vehicles.

Japan has reserved the 700-MHz band[(1)] for wireless communications using cooperative techniques, and work is progressing on implementing a system that provides driver assistance services using this band (hereinafter referred to as the "700-MHz cooperative vehicle-infrastructure system" or "700-MHz CVIS").

The provision of information to vehicles via wireless communications is intended foremost to enhance things like safety and environmental functions and performance. Vehicles that are equipped with sensors, actuators, wireless communications, and other such functions can be thought of as Internet of things (IoT) devices, with significant potential for being used as a means of collecting data in big data systems.

In other words, by using cooperative techniques to utilize the data (position and speed, etc.), communication logs, and other information from vehicles as big data, Hitachi believes that further advances are possible in intelligent transport systems (ITSs), such as the monitoring and control of traffic flows over wide areas in realtime (see Fig. 1).

This article describes Hitachi's work on the 700-MHz CVIS and its views on the future of ITS.

DEVELOPMENTS RELATING TO 700-MHZ CVIS

The 700-MHz CVIS works by using communications between vehicles and between roadside infrastructure and vehicles to exchange vehicle information and infrastructure information (signal information, regulation information, pedestrian information, etc.), to help ensure driving safety by warning the driver of hazards such as the approach of other vehicles at intersections or the approach of emergency vehicles.

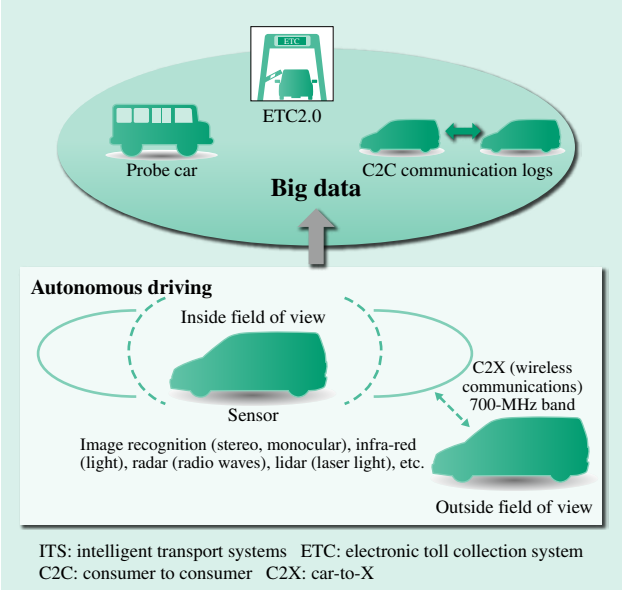

Fig. 1—Hitachi's Vision for Future ITS.
Future ITSs will create new value by utilizing the information collected from vehicles using both autonomous and cooperative techniques as big data.

Examples of services that could be implemented using this system include helping to avoid collisions when turning or when entering or passing through an intersection, helping with awareness of nearby vehicles such as providing notification of approaching ambulances or other emergency vehicles, or providing information about passengers getting on or off a bus[2], with the potential to significantly decrease the frequency of traffic accidents due to inattention or bad decisions by drivers.

On the other hand, because these systems handle information associated with driver awareness and decision making, they need to take account of cyber-attacks and incorporate adequate protection.

One example involving the 700-MHz CVIS is the potential for causing confusion among other road users if someone with malicious intent causes incorrect vehicle data to be transmitted in an attempt to pass their vehicle off as an emergency vehicle[3]. To prevent this, information exchanged via the 700-MHz band needs to adopt countermeasures including proof of integrity such as an electronic signature or message authentication code (MAC). The maintenance of security also requires the management of resources such as the keys used to generate and verify electronic signatures or MACs[4].

In preparing for the introduction of the 700-MHz CVIS, the Ministry of Internal Affairs and Communications of Japan published the Security Requirements for 700 MHz Band Driving Safety Support Systems[5] (hereinafter referred to as the "Security Requirements") in June 2014 and the Security Guidelines for Construction of 700 MHz Band Safe Driving Support System[6] (hereinafter referred to as the "Guidelines") in July 2015. The Security Requirements specify requirements for the entities (onboard system vendors, etc.) involved in the implementation and management of the 700-MHz CVIS. The Guidelines specify policies for implementing the 700-MHz CVIS based on the Security Requirements. Demonstration projects have also been undertaken under the Development of V2V, V2I Communication Technology toward the Automated Driving Systems[7] FY2014 Cross-ministerial Strategic Innovation Promotion Program (SIP) established by the Cabinet Office, and the subcontracted investigation of communication technologies toward the establishment of next-generation ITS[8], a Ministry of Internal Affairs and Communications budget process. In the private sector, the ITS Connect Promotion Consortium was established in October 2014 to promote the implementation and widespread adoption of the 700-MHz CVIS. The activities of the Consortium have included technical discussions on the security specifications required to satisfy the Security Requirements and support for operational management (see Fig. 2).

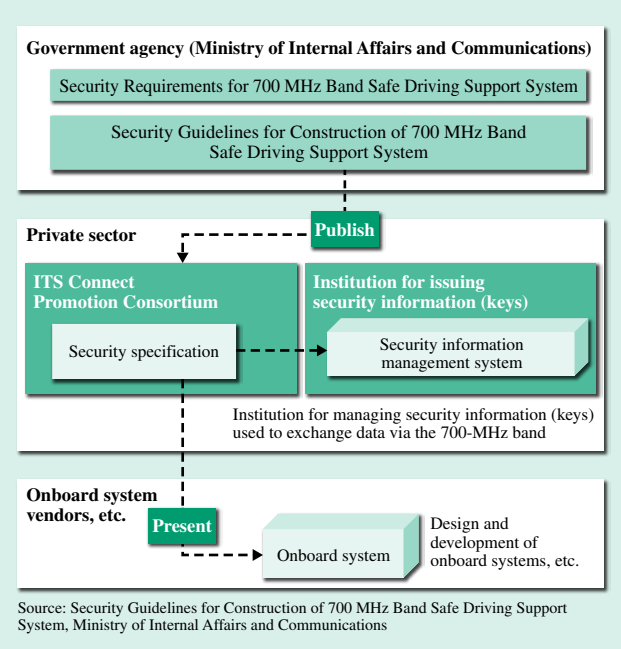

Fig. 2—Public- and Private-sector Developments in Security for the 700-MHz CVIS.
The introduction of the 700-MHz CVIS is progressing through collaboration between the public and private sectors.

As a result of these efforts, preparations for the 700-MHz CVIS are proceeding and introduction of the service is imminent.

SECURITY OPERATION MANAGEMENT INITIATIVES FOR 700-MHZ CVIS

This chapter describes Hitachi's work on system security operation management aimed at helping encourage the wider adoption of the 700-MHz CVIS.

Past Work by Hitachi

Hitachi has been involved in work on specification reviews and the implementation of security operation management in the lead up to commercialization of the 700-MHz CVIS.

(1) Participation in ITS Connect Promotion Consortium

As a member of the ITS Connect Promotion Consortium, Hitachi has participated alongside other members in a review of the specifications of systems for managing keys and other security resources (security information management systems) and a study of security management schemes, including people's movements.

(2) Work as a system vendor

In its role as a system vendor, Hitachi has developed a security information management system that complies with the ITS Connect Promotion Consortium specifications. This development was based on an analysis of potential threats and drew on Hitachi's know-how from similar systems in the ITS field. Hitachi is also looking at management procedures that are based on the management schemes defined by the ITS Connect Promotion Consortium.

Upcoming Hitachi Activities

As noted in the introduction to the Security Requirements, implementing appropriate countermeasures that keep up with changing social and technical factors is important to maintaining and improving security[5]. In response to the need to maintain and improve the security of the social infrastructure that underpins public and corporate (economic) activity, Hitachi has devised and is working on the implementation of Hitachi's concept for social infrastructure security[9].

This section describes security operation management for the 700-MHz CVIS in terms of Hitachi's concept for social infrastructure security and the key issue of responsiveness that Hitachi will consider proposing in the future (see Fig. 3).

Overview of Hitachi's Concept for Social Infrastructure Security

Hitachi's concept for social infrastructure security identifies trends associated with social infrastructure security: the growing diversity of threats, the importance of post-incident follow-up, and the expanding scale of interdependence, and focuses on the three requirements of adaptability, responsiveness, and cooperativeness.

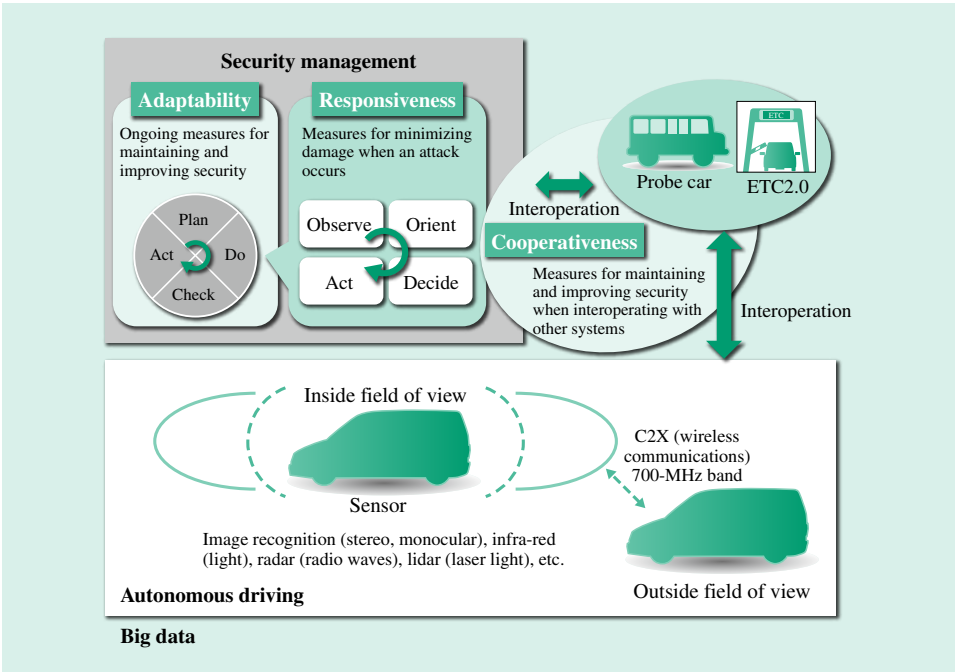

Fig. 3—Hitachi Proposal based on its Concept for Social Infrastructure Security. Hitachi is proposing an approach to security management, based on its concept for social infrastructure security, which considers the medium- to long-term development of the 700-MHz CVIS.

(1) Adaptability

Dealing with increasingly diverse threats that include more sophisticated forms of attack requires ongoing measures utilizing the well-known plan, do, check, act (PDCA) method of security management. Because of the significant potential impact of an attack on social infrastructure, it is important to adopt a philosophy of defense in depth and to work through the PDCA cycle for each layer of the system (cyberspace, physical space, and operational management).

(2) Responsiveness

As unexpected attacks can still occur even when pre-emptive countermeasures are in place, it is important to minimize the damage when an attack occurs and quickly restore operation.

To achieve responsiveness, Hitachi has adopted the observe, orient, decide, and act (OODA) loop concept of operational management.

(3) Cooperativeness

In general, social infrastructure systems operated by different service providers and other organizations are increasingly linked together to improve the convenience and efficiency of services. As this makes centralized system management difficult, an attack on one system can have major impacts on other systems. Accordingly, it is important to take steps to minimize damage by having service providers and other organizations cooperate with each other and share a common situational assessment.

700-MHz CVIS Considered in Terms of Hitachi's Concept for Social Infrastructure Security

This section describes work on the adaptability, responsiveness, and cooperativeness of the 700-MHz CVIS in its role as part of the social infrastructure.

(1) Adaptability

The implementation of the 700-MHz CVIS will expose vehicles to risks from a new type of threat. As noted above in "Developments Relating to 700-MHz CVIS," the public and private sectors have been collaborating in preparation for the commencement of 700-MHz CVIS services, working on the "plan" and "do" aspects of security that are necessary for introducing services by identifying requirements that encompass not only cyberspace, but also physical and operational management considerations; reviewing security specifications; and studying management schemes. Once services are up and running, Hitachi intends to propose activities to the ITS Connect Promotion Consortium that cover the "check" and "act" aspects.

(2) Responsiveness

The wider adoption of the 700-MHz CVIS will increase motivation for attacks, which will likely include some of an unanticipated nature. In preparation for the wider use of the 700-MHz CVIS, Hitachi is collating requirements with a view toward proposing security information management systems that incorporate the OODA loop concept. Details are described below.

(3) Cooperativeness

As noted in the introduction, the 700-MHz CVIS is likely to undergo further development in the medium and long term involving greater integration with other systems. In preparation for this more extensive interoperation between systems, Hitachi intends to start looking at techniques for ensuring that systems are cooperative.

Hitachi's Proposal for "Responsiveness" Based on the Company's Concept for Social Infrastructure Security

As noted above, Hitachi is collating requirements for security information management systems that incorporate the OODA loop concept.

(1) Observe

The collection of communication logs from onboard systems and roadside infrastructure will be required to determine the status of the 700-MHz CVIS. Hitachi is undertaking studies and other work looking at things like what data is required for analysis, considering such issues as the impact of driver assistance services that require realtime performance and the processing load on onboard systems.

(2) Orient (situation assessment)

To minimize the damage when an attack occurs, it is necessary to quickly detect unconventional attacks or other failures and accurately assess or predict the damage. To achieve these, Hitachi is undertaking studies with a view to using business intelligence (BI) tools and its own technology for high-speed data access platforms.

Depending on the data being collected, privacy may also be an issue. Hitachi is working on the research and development of privacy technologies such as k-anonymization and searchable encryption, and looking at how they can be deployed.

(3) Decide

To choose the best countermeasures to adopt, it is necessary that the results of analysis (damage updates and urgency, etc.) be presented visually. To achieve this, Hitachi is collating what information other than analysis results is needed for decision making

(available countermeasures, etc.) and investigating matters such as how to present it.

(4) Act

To find ways to implement the action chosen by the "observe," "orient," and "decide" process, it is essential that the entities involved in operation and management of the 700-MHz CVIS coordinate with each other. The importance of coordination between entities when an incident occurs has also been highlighted for the Security Requirements, and Hitachi is working on incident response measures in collaboration with the relevant entities through the ITS Connect Promotion Consortium.

CONCLUSIONS

A variety of studies are underway as part of moves toward the introduction of autonomous driving. This article has described what Hitachi is doing in relation to the use of cooperative techniques for security operation management of the 700-MHz CVIS, and its plans for the future. Hitachi is contributing to the wider adoption and development of the 700-MHz CVIS by working on security operation management based on its concept for social infrastructure security.

In the future, Hitachi also plans to pursue the potential for creating useful information and extending the technology to applications such as using the collected log data for things like planning roads, detecting faulty roadside infrastructure, and investigating the cause of accidents and other incidents.

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Featured Articles

Involvement in Digital Textbook Business for Realization of the Vision for ICT in Education

Noriko Takada
Yasuhiro Nakada
Miki Mayama
Yukio Suzuki

OVERVIEW: The consortium for the promotion of a digital text platform established by Hitachi and 12 textbook companies has been developing a common platform for digital textbooks, which play a central role in The Vision for ICT in Education promoted by the Ministry of Education, Culture, Sports, Science and Technology. The development of digital textbooks posed many difficult challenges that required the utilization of IT technologies, including achieving consistent operation across all textbook companies, textbook distribution, collaborative learning, and recording learning activity. Hitachi overcame these challenges one by one by proposing a common platform made up of a viewer and server, finalizing its specifications in consultation with the textbook companies, and conducting field trials, culminating in the successful completion of V1 development. The platform was introduced in elementary schools throughout Japan beginning in April 2015 and its use is still expanding. In the future, Hitachi intends to contribute to the establishment of educational infrastructure in the form of common platforms that serve as de facto standards by extending deployment to junior high schools and high schools.

INTRODUCTION

THE New Strategy in Information and Communications Technology[1] formulated by the government's Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society (IT Strategic Headquarters) in 2010 considered how to provide schooling suitable to the 21st century. In response, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) formulated The Vision for ICT in Education[2]. This document emphasized the importance of fostering the capacity to utilize information and concluded that there was a need to establish a one-device-per-child environment in order to extend children's individuality.

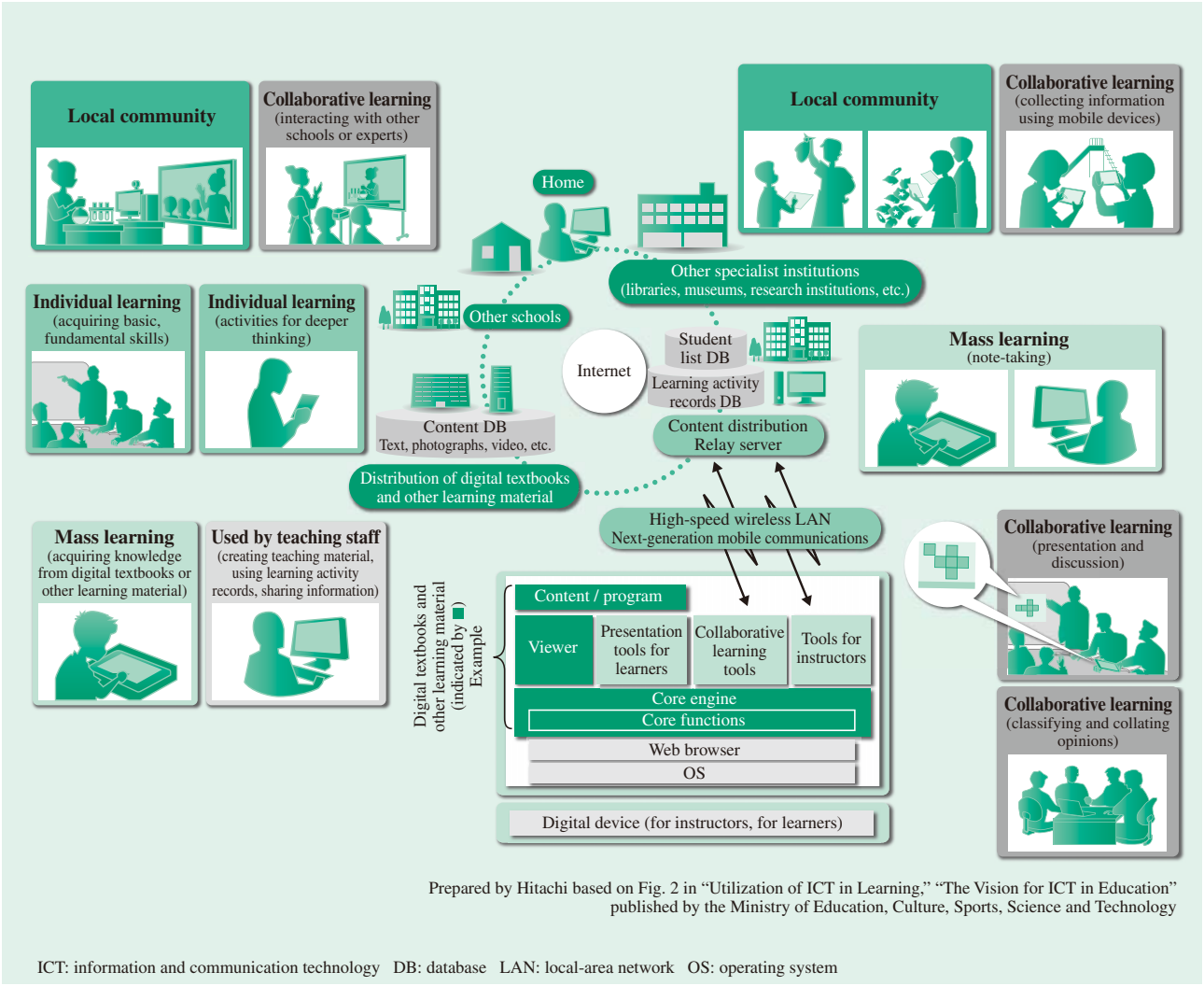
With regard to the format of textbooks and other learning material, it also identified the importance of field trials to evaluate the best form for both the digital textbooks for instructors used by teachers and the digital textbooks for learners used by pupils. Digital textbooks need to utilize information technologies (ITs) such as the cloud and other networks, and Hitachi believes they play a major role in establishing the social infrastructure of education. This article describes Hitachi's digital textbook business.

DIGITAL TEXTBOOKS AND LEARNING IN THE 21ST CENTURY

It is important that the education required by children living in the 21st century take advantage of the capabilities of information and communications technology (ICT), including bidirectional interaction and the ability to send information to remote locations and to large numbers of people instantaneously and simultaneously. The Vision for ICT in Education lays out what this means in practice.

Vision for ICT in Education

The "Learning Environment Suitable for the 21st Century and Learning Based Thereon" described in The Vision for ICT in Education (see Fig. 1) considers not only conventional "mass learning," but also "individual learning" that is tailored to the individual capabilities and characteristics of each child, and "collaborative learning" in which children study together. In each of these cases, the use of ICT is considered a prerequisite, with the digital textbook acknowledged as being the most important technology of all. Digital textbooks are a form of learning material for use on various types of digital devices that augment



Prepared by Hitachi based on Fig. 2 in "Utilization of ICT in Learning," "The Vision for ICT in Education" published by the Ministry of Education, Culture, Sports, Science and Technology

ICT: information and communication technology DB: database LAN: local-area network OS: operating system

Fig. 1—Learning Environment Suitable for the 21st Century and Learning Based Thereon (Example).
The use of ICT in teaching creates a learning environment that combines mass learning, individual learning, and collaborative learning.

the existing content of textbooks and software used for reading it with other core functions that include editing, transferring, adding, and deleting content.

What is Expected of Digital Textbooks

There are two types of digital textbook, one is for instructors that teachers use to present lessons along with use of an Interactive Whiteboard (IWB) and other resources, and the other is for learners that pupils use on a tablet computer. Along with displaying the content of the textbook itself, digital textbooks for instructors need the sort of functions made possible by digital devices, including displaying enlargements, taking notes, reading text aloud, and playback of video.

Digital textbooks for learners, meanwhile, need not only to support the enlargement, note-taking, and other functions provided by the textbook for instructors, they also need to be able to run on a range of devices, including the iPad[*1] as well as Windows[*2] tablets. They also need to support networking functions so that communication between teachers and pupils can be used to distribute exercises for pupils to complete and return. There is also scope for their use to provide more effective ways for pupils to express themselves by enlarging and displaying their answers on an IWB.

ESTABLISHMENT OF CONSORTIUM AND THE ROLE HITACHI PLAYS

To date, textbook companies have only developed digital textbooks for instructors. A problem with these is that they have been difficult to use, with each company adopting a different user interface.

*1 iPad is a trademark of Apple Inc., registered in the U.S. and other countries.
*2 Windows is either a registered trademark or trademark of Microsoft Corporation in the United States and/or other countries.

The requirements for the next generation of digital textbooks include copyright protection for the textbook's text and photographs as well as making use of networks and supporting multiple operating systems (OSs). As advanced IT is needed to implement all of these, it is very difficult for textbook companies to achieve on their own.

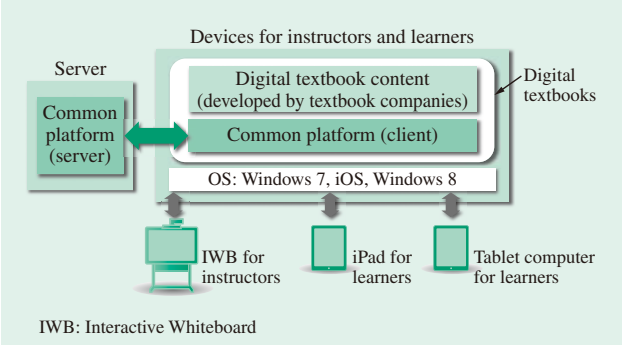


Fig. 2—Configuration Adopted for Consortium for the Promotion of a Digital Text Platform.
Hitachi provides a common platform and the textbook companies focus on developing content for sale.

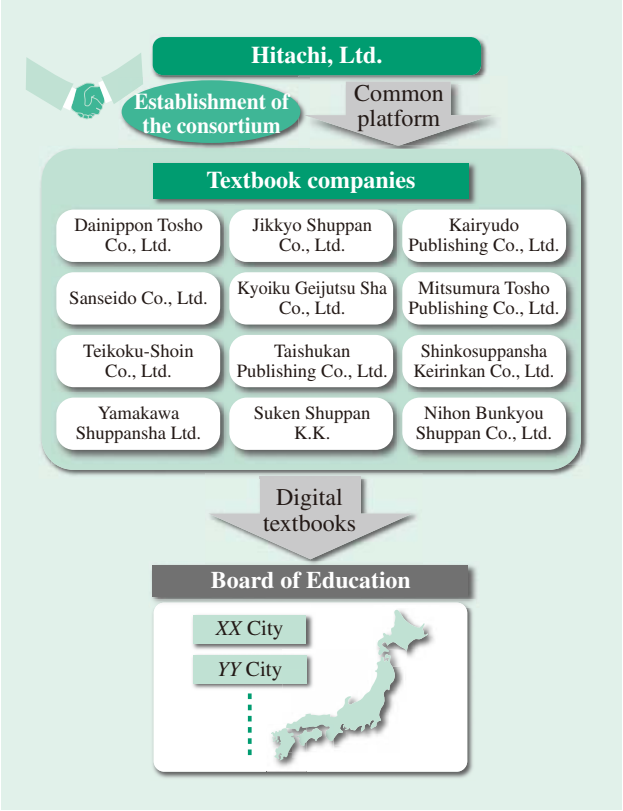


Fig. 3—Establishment of the Consortium.
The membership of the consortium for the promotion of a digital text platform includes 12 major textbook companies. Content is hosted on the common platform developed by Hitachi and marketed as digital textbooks throughout Japan.

Accordingly, it was proposed that a common platform be developed to enable textbook companies to overcome these problems. The approach adopted for this was to separate the textbook content from the control and management functions, which include display, operation, data management, communications, graphical user interface (GUI), and network control (see Fig. 2).

The advantage of this for textbook companies is that it resolves the IT issues and allows them to concentrate on developing content, while also reducing overall costs. The consortium for the promotion of a digital text platform was established on the basis that Hitachi would work with 12 textbook companies to prepare a set of common specifications, and that Hitachi would carry out the development[3] (see Fig. 3).

DEVELOPMENT OF A COMMON PLATFORM

Hitachi developed a common platform for digital learning material and provides it as a service to the consortium members (textbook companies) and others. The platform is made up of a viewer for displaying and manipulating digital learning material and a server system for managing and distributing the viewers and digital content (see Fig. 4).

The platform works by allowing textbook companies to register content so that it can be downloaded from the cloud for use by schools subject to a licensing procedure. Whereas the past practice when changes were made to a textbook was to distribute the update on a digital versatile disc (DVD) or similar format, the

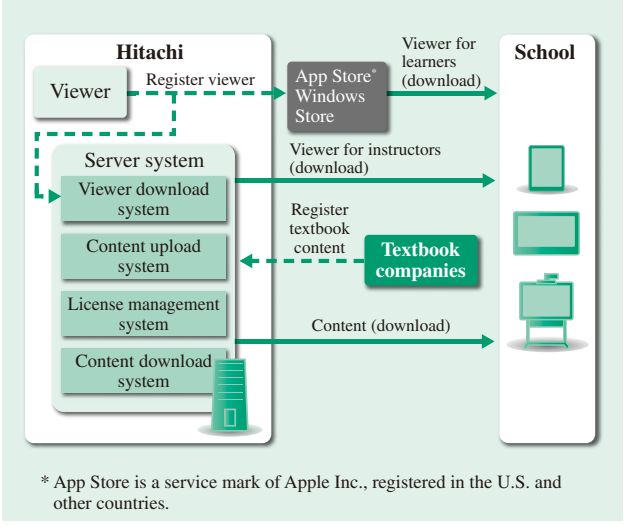
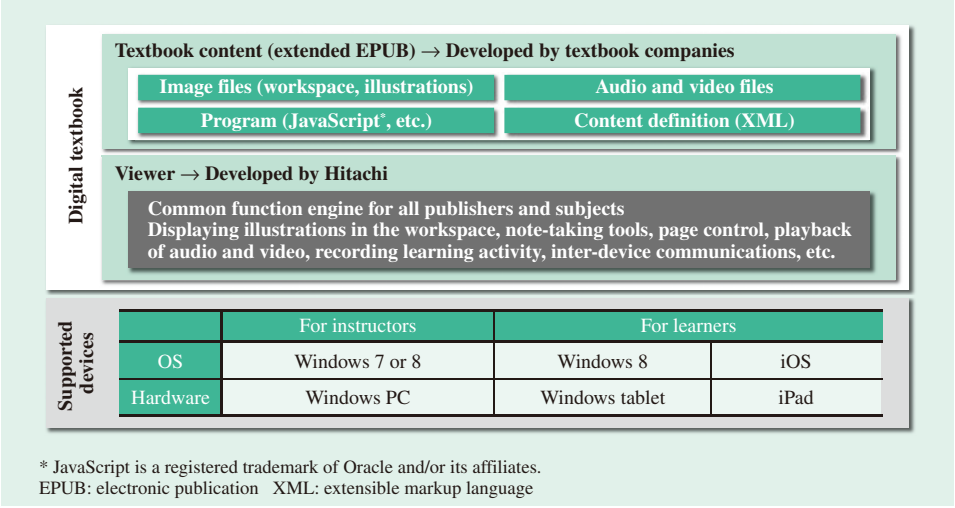


Fig. 4—Overview of Common Platform for Digital Learning Material.
The common platform for digital learning material is made up of a viewer and a server system.



* JavaScript is a registered trademark of Oracle and/or its affiliates.
EPUB: electronic publication XML: extensible markup language

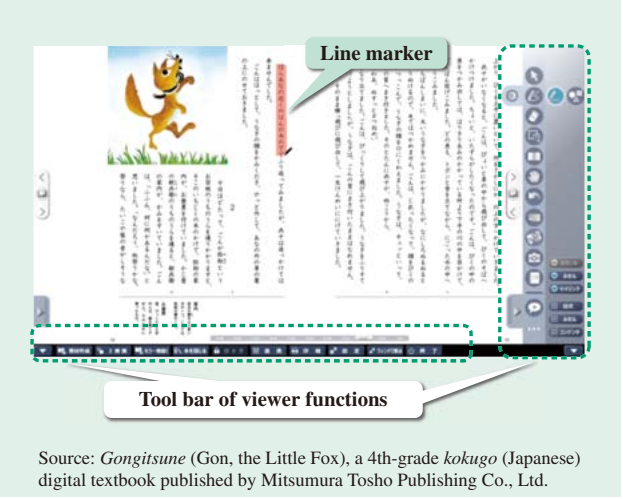
Fig. 5—Structure of Digital Textbooks.
Digital textbooks are made up of a viewer and the textbook content.

platform enables schools to choose when to download updates and saves textbook companies the cost of producing and distributing the DVDs.

Viewer Features

Whereas past digital textbooks have combined the viewer and content in a single application, a major feature of the newly developed digital textbooks is that the viewer and content are entirely separated. This provides a standardized user interface for the viewer and support for multiple OSs. It also helps to reduce development costs by allowing textbook companies to focus on content development. The viewer functions include functions for displaying workspaces the same way for all textbook companies and subjects, use of a pen for note-taking, page control, playback of audio and video, and recording learning activity. Individual viewers are provided for instructors and learners respectively. The instructor's viewer can run on Windows 7 and 8, and the learner's viewer on IOS[*3] and Windows 8 (Store), making a total of three OSs. Essentially, content from a single source can be used on any of the three OSs (see Fig. 5).

The main features of the viewers are as follows.
(1) Identical operation for all textbook companies and subjects (see Fig. 6)
(2) Inter-textbook linkage function for linking content across different grades and subjects (see Fig. 7)
(3) Inter-terminal communication function for the transfer of data between teacher and pupil or between pupils
(4) Page snapshot function and learning activity record storage function for recording entered notes or learning activity
(5) Editing function for allowing users to create learning material
(6) Copyright protection to prevent copying of content data



Source: *Gongitsune* (Gon, the Little Fox), a 4th-grade *kokugo* (Japanese) digital textbook published by Mitsumura Tosho Publishing Co., Ltd.

Fig. 6—Viewer Functions for Providing Standardized User Interface.
The tool bar provides pencil, zoom, and other functions.

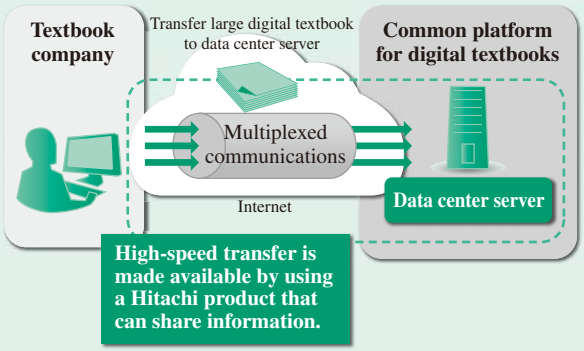
The data format specification used by the viewers is based on EPUB[*4] 3.0, an international standard for electronic books. Hitachi has also defined its own proprietary data format for those digital textbook features that are not supported by EPUB 3.0. Hitachi is also working on the standardization of some parts of this proprietary format for digital textbooks, including registering it with the International Digital Publishing Forum (IDPF), the standards body of the US electronic publishing industry, in January 2015.

*3 IOS is a trademark or registered trademark of Cisco in the U.S. and other countries and is used under license.

*4 EPUB is a registered trademark of the IDPF.

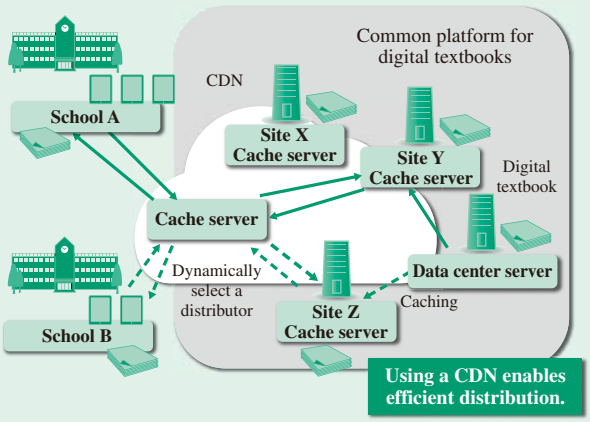
Source: *Kujiragumo* (The Whale-shaped Cloud), a 1st-grade *kokugo* (Japanese) digital textbook published by Mitsumura Tosho Publishing Co., Ltd. (left)
Weather Change, Wakuwaku Rika 5 published by Shinkosuppansha Keirinkan Co., Ltd. (right)

Fig. 7—Inter-subject Links.
Linking content across subjects can be used to display two different subjects (in this case Japanese and science) on two screens at once.



MIE: managed information exchange

Fig. 8—High-speed Transfer of Large Digital Textbooks.
A Hitachi product that can share information enables textbook companies to transfer large digital textbooks to the system at high speed via an Internet connection.



Solid lines indicate content delivery for school A, and dotted lines for school B.
CDN: content delivery network

Fig. 9—Efficient Digital Textbook Distribution.
Hitachi utilizes technology designed for content delivery networks to provide high-speed and reliable distribution of digital textbooks to schools throughout Japan.

Server System

The server system draws on Hitachi's expertized and trusted technologies and other products to ensure security as well as the efficient registration and distribution of textbook data.

The following describes three notable features.

(1) High-speed transmission of large digital textbooks

Because they include high-quality photographs, video, and other forms of content specific to digital formats, the data size of digital textbooks is often as large as several gigabytes. Furthermore, because the updating of content on the system occurs mainly during specific busy seasons such as March when textbook companies are finalizing the production of their digital textbooks, a mechanism is required for the reliable and high-speed transfer of large files.

This is achieved using a Hitachi product that can share information (see Fig. 8).

A Hitachi product that can share information allows even users who do not have communication links to transfer files efficiently using multiplexed communication techniques, achieving speeds that are several times, or several tens of times, faster than can be achieved using the conventional hypertext transfer protocol secure (HTTPS). This means that textbook companies located around the country can use an Internet connection to update large digital textbooks on the system, reliably, and at high speed.

(2) Efficient distribution of digital textbooks throughout Japan

The common platform can be used to download digital textbook data from the server. As the devices used in schools are commonly set up in March or April, or during the summer holidays, it is assumed that most downloading of digital textbooks will also take place during these periods. Accordingly, Hitachi has utilized technology designed for content delivery networks to provide high-speed and reliable distribution (see Fig. 9).

Efficient distribution is also achieved by providing the common platform with functions such as the ability to cope with the large size of digital textbooks by downloading only the required part, and a resume function for restarting an interrupted download.

(3) Ensuring the security of textbook data

Because the system server handles information that must be kept secure, including the digital textbooks and their licenses, it requires data security features, such as preventing tampering with textbook data and ensuring that access is only granted to textbook companies and the schools that purchase digital textbooks. The common platform for digital learning material maintains data security for the server system and textbook data by utilizing techniques and know-how from a Hitachi product that prevents data leaks. The platform also combines numerous different techniques, including the implementation of system-specific mechanisms for detecting tampering, to achieve a higher level of data security.

FIELD TRIALS

Field trials were conducted at elementary schools with the involvement of experts to assess which specific information technologies, and ways of utilizing them, work well in lessons that are based on the use of digital textbooks, IWB, and student devices; and to test the user interfaces of digital textbooks and how easy they are to use.

Details of these field trials are as follows.

(1) Sites

Tokyo Gakugei University

Koganei Elementary School, Tokyo Gakugei University

Dainana Elementary School, Kodaira City

(2) Field trial coordinator

Naoki Kato

Center for the Research and Support of Educational Practice

Tokyo Gakugei University

(3) Field trial period

July 2014 to the end of March 2015

(4) Digital textbooks used

Digital textbooks for instructors (see Fig. 10)

Digital textbooks for learners (for iPad) (see Fig. 11)

After participating in lessons, the pupils were surveyed about their impressions of the digital textbooks and the functions they provided. Overall, the responses were broadly positive, with the majority of responses reporting that lessons using digital textbooks were “very enjoyable” and that ”the textbooks were very easy to understand,” and with a high proportion of responses to the survey of viewer functions reporting that the sticky note function, line marker, and text input were “very easy to use.” On the other hand, there were a small number of responses reporting that the enlargement and curved line drawing functions were “somewhat difficult to use,” indicating areas for improvement.

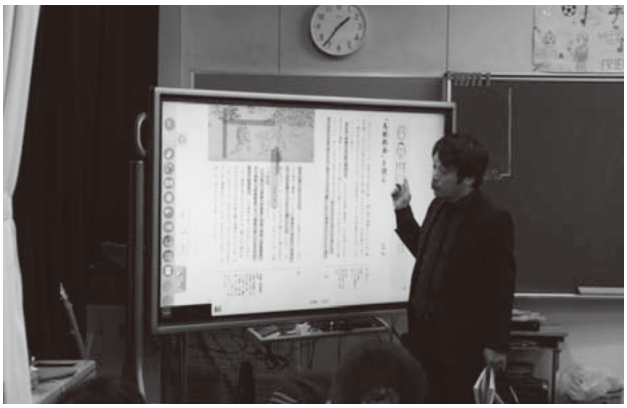


Fig. 10—Example Lesson Using Digital Textbook for Instructor.
A digital textbook for instructors is displayed on the IWB screen and the pen function allows the instructor to indicate the relevant points.

Fig. 11—Example Use of Digital Textbook for Learner to Answer Questions.
As instructed by the teacher, the pupil uses the marker function to highlight passages of text he/she can relate to or finds interesting. Unlike paper, this allows pupils to make as many changes as they want.

In the future, Hitachi intends to make further improvements to make the system easy to use in lessons and other forms of learning with reference to the views of experts and of school teachers and pupils from other similar field trials or from actual use in the field.

FUTURE DEVELOPMENT

This article has described the development of the first version (V1) of the core functions (viewer) and server distribution platform functions.

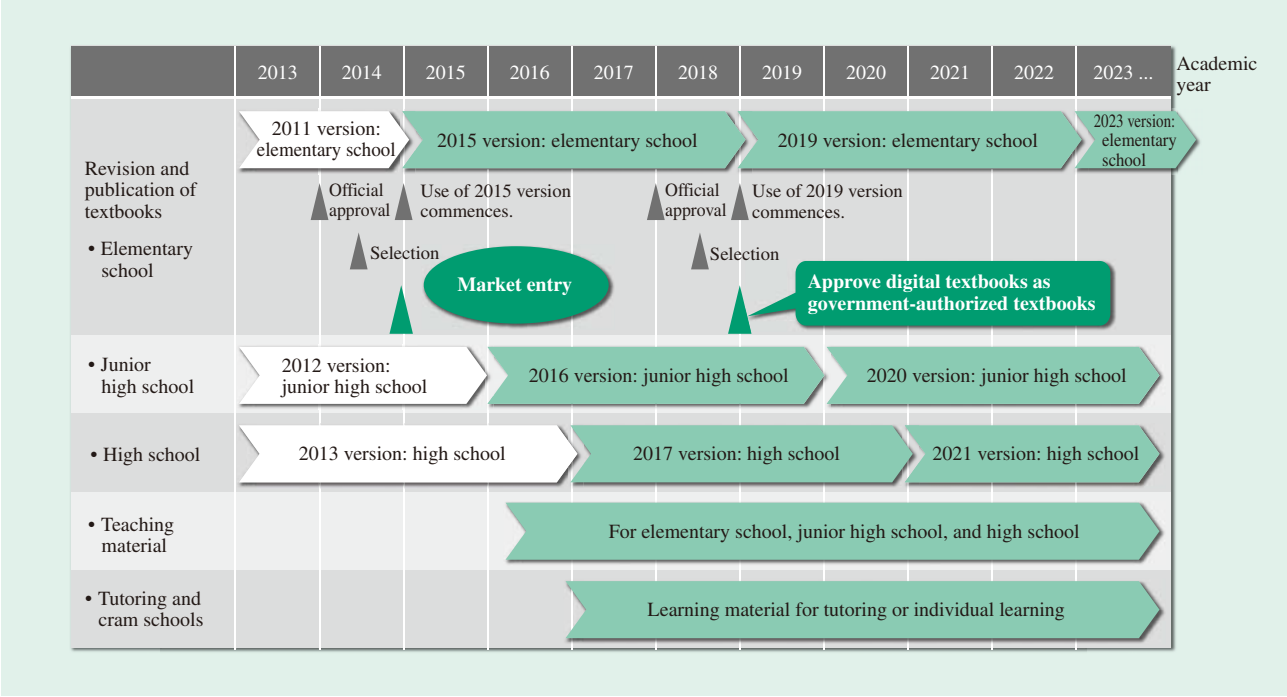


Fig. 12—Ideas for the Future and Plans for Wider Scope of Use.
Following the same practice as ordinary textbooks, which are revised every four years, deployment of the 2015 version in elementary schools will be followed up by the progressive release of versions for junior and senior high schools. There are also plans to publish teaching material for schools and tutoring classes.

Digital textbooks based on the viewer platform have been used for teaching at elementary schools since April 2015.

In 2016, Hitachi intends to consult with users with the aim of making the system even easier to use. Work currently in progress includes making enhancements to core functions and functional enhancements aimed at expanding use to junior high schools. The former include workspace reflow for student tablets and linking content to supplementary teaching materials such as existing digital textbooks and atlases.

The reflow function is intended to allow use of the system in special needs education. When the workspace display is enlarged, it reformats the layout of enlarged text so that it can be read without frequently scrolling to reposition the workspace. Content linking provides a broader scope for education by linking textbooks to supplementary teaching materials (such as dictionaries) on the bookshelf, enabling users to look up the usage of words in a dictionary, for example.

Hitachi aims to establish an environment that provides children with a broader range of learning options by working with the industry so that supplementary teaching materials, books, dictionaries, and other non-textbooks can be included on the bookshelf.

Among enhancements aimed at expanding use to junior high schools, Hitachi intends to develop a function that uses the audio required for English teaching to read highlighted text out loud using native-speaker pronunciation.

From the 2016 academic year onward, the plan is to extend the range of learning material available for use in other forms of education such as high schools, tutoring, and cram schools. In the case of high schools, in particular, the intention is to add support for recording learning activity, private sales, and other material suitable for a wider range of learning situations, including reference books, teaching material, and tests and exercises.

To facilitate use in tutoring and other types of cram schools, Hitachi is currently considering ways of collecting data on the learning activity records of individual students and using big data analysis to provide feedback to tutors on teaching materials and student learning practices (see Fig. 12).

Ideas for the future include strengthening server functions in anticipation of the adoption of the one-device-per-student policy and allowing distribution of content to the home. Hitachi aims to support adaptive learning in which students learn at their own pace and offer an extensive range of cloud services that

are available everywhere and all the time in order to expand use of the viewer so that it can become a widely used common platform in Japan.

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Featured Articles

Requirements Definition Technique for Public Systems

Tsutomu Matsuo
Shinji Itoh
Kazuki Tateoka
Hisaya Hirata
Masao Serizawa

OVERVIEW: Many of the public services undertaken by national and local government agencies, etc. are carried out in accordance with statutes. Accordingly, the systems used for public services must also be developed in accordance with these statutes. As things currently stand, however, the requirements definition documentation for the development of systems based on statutes in the public sector are prone to a high degree of variability depending on who is responsible for them because the task of linking statutes to work processes is performed manually. To overcome this problem, Hitachi has been researching development methodologies for analyzing statutes and work processes with the aim of improving the quality of requirements definitions. Through this research, Hitachi has succeeded in establishing methods for determining the requirements for implementing statutes, methods for modeling statutory requirements, and requirements definition procedures and associated verification methods. In the future, Hitachi intends to conduct further evaluation and make improvements in preparation for deploying the methods in practice.

INTRODUCTION

MANY public services undertaken by national and local government agencies, etc. such as pensions, taxation, and handling citizen information, are carried out in accordance with statutes. As a result, these public services need to be designed to comply with statutory requirements (the requirements specified in the statutes), as must be the systems that support the associated work processes. Furthermore, because statutes are frequently amended, system development must be performed in ways that have the flexibility to change on short notice and without compromising quality.

Requirements definition for the development of systems that are based on statutes begins with statutes analysis (analysis of the relevant statutes) as well as analysis of work processes and systems. Based on the results of requirements definition, this is followed by design, implementation, and testing. As the cost of resolving any inadequacies in the requirements definition increases the longer the problem goes undetected, requirements definition is extremely important, with a significant impact on the cost of the latter stages of system development.

As a consequence, requirements definition, specifically statutes analysis and work process analysis, is currently done manually by an expert. This makes the job of assessing the impact of any changes to the statutes or work processes dependent on the expert. Furthermore, because there is a high degree of flexibility in the form of current requirements definition documents, they tend to be prone to variability depending on who is responsible for them. Given this background, Hitachi has been researching development methodologies for the analysis of statutes and work processes with the aim of improving the quality of requirements definition. This article describes work to date on statutes analysis and work process analysis.

OVERVIEW OF REQUIREMENTS DEFINITION

Ensuring the quality of system development during the requirements definition and other early-stage processes is vital for preventing rework in subsequent processes or the building-in of latent problems.

Fig. 1 shows an overview of requirements definition incorporating statutes analysis and work process analysis.

First, statutes analysis involves listing the terminology definitions, statute data requirements, and statute use cases based on the categories of the system requirements identified from the relevant statutes.

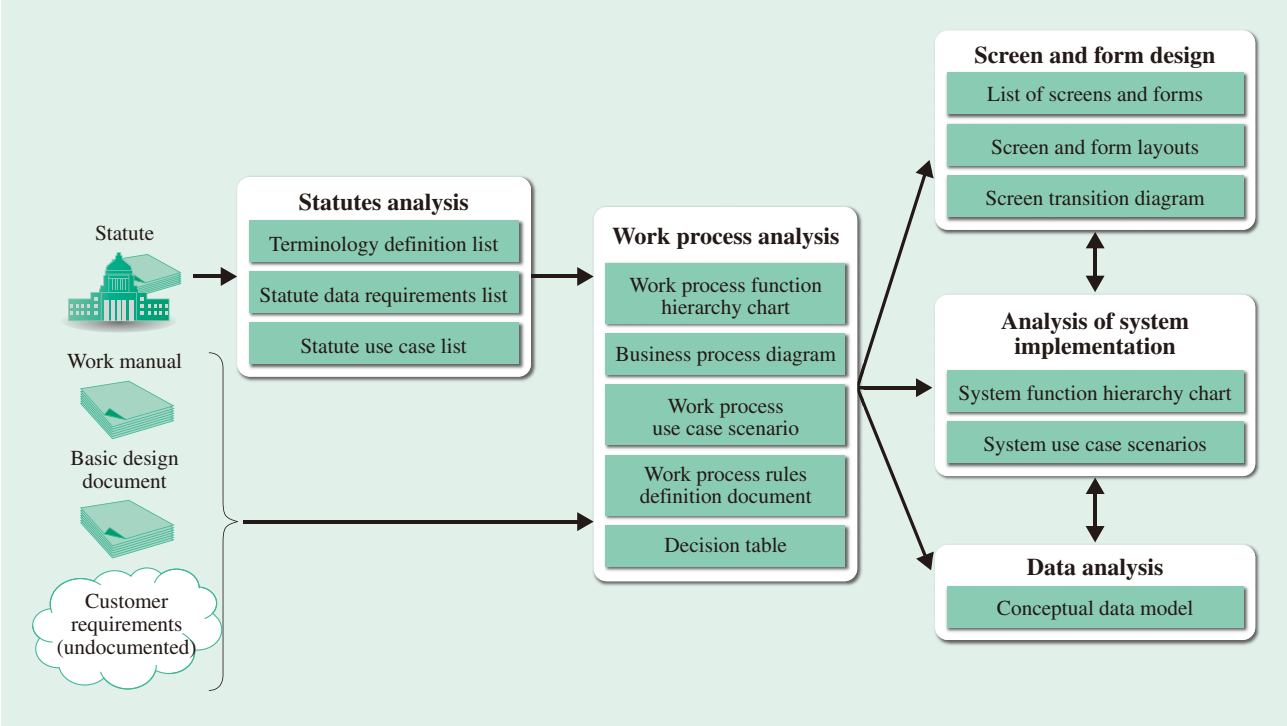

Fig. 1—Overview of Requirements Definition.
The development of systems based on legal statutes includes statutes analysis and work process analysis, and also screen and form design, analysis of system implementation, and data analysis to define the system requirements.

Next, work process analysis involves identifying the work process functions for the system with reference to the results of statutes analysis, and clarifying the tasks and work process rules associated with each function. These functions are specified in a work process function hierarchy chart and the relationships between functions are represented in a business process diagram. The tasks associated with each work process function are specified in work process use case scenarios and the work process rules are specified in a work process rules definition document. This demarcates the deliverables at each level of requirement granularity from the perspective of work processes, and improves maintenance by enabling the isolation of deliverables that need to be revised when a modification occurs. Labeling the identified requirements with an identification (ID) ensures the traceability of statutes and work processes. Furthermore, a decision table is used to verify that the work process rules definition document does not contain any omissions or inconsistencies.

Screen and form design, system implementation analysis, and data analysis are performed to clarify the functional requirements of the system with reference to the results of statutes analysis and work process analysis. The traceability of work processes and systems is ensured by assigning the IDs for the work process analysis elements to these individual deliverables. The following sections describe statutes analysis and work process analysis in detail.

STATUTES ANALYSIS

This chapter describes the workflow for statutes analysis together with details of how statutory requirements are identified, a central part of statutes analysis[(1)].

Statutes Analysis Workflow

Statutes analysis involves: (1) Collecting information, (2) Sorting, (3) Identifying statutory requirements, and (4) Collating statutory requirements. Each step is summarized below.

(1) Collecting information

Documentation on the relevant statutes is obtained from the web or customer (national or local government agency).

(2) Sorting

Quick checks are made of the collected documentation to determine whether a detailed analysis is needed (whether or not the statute affects the system being developed). The results of this check are recorded on a statute documentation management form.

(3) Identifying statutory requirements

A detailed analysis is conducted of those documents for which it is deemed necessary and the identified statutory requirements are recorded on a statute documentation analysis form. This form is used to record information such as the text of the statute, the identified statutory requirements, requirement type (terminology, data, or use case), and the statutory requirement ID (in cases where the requirement relates to other requirements). This clarifies the correspondence between the statute text and the statutory requirements.

(4) Collating statutory requirements

The statutory requirements recorded on the statute documentation analysis form created for each document are collated by requirement type (terminology, data, or use case). Collating all of the statutory requirements from multiple sources in one place eliminates the need to keep going back to the various original documents, and makes it easier to understand the statutory requirements.

Technique for Identifying Statutory Requirements

Identifying statutory requirements includes the preparation of statute documentation analysis forms. These forms have a format that makes clear the correspondence between the statute text and the statutory requirements. The form thereby minimizes the number of requirements that are overlooked by providing a visual indication to both the person who produced the form, and the person reviewing it, of the locations in the statute documents from which statutory requirements were and were not identified.

The steps for producing a statute documentation analysis form are: (1) identifying the provisions relevant to the system being developed, (2) classifying the statutory requirements by type, and (3) determining the statutory requirements from the statute text. Details of each step are described below.

(1) Identifying the provisions relevant to the system being developed

In order to analyze statutes efficiently, it is important to determine which parts require a detailed analysis. The provisions that require a detailed analysis are first narrowed down by chapter and section, and subsequently by clause. Specifically, after a preliminary step of determining who will deal with the system being developed ("system principals"), whether or not the statute text requires a detailed analysis is determined based on whether or not it covers the system principals, and a judgment is made about whether the text relates to the external or internal environment. In cases where it is not possible to decide whether detailed analysis is required based on the system principals, whether or not referenced statute text requires analysis is determined from the reference data included in the statute text.

Table 1. Types of Statutory Requirements

Statutory requirements are classified as "terminology," "data," or "use cases" depending on their content.

Type	Explanation
Terminology	Information about the definition of terms
Data	Requirement for data that serves as an input or output for a use case. Examples include the data fields that appear in a report and data field constraints.
Use case	Requirement related to work procedures.

(2) Classifying the statutory requirements by type

The statute text selected for analysis is classified based on the type to which it belongs, as listed in Table 1. While classification is performed by clause, some clauses may be assigned to two or more types.

The classification of statutory requirements includes collating the statute text for each requirement type based on how it is formatted ("patterned"). Although statute text is written in natural language, because it is drafted in accordance with certain rules, it is characteristically easy to form into patterns. This helps the person doing the work to choose the right classifications for the statutory requirements.

(3) Determining the statutory requirements from the statute text

After classifying the statutory requirements, statute text that contains statutory requirements is entered into the "Name" and "Statutory requirements" columns of the statute documentation analysis form. Individual variation between the people doing the work is minimized by providing them with data entry rules (requirements with an "and" relationship are entered in itemized form, requirements with an "or" relationship are noted as such) and a library of patterns for statutory requirements identification.

WORK PROCESS ANALYSIS

This chapter describes the sequence of steps for work process analysis and the work process rules definition document, which is one of the features of work process analysis.

Work Process Analysis Workflow

Work process analysis involves visualizing the work processes and administrative procedures. Each step is summarized below.

(1) Visualizing work processes

The work process functions associated with the system being developed are determined based on the results of statutes analysis and are recorded in a work process function hierarchy chart.

In parallel with the creation of the work process function hierarchy chart, the sequence of work process functions is recorded in a business process diagram. The name used for a work process function in the business process diagram is the same as the name used in the work process function hierarchy chart.

(2) Visualizing administrative procedures

Details of the tasks to be performed for the work process functions to be implemented in the system are specified in work process use case scenarios in the work process function hierarchy chart.

Whether or not work process rules (such as formulas or decision criteria) exist for each scenario for the work process use cases is determined with reference to the results of statutes analysis, and the details entered in the work process rules definition document. The name of each work process rule is also entered in the work process rule list along with a summary. In the case of simple work process rules (such as performing a check of a single criterion), the work process rule is specified in the "Summary" column of the work process rule list and therefore a work process rules definition document does not need to be produced. In the case of complex work process rules (such as two or more criteria), however, a decision table is produced to check for any omissions or inconsistencies.

Method for Preparing Work Process Rules Definition Documents

The work process rules definition document is the deliverable that records things like decision criteria or calculation procedures for administrative procedures. The main items included in a work process rules definition document are the work process rule ID, work process rule name, information about the source, inputs, output, intermediate variables, and sub-rules (including sub-rule ID, condition, and result).

The work process rule ID and work process rule name are used to identify work process rules. The work process rule ID is referenced from the work process use case scenario and ensures the traceability of the work process use case scenario and work process rules definition document. There are also cases where the work process rule ID is referenced from other work process rules. The "information about the source" indicates where information relating to the rules specified in the work process rules definition document is recorded. The "Inputs" field records information about the data items used as inputs for the work process rule. There is one "output" for each work process rule. If a work process rule has more than one output, the work process rules definition document is split. "Intermediate variables" are used when specifying a calculation procedure in order to add clarity by providing variables to store intermediate calculation results. The "Sub-rule" field describes the relationship between the conditions and results of a work process rule.

Sub-rule conditions and results eliminate ambiguity by clarifying the notation and also enable interpretation by machine. This also makes it possible to verify whether there are any inconsistencies, omissions, or other problems[2), 3)].

CASE STUDY

Hitachi has trialed the requirements definition method it developed on an actual public-sector project. The input information was made up of 77 primary provisions and 23 supplementary provisions from laws and (draft) enforcement ordinances.

Statutes analysis took approximately 14 hours and identified 191 statutory requirements. Two of the 14 hours were spent on verification and revision. Classification of the statutory requirements found 25 terminology, 16 data, and 38 use case requirements. Linking of these statutory requirements to work process requirements was performed for all of the data and use cases that related to the scope of the work process analysis.

Work process analysis took about 18 hours, resulting in 24 items being recorded in the work process function hierarchy chart as level 3 work process functions and 29 as level 4. Work process use case scenarios were produced for three of these 29 level 4 work process functions. A total of 23 work process rules definition documents were produced for two of the three work process use case scenarios, of which 11 were verified as having no inconsistencies or omissions.

CONCLUSIONS

This article has described a development methodology for statutes analysis and work process analysis that ensures the quality of requirements definition. Use

of the method reduces the degree of variability in requirements definition documents depending on who produced them, and ensures the traceability of statutory requirements and work process requirements. Although identification of statutory requirements and preparation of work process rules definition documents have been automated to some extent, other aspects of these tasks are still performed manually. Hitachi expects to achieve further improvements in quality in the future through continued research into verification methods for requirements definition documents, while also making progress on the automation of these manual tasks.

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Featured Articles

Measures for Ensuring High Reliability in Public-sector Systems

Fumihiko Nii
Noriaki Nishimura
Takao Narita
Yasufumi Aburada

OVERVIEW: Large public-sector systems often incorporate a number of separate systems, with system considerations that include ensuring processing performance and maintaining consistency when systems interoperate, and business considerations that include the ability to control processing and permissions in ways that take account of legal restrictions and other factors. As large public-sector systems are currently undergoing an ongoing shift to open systems, this article uses a number of actual examples to describe measures for ensuring high reliability in open systems.

INTRODUCTION

PLANS for the optimization of processes and systems at government agencies[1), 2)] that were prompted by the e-Japan Strategy and e-Japan Strategy II published by the Japanese government in 2000 and 2003 respectively are still ongoing, and most of these involve a shift to open systems. Because the 2015 revision of the "Declaration to be the World's Most Advanced IT Nation" specifies policies for reducing operating costs[1), 2)] among the reforms to government information systems, it is anticipated that the trend toward the adoption of open systems, including cloud-based systems, will continue in the future.

Accordingly, because of the way the public sector thinks about reliability and the unique regulatory requirements and other operational characteristics that apply to the information systems of government agencies responsible for important public services, it is necessary for open systems to comply with these requirements as well. This article describes ways of thinking about reliability that are specific to the public sector, and techniques for achieving this reliability.

CHARACTERISTICS OF PUBLIC-SECTOR INFORMATION SYSTEMS

System Reliability

(1) Ensuring consistent processing performance

Because the public-sector information systems that administer activities such as taxation or pensions handle large amounts of important data, there are cases where not only system outages or loss of data but even delays in processing have the potential to impact the public.

For example, control of the relative priority of online and batch processing is needed to prevent over-the-counter services from being interrupted by the execution of high-volume batch processing during working hours. There are also cases when there is a need to control the relative priorities of different online processes or different batch jobs. In other words, in the context of public-sector systems, reliability also includes ensuring consistent processing performance.

(2) Ensuring consistency when business systems interoperate

Because large systems are made up of multiple individual business systems, there is a need to consider consistency across these systems.

(a) Synchronized message exchange

In cases that involve the exchange of messages between different business systems, the maintenance of data consistency requires that synchronization between sender and receiver be restored when there is a fault in the receiving system.

As this synchronization is not supported by standard message queue (MQ) products, providing such a function on open systems involves implementing the same message exchange function independently on each system. Unfortunately, difficulties arise that are specific to open systems if each system is from a different vendor, such as the need to take account of factors such as differences between the middleware in each business system or the use of a cluster configuration.

(b) Retry and cancelation of file transfers

If a transfer of files between business systems cannot be completed due to a fault in the target system, it is best to halt the transfer and then perform automatic retry once the system has recovered. To allow for cases when the status of the target system makes retrying undesirable, it is also necessary to have a function that cancels the transfer on the source system.

As this mechanism is not available in standard file transfer protocol (FTP) software, it presents the same problems as in synchronized message exchange.

(3) Fault analysis and operational statistics covering multiple servers

If a fault occurs on information systems that play a central role in providing services to the public, it is important to identify the cause and to restore system (and service) operation quickly. In the case of processing that involves the interoperation of a number of servers, however, because the information needed to analyze a fault is spread across these different servers, analyzing the cause is made difficult by having to use different applications and middleware that provide different levels of output and use different formats.

Accordingly, it is essential to be able to perform timely fault analysis using this information. Also required are statistical functions that can monitor the variation in processing load under normal conditions.

Application Characteristics

(1) Ensuring the ability to maintain application programs

Public-sector systems sometimes require program changes at short notice to coincide with the introduction of amendments to law. This makes it desirable to have individual programs that are highly independent, with minimal impact on each other.

To achieve this, it is necessary to adopt practices such as a service-oriented architecture (SOA) and to provide a framework under which each application program can run independently.

(2) Batch processing in accordance with legal deadlines

It is common for public-sector systems to handle procedures such as applications or payments that have deadlines, with batch processing often being matched with business procedures. Depending on the task, batch processing must be available either as batch jobs run by a data center or batch jobs run online.

Batch jobs that are run by a data center are used to process large volumes of data at high speed or for overnight processing of data that was updated online during the day. Because of the large volume of data involved, mechanisms are provided for halting batch jobs and restarting them on the following day so that the work can be split up and run over the course of several days.

Batch jobs that are run online are used in cases such as performing searches of large volumes of data based on criteria that a user enters from a screen, the output of large reports based on user-specified conditions, or when a batch job is invoked from data that is input online.

(3) Output report control

Public-sector systems include reports with information that, if leaked, could have a major impact on the public, such as administrative documents or address cards relating to city residents or the general public. Accordingly, the confidentiality of these reports means they need to be handled in ways that take account of security, including preventing them from being output unnecessarily or from being accessed by users other than those who are authorized to see them.

(4) Exclusive control of application programs

Because of factors such as legal restrictions on the processing order of application programs and limitations on the execution permissions of the staff responsible, public-sector systems include application programs that cannot be run concurrently and that require control of the order of their execution. Similarly, to prevent the impact of problems such as program errors or data corruption in the processing for a particular locality from spreading throughout the country, there is also a need to specify rules governing when processing can be executed for different regions, or to otherwise control execution.

This exclusive control of application programs and their execution normally cannot be implemented using the functions available on an application server, or even if it can be implemented to a certain extent, it is significantly difficult to maintain. Accordingly, it is very important to be able to provide systems with standardized middleware (common platform) so that these functions can be made available on vendor-specific middleware as application interfaces.

MEASURES FOR ENSURING RELIABILITY

Practices for Ensuring Reliability

Hitachi has adopted the following practices to provide the functions that these characteristics make necessary.

(1) Enhance the ability to maintain application programs while also providing functions that need to interoperate with application programs in the form of

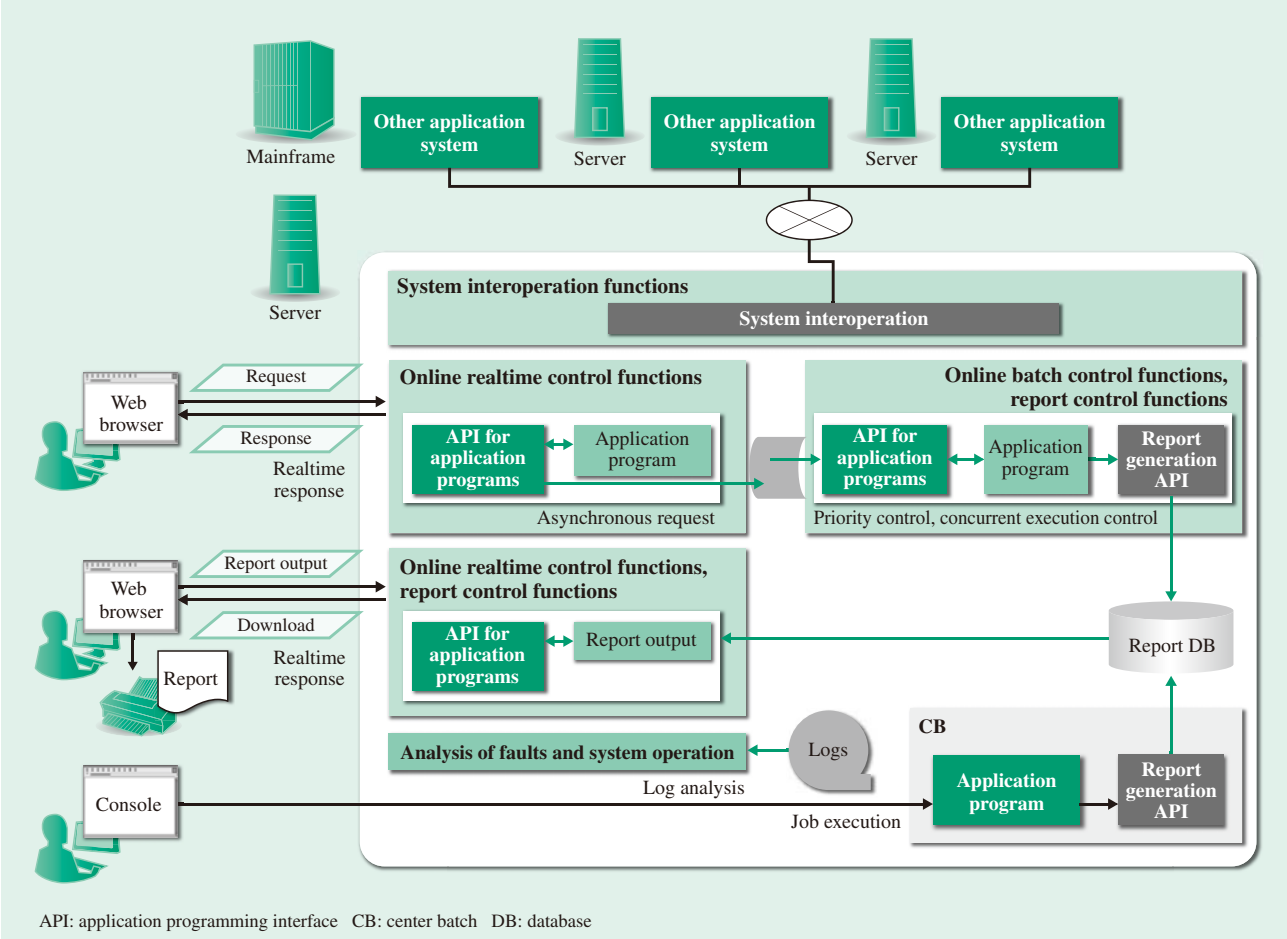

Fig. 1—Processing Functions of Common Platforms.
The figure shows a flowchart of the business processes performed using functions provided by the common platform.

an application framework. These functions include control functions for ensuring reliable performance; functions for interoperation between systems, such as message exchange and file transfer; functions that support the analysis of faults or system operation; functions for running batch jobs online; output report functions; and functions for exclusive control of application programs.

(2) Extend functions as needed for those aspects that are handled using existing utilities or other products, especially in the case of functions for running batch jobs at a data center.

Measures Adopted

(1) Application framework

Hitachi supplies an application framework with the following functions that it developed itself.

Developers can use the application programming interfaces (APIs) provided by the application framework to perform development in accordance with the business logic (see Fig. 1).

(a) Online realtime control functions

This API provides application processing results in realtime in response to requests from a web browser, and also handles tasks such as disabling application programs and checking whether they are permitted to run.

(b) Online batch control functions

This API runs application programs independently of realtime processing and includes multitasking control for priority-based scheduling and ensuring efficient use of server resources.

(c) Report control functions

This API includes functions for producing output reports such as address cards or administrative documents for the public. It also includes functions for managing the scope of access granted to users based on their access rights, and setting how long information is to be kept, and for enhancing the confidentiality of report data by working with End-User Reporting (EUR), a report management product, to prevent report data from being saved on client devices.

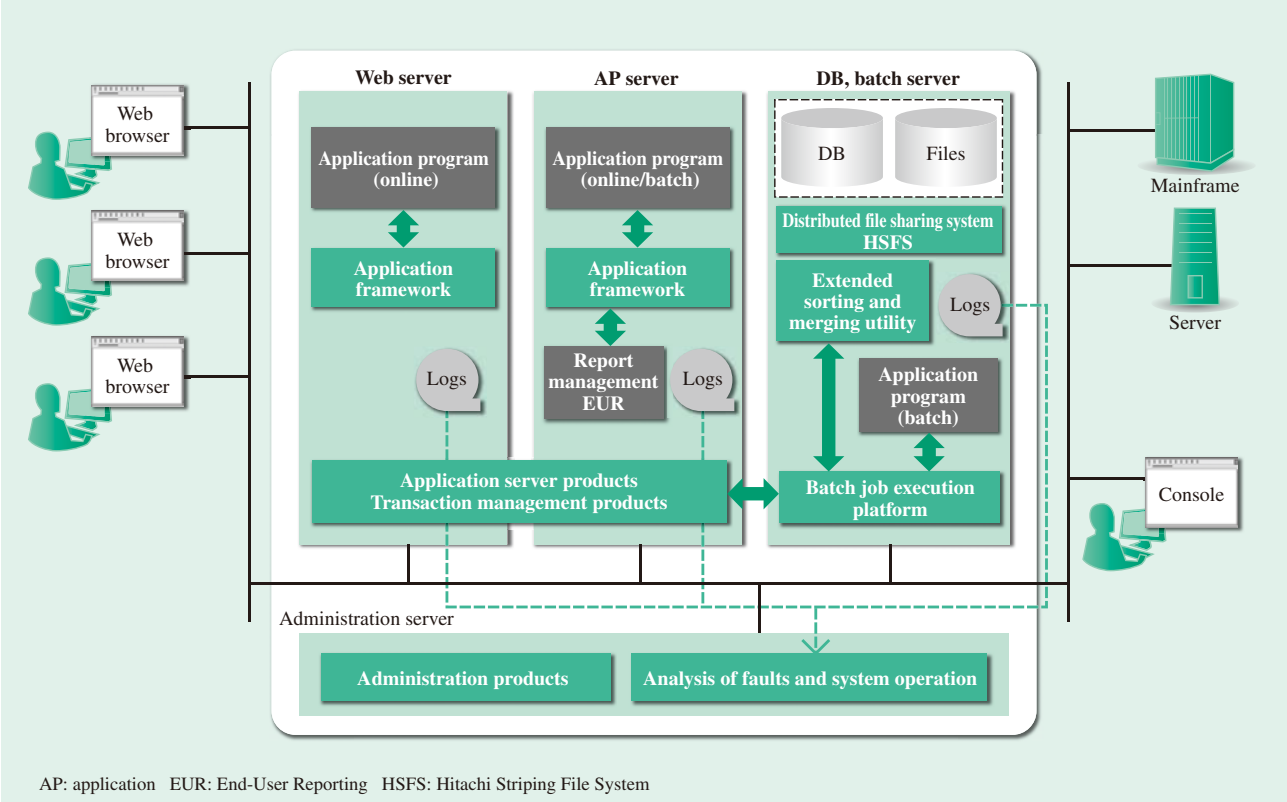

Fig. 2—Example Open System Configuration.
The open system is made up of a variety of servers with different roles, including web servers, AP servers, DBs, batch servers, and administration servers.

(d) System interoperation functions

To ensure the seamless coordination of data between business systems, this API provides functions for establishing communications with other systems as well as rollback and other mechanisms for keeping systems synchronized, while also keeping the influence on business applications to a minimum. To adapt flexibly to operational requirements, the functions work with both open systems and mainframes and can use either message passing for handling small amounts of data or file transfer for large amounts of data.

(e) Analysis of faults and system operation

To reduce the workload associated with consolidating and analyzing logs in the event of a fault that involves a number of servers, this API provides executable commands that can combine application logs and other journal data that is output by multiple servers and collate it in a time-series format.

Also, because of the need to identify in advance any over- or under-resourcing of servers or other bottlenecks when fluctuations in processing load are anticipated for reasons such as amendments to law, the API also provides executable commands that can collate information for analyzing things like the number and time-per-transaction of the transactions handled by each application.

(2) Batch jobs run by a data center

As public-sector systems require changes to their processing capacity, methods, etc. used to extract and edit data in order to process a large volume of data, Hitachi has made changes to products to achieve this (see Fig. 2).

(a) Extended sorting and merging utility

Extended sorting and merging utility can sort and merge different types of data quickly and efficiently using the same functions as a mainframe, including selecting, collating, and editing records and splitting files.

(b) Distributed file sharing system

Because open systems typically achieve their performance by operating a number of application and other servers in parallel, it is necessary to consider the effect that transferring data between servers will have on the network and how to use disk resources efficiently. Hitachi Striping File System is a distributed file sharing system that can combine a number of logical units into a single file system that can be accessed by multiple servers at the same time.

(c) Batch job execution platform

Batch job execution platform provides job definition, spooling and other functions on open systems. It enables existing job control language (JCL) to be reused when migrating from a mainframe to an open system.

CONCLUSIONS

This article has described how to ensure the reliability of public-sector systems that handle particularly large quantities of important data.

Along with ongoing work on optimization plans for the activities and systems of government agencies and the introduction from 2015 of the identification number system, it is anticipated that the scope of systems that demand high reliability will expand further in the future. Based on the technologies it has built up over time, Hitachi intends to respond to these requirements in ways that include enhancing its application framework and extending the functions it provides and the format in which it provides them according to the size of the user base.

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(2) Ministry of Internal Affairs and Communications Website, http://www.soumu.go.jp/english/index.html

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Featured Articles

Techniques for Migration and Refactoring (Downsizing) of Application Assets

Atsushi Awakawa
Katsuya Tokuda
Toshimitsu Shibayama
Takuro Matsuzawa

OVERVIEW: In formulating its e-Japan Strategy in 2001, the Japanese government introduced policies covering such matters as the establishment of IT platforms, the use of IT in government, and the promotion of e-government. Furthermore, a 2002 report by the Board of Audit of Japan about the problem of legacy system procurement began moves toward system reform in government information systems and elsewhere through the migration of legacy systems running on mainframes to open systems. Hitachi Government & Public Sector Systems, Ltd. launched its migration service for application assets in March 2002. Hitachi's migration service transforms application assets from existing systems so that they are able to run on a new architecture. It has undertaken more than 160 such projects to date (totaling approximately 110 megasteps). Along with migration, the service also performs "refactoring" (downsizing), which in this context means reorganizing application assets and reducing their size. This refactoring process was added as an official service option in June 2015. In the future, Hitachi intends to continue contributing to system reform by providing services with more advanced functions and higher quality.

INTRODUCTION

Background to Migration

IN formulating its e-Japan Strategy in 2001, the Japanese government introduced policies covering such matters as the establishment of information technology (IT) platforms, the use of IT in government, and the promotion of electronic government (e-government). The progress of IT became increasingly rapid from around this time, with a steady stream of new hardware and architectures being released (see Fig. 1).

A 2002 report by the Board of Audit of Japan about the problem of legacy system procurement in government information systems belonging to public agencies began moves toward system reform through the migration of legacy systems running on mainframes to open systems.

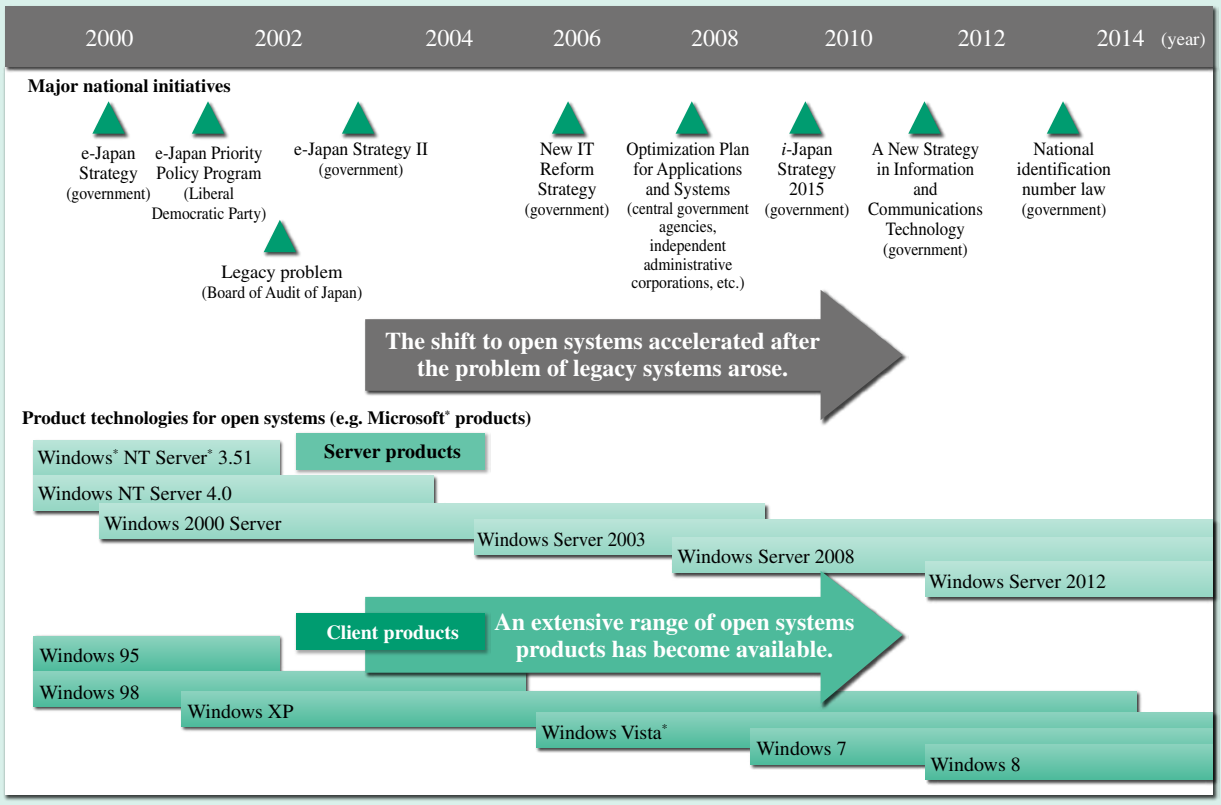
In response to these moves toward system reform through the adoption of open systems, Hitachi launched a migration service for application assets in March 2002 that has undertaken more than 160 projects to date (totaling approximately 110 megasteps).

Whereas the tendency when the service was first introduced was for the adoption of open systems to be prompted by the expiry of mainframe maintenance contracts, projects of this nature have tailed off in recent years. Nevertheless, the reform process for government information systems belonging to public agencies remains incomplete with large systems running on mainframes still in existence. There are also systems that have been through the reform process but need to be migrated to a common government platform that commenced operation in 2013. Consequently, it is anticipated that demand for migration will grow in the future.

Background to Refactoring (Downsizing)

As systems undergo numerous modifications over the course of their operating lives, there are many cases in which application assets have ballooned in size and grown complex. Because performing maintenance on such systems can have widespread implications, the cost tends to increase. Hitachi is frequently consulted by customers adopting open systems who want to downsize programs and minimize maintenance costs, and has undertaken refactoring (downsizing) projects involving the reorganization of application assets and reducing their size.

Hitachi has consolidated this know-how and added refactoring as a service option in June 2015. The



IT: information technology
* Microsoft, Windows, Windows Server, and Windows Vista are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

Fig. 1—Trends in Open Systems.
The adoption of open systems has been accelerating since 2002, with a comprehensive range of open system products now available.

service reorganizes application assets by identifying programs that are unnecessary or similar to other programs, and then eliminating or consolidating them.

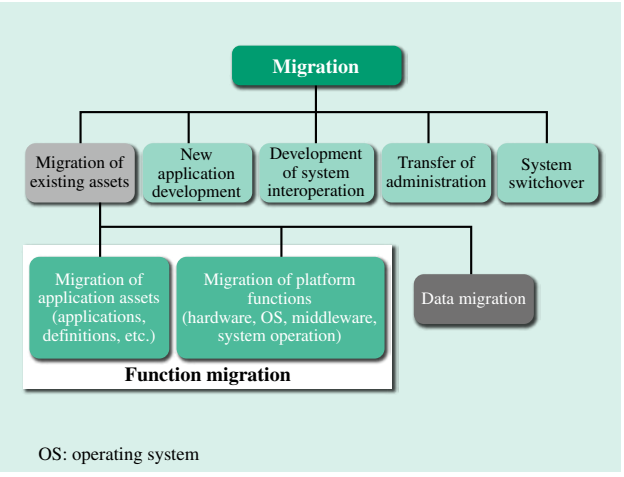
The first of these five steps, migration of existing assets, can be further broken down into the following three steps (see Fig. 2).

MIGRATION

Migration Process

When migrating a system to a different environment, it is necessary to deal with a variety of problems that arise due to the differences between the new and old systems. Examples include the influence of differences in hardware and architecture on existing assets, system switchover, post-switchover operation, interoperation with other systems, and how to satisfy new requirements. Hitachi believes that undertaking migration in a way that deals with these issues involves the following five steps (see Fig. 2).

(1) Migration of existing assets
(2) System switchover
(3) Transfer of administration
(4) Development of system interoperation
(5) New application development



OS: operating system

Fig. 2—Migration Process.
The migration process can be broadly divided into five steps. The migration service supports the migration of application assets and data migration.

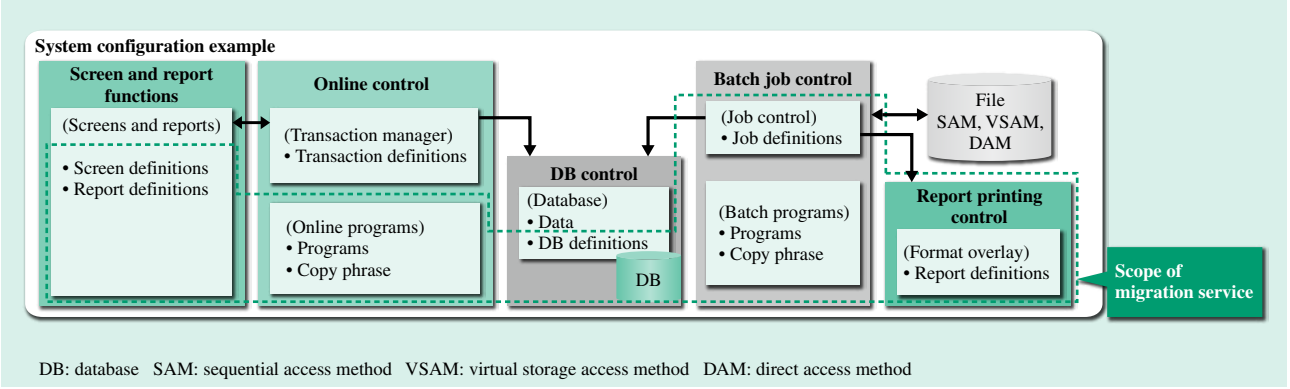


Fig. 3—Scope of Migration Service (System Configuration Example).
The migration service covers programs, job definitions, screen and report definitions, and DB definitions.

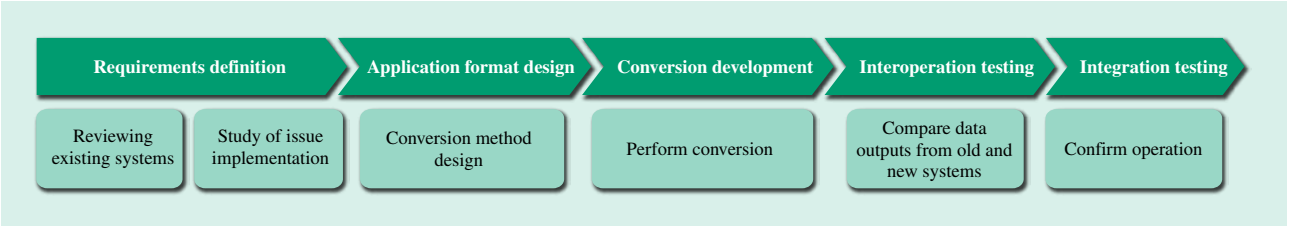


Fig. 4—Migration Process.
A key point with refactoring (downsizing) is to eliminate unused assets during the phase of reviewing the existing systems.

(1) Migration of application assets
(2) Migration of platform functions
(3) Data migration

The migration service supports the migration of application assets and data in particular, drawing on Hitachi's extensive know-how and techniques for analyzing existing systems to strive to make maximum use of the valuable assets that customers have built up over time and to avoid letting them go to waste.

Migration of Application Assets

The application assets of a system come in a variety of different types. The migration services can deal with a wide range of different types of assets, including programs such as those written in Common Business Oriented Language (COBOL), job definitions, screen and report definitions, and database (DB) definitions (see Fig. 3).

Migration Service Options

In addition to supporting the adoption of open systems for application assets, the migration service also includes a language upgrade service that includes languages such as COBOL and Java[*1]. The refactoring (downsizing) service is also offered as an option.

*1 Java is a registered trademark of Oracle and/or its affiliates.

Many customers use the refactoring service in conjunction with a service that supports migration to open systems and appreciate its ability to reorganize application assets as well as performing the migration. The following section describes how refactoring is done.

KEY POINTS IN REFACTORING

A key point when undertaking refactoring as part of migration is to perform this in the requirements definition phase. The reason for this is that, while the migration process starts with requirements definition and continues up to testing, the workload in the latter stages is significantly influenced by eliminating unused assets during the review of existing systems that forms part of the requirements definition phase (see Fig. 4).

REFACTORING PHILOSOPHY

The refactoring service for application assets is best undertaken in terms of both technical and business considerations. The service undertakes asset rationalization (downsizing) in accordance with technical considerations and supplies the information used as a basis for making decisions regarding the

reorganization of business functions with respect to business considerations. The services are described below.

(1) Technical considerations

(a) Elimination of unused assets

This identifies unused assets and highlights those that can be eliminated by analyzing information about the operation of the system and the relationships involved in calling application assets.

(b) Downsizing by consolidation

Code cloning techniques are used to find similarities between programs and identify program code that can be merged or shared.

(c) Elimination of redundant processing

This identifies unnecessary logic such as processing that is never executed.

(2) Business considerations

(a) Provision of information to facilitate elimination of functions

This involves analyzing logs to review system operation and provide information that can be used as a basis for making decisions about when functions can be eliminated.

(b) Provision of information to facilitate merging of functions

By identifying similar functions, this provides information that can be used as a basis for making decisions about which functions can be merged.

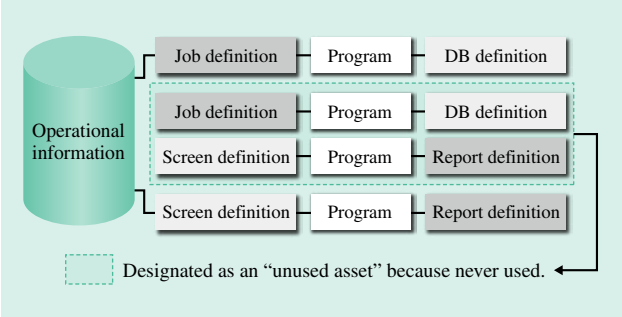


Fig. 5—Elimination of Unused Assets.
Application assets that are never used are designated as "unused assets."

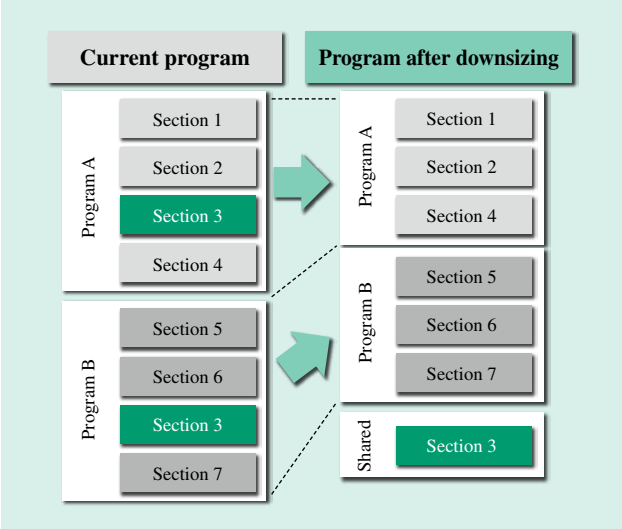


Fig. 6—Downsizing by Consolidation.
The sizes of program A and program B are reduced by factoring out the part they have in common (Section 3).

REFACTORING TECHNIQUES

The following techniques are used to deal with the technical considerations described above.

(1) Elimination of unused assets

This analyzes information about system operation to identify jobs or transactions that are never executed, and designates the associated job, program, and DB definitions as unused assets (see Fig. 5).

(2) Downsizing by consolidation

This reduces the size of the system by consolidating and factoring out data definitions or equivalent sections used by multiple programs (see Fig. 6).

(3) Elimination of redundant processing

This reduces the size of the system by identifying and deleting statements or sections of programs that are never executed (see Fig. 7).

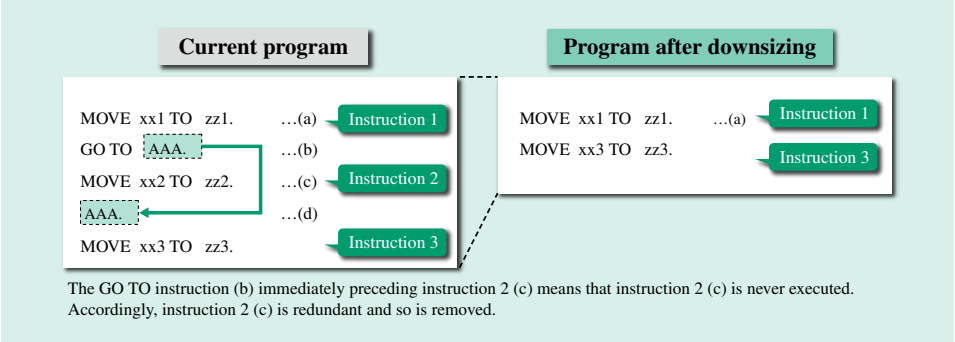


Fig. 7—Elimination of Redundant Processing.
Processing that is not executed is assumed to be redundant and is removed.

TABLE 1. Benefits of Downsizing Application Assets
The table lists the benefits of downsizing application assets in three case studies.

	Development date	Size of existing asset		Size of asset after downsizing		Reduction in size
Case study A	1980s	757 kilo-steps	1,520	526 kilo-steps	1,023	30.5%
Case study B	1980s	676 kilo-steps	1,687	361 kilo-steps	914	46.6%
Case study C	2000s	1,128 kilo-steps	1,438	1,064 kilo-steps	1,407	5.7%

Breakdown

	Technical considerations			Business considerations	
	Elimination of unused assets	Downsizing by consolidation	Elimination of redundant processing	Downsizing by eliminating functions	Downsizing by merging functions
Case study A	20.2%	2.4%	2.9%	3.3%	1.7%
Case study B	21.7%	2.5%	2.7%	19.7%	0%
Case study C	0.1%	5.4%	0.2%	Not used	Not used

CASE STUDY

Benefits of Downsizing Application Assets

Table 1 lists the benefits of downsizing application assets (programs) in projects where refactoring was undertaken.

Cases A and B were systems that had been in operation for several decades and had a large number of unused assets. Similarly, work on reorganizing functions also succeeded in downsizing application assets (programs) by roughly 30% to 46%.

Case C was a comparatively new system and had almost no unused assets. However, because there had been considerable reuse of existing programs and writing of new programs, benefits were achieved through consolidation.

Maintenance and Operating Cost Savings

Along with the benefits of downsizing application assets described above, the reduction in application assets is also expected to deliver the following maintenance and operating cost savings.

(1) Lower costs for modifications and other maintenance due to reduction in application assets

(2) More efficient maintenance due to consolidation of application assets

(3) Lower operating costs due to rationalization of operational processes through reorganizing of applications

CONCLUSIONS

Work has gotten underway in recent years on reforming large government information systems belonging to public agencies that still run on mainframes and that have been seen in the past as being difficult to reform.

In the future, Hitachi intends to continue contributing to the reform of large systems by working on refactoring (downsizing) and other migration techniques with more advanced functions and higher quality, and by providing these as services.

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Featured Articles

Benefits and Uses of Private Cloud based on Next-generation Technology that Supersedes Virtualization

Norihiro Hayakawa
Yasufumi Sato
Hiroyuki Nakano
Tomotaka Shoji
Yasutaka Yorifuji

OVERVIEW: Hitachi launched its Hitachi Cloud Platform Installation Solution for installing private clouds on customer systems in FY2011. While virtualization is the basis of current IT platforms, private clouds are attracting interest as a new approach that can overcome the problems of that technology. In addition to describing case studies of Hitachi private clouds that provide example applications of cloud technology, this article also considers use cases in which a private cloud is a useful option. Hitachi intends to supply this solution to universities as well as to other organizations such as local government or research institutions, and along with adding functions to keep up with market developments, Hitachi also plans to extend the technology to support the hybrid clouds that represent the next level for private clouds.

INTRODUCTION

THE use of virtualization to partition a server into a number of virtual machines enables efficient use to be made of available computing resources. However, there are clear limits to what is possible with virtualization, and this has led to interest in private clouds as a way of delivering the speed and efficiency improvements demanded of modern information technology (IT).

POTENTIAL OF PRIVATE CLOUDS

Limits of Virtualization

Virtualization is subject to a number of problems.

The first is that, because administration is performed manually, it can take between several days and several weeks to respond to user requests.

The second is the inadequate support for multi-tenant configurations (in which administration rights are delegated, and IT space is provided on a tenant-by-tenant basis). As server consolidation is extended from the departmental to the company-wide level, the same integrated platform can end up hosting business systems administered by different support organizations. Unfortunately, virtualization lacks adequate mechanisms for restricting access based on the delegation of administration rights for each system.

The third problem relates to the ability to manage and make available IT resources in an integrated manner. IT platforms are made up of a wide variety of components, including networking, storage, servers, and desktops, with multiple administration systems being needed if virtualization is to be used to virtualize each of these independently, and this requires administrators to have a high level of expertise and undertake complex procedures.

It has become apparent that virtualization on its own is inadequate for providing all of these resources required by IT, quickly and all at once.

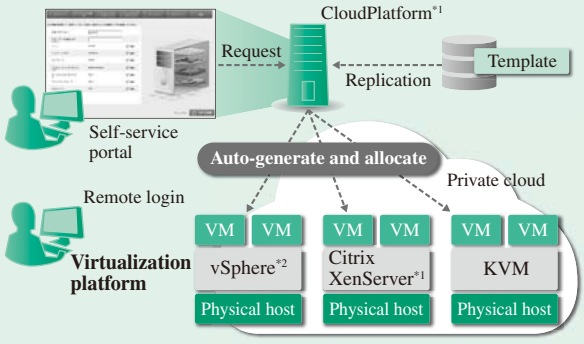
Public and Private Clouds

Another option for speeding up service delivery is the public cloud. Public clouds use a cloud management system with the features listed below to deliver services efficiently to a large number of users.

(1) Mechanisms for offering a menu of services and centralized management
(2) Mechanisms for automated service delivery
(3) Mechanisms for managing contracts with users (multi-tenant)
(4) Mechanisms for providing partitioned IT space to multiple users

The private cloud makes these same technologies available in on-premises IT systems.

A cloud management system provides integrated management of the core IT components for networking, storage, servers, and desktops, and makes them available in the form of a menu of options so that users can visit a self-service portal (a type of online



VM: virtual machine KVM: kernel-based virtual machine
*1 CloudPlatform and Citrix XenServer are trademarks of Citrix Systems, Inc. and/or one or more of its subsidiaries, and may be registered in the United States Patent and Trademark Office and in other countries.
*2 VMware vSphere is a registered trademark or trademark of VMware, Inc. in the United States and/or other jurisdictions.

Fig. 1—Cloud Management System.
The cloud management system automatically generates virtual machines and virtual networks as required rather than having this done manually by system administrators as in the past.

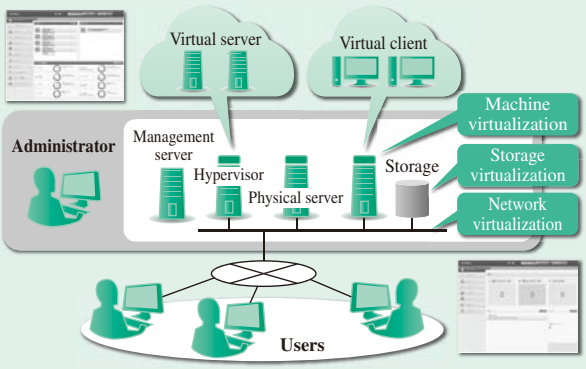


Fig. 2—Outline of Cloud Platform System.
CloudPlatform provides virtualization of physical servers, storage, and networking to provide users with what they need.

store) and automatically generate a virtual machine with the requested specifications on a virtualization platform (hypervisor)[(1)] (see Fig. 1).

On both public and private clouds, services are classified as software as a service (SaaS), platform as a service (PaaS), or infrastructure as a service (IaaS) depending on how the service is provided, with a desktop as a service (DaaS) option also available for providing desktop personal computers (PCs). This article looks in particular at private clouds that have adopted IaaS technology for virtualization.

HITACHI CLOUD PLATFORM INSTALLATION SOLUTION

Hitachi began supplying its Hitachi Cloud Platform Installation Solution for installing private clouds for IaaS and PaaS applications in FY2011, initially in the education market and expanding from FY2014 into the wider public-sector market that includes local government and government agencies. The service uses the CloudPlatform cloud management system of Citrix Systems, Inc. and adds an integration service and customization in the form of proprietary functions (see Fig. 2).

CASE STUDIES CLOUD BENEFITS

As of March 2015, the solution has been used to install seven private clouds at four different organizations. This chapter describes the objectives, features, and benefits of each private cloud.

Hokkaido University

In FY2011, Hokkaido University began operating the Hokkaido University academic cloud, an IaaS and PaaS private cloud that provides on-demand application servers and research computing resources that are available to users inside and outside the university[(2)].

The cloud runs on 114 physical servers [with 40 central processing unit (CPU) cores and 128 Gbyte of memory per server] and has the capacity to provide up to 2,000 virtual machines.

In addition to implementing the private cloud, Hitachi also supplied a proprietary portal and other additional functions. Users can gain immediate access via the proprietary portal to a message passing interface (MPI) cluster, Hadoop*1 cluster, online storage, blog server, and other resources that are spread across multiple computers.

Other features provided in the form of additional proprietary functions include a function that supports the creation of a cluster of virtual machines and a distributed input/output (I/O) function for storage. This automates most of the work involved in preparing a large number of virtual machines with the same configuration, and provides automatic system load balancing (see Fig. 3).

This is an example of a private cloud being used to provide IT resources to an organization's IT users, with its IT department acting as a service provider.

*1 Hadoop is a trademark of the Apache Software Foundation.

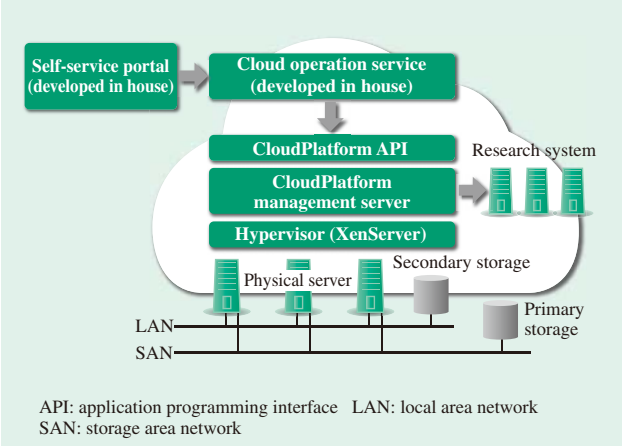


Fig. 3—Hokkaido University Academic Cloud.
By pooling the computing resources of the on-campus cloud to provide the required resources as necessary, researchers can get started on their work immediately without having to deal with hardware purchasing or configuration.

Among the benefits of the cloud are that users can gain access to IT resources in as little as 10 minutes without the need to purchase or configure hardware, and that the high availability (HA) functions of the cloud provide a high level of redundancy and reliability that would be difficult to fund out of departmental budgets.

Kyushu University

Kyushu University introduced a campus cloud from FY2012 that is used for on-site research (Hadoop environment and development servers), departmental servers (web and mail servers), and educational computing[(3)].

The cloud runs on a total of 496 CPU cores with 1,984 Gbyte of memory, provides on-demand educational support systems, and is being used for on-site research and business applications. Hitachi supplied proprietary functions for a single sign-on function using Shibboleth[*2, *3], a workflow function for the approvals process that handles the steps from user request to authorization, and an expiry function that prevents resources from being wasted on virtual machines that are not in use. This provides ways of effectively utilizing and recycling computing resources.

It has been reported how Kyushu University, since FY2013, has been promoting the use of PC-based textbooks whereby students receive lessons on their own PCs, with a lot of work going in to ensuring uniformity in things like hardware and operating systems (OSs)[(4)]. A feature of this cloud is the distribution of educational environments set up on the cloud for teaching purposes to student PCs, which started in FY2014.

Accordingly, this is an example of how a private cloud needs support mechanisms in order to handle the highly efficient turnover of computing resources that prevent them from being left idle.

The distribution of educational environments to individuals' PCs also demonstrates how these PCs can be used for both application and educational purposes by having the cloud provide a uniformly regulated application environment on a heterogeneous environment of individual PCs.

Toyohashi University of Technology

In collaboration with Nagaoka University of Technology and the National Institute of Technology, the Toyohashi University of Technology launched a wide-area integrated information system for education and research in FY2014. The system provides a cloud platform for education and research for students and researchers from the three institutions, both in Japan and overseas[(5)].

The cloud runs on 32 physical servers (with 640 CPU cores and 4,096 Gbyte of memory), providing an on-demand environment for research and education to a combined campus that uses a network to interlink Toyohashi University of Technology, Nagaoka University of Technology, the 51 technical colleges of the National Institute of Technology, Japan, and their overseas affiliates (see Fig. 4).

This is an example of a cloud used jointly by a community made up of two universities and 51 technical colleges and is characterized by its provision of a platform for research and educational activities that is utilized by other facilities around the world as well as its provision of cloud-based storage of application data for research and education.

Clouds like this are called "community clouds" and they are recognized as having the potential to optimize costs through the synergies and resource sharing made possible by cloud-based collaboration while also avoiding concerns about public clouds where data is held by a third party.

There is scope for this system to be deployed in applications such as a community cloud for a local authority or as an education platform cloud for elementary or junior high schools run by a board of education.

*2 Shibboleth is an open source software authentication and authorization platform technology supplied under the Apache 2 license that provides for single sign-on across multiple organizations.
*3 Shibboleth is a registered trademark of Internet2.

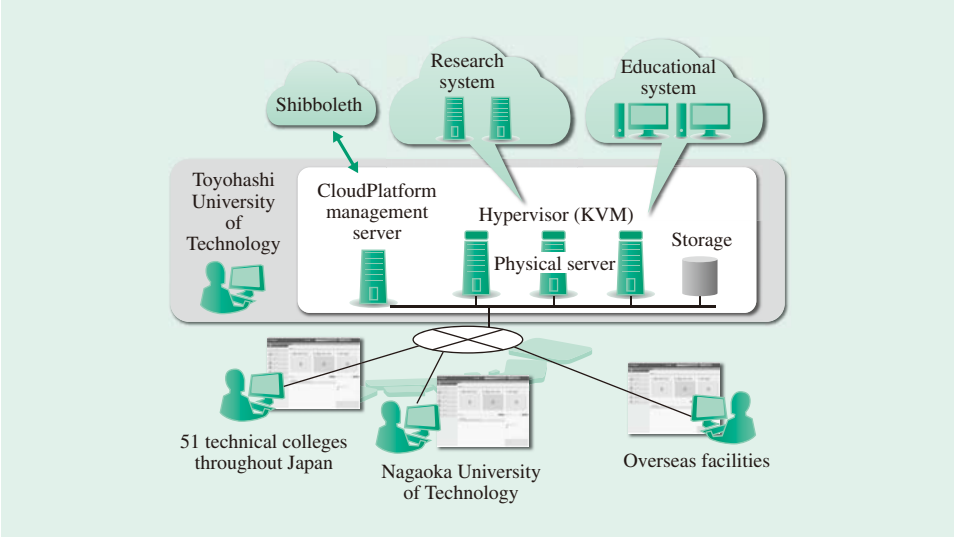


Fig. 4—Wide-area Integrated Information System for Education and Research at Toyohashi University of Technology.
In addition to providing computing resources to community organizations around the country, the cloud acts as a hub for encouraging innovation by providing a forum for joint research.

National Research Institute for Earth Science and Disaster Prevention

The National Research Institute for Earth Science and Disaster Prevention launched a public information cloud system in FY2014 that forms part of its disaster prevention information system. The disaster prevention information system includes a large simulation system as well as the public information cloud system, the latter being used to provide on-demand servers for publishing the results of analysis undertaken by researchers on the simulation system[6].

Servers are generated based on cloud templates, and the templates are regularly updated. Because the volume of accesses to the public information service increases when a disaster strikes, while demands on the analysis system decrease, the public information cloud system and large simulation system share some of their physical servers so that resources can be redirected to web servers during a disaster (see Fig. 5).

This is an example of how hosting multiple application systems on a private cloud enables computing resources to be used effectively by reallocating them as required. It also demonstrates the value of template functions on the cloud, which provide a consistent baseline for dealing with vulnerabilities in the OS or applications and enable ongoing improvement.

FUTURE OUTLOOKS

This chapter describes Hitachi's future outlooks to supply private clouds for local government and research institutions and support for hybrid clouds.

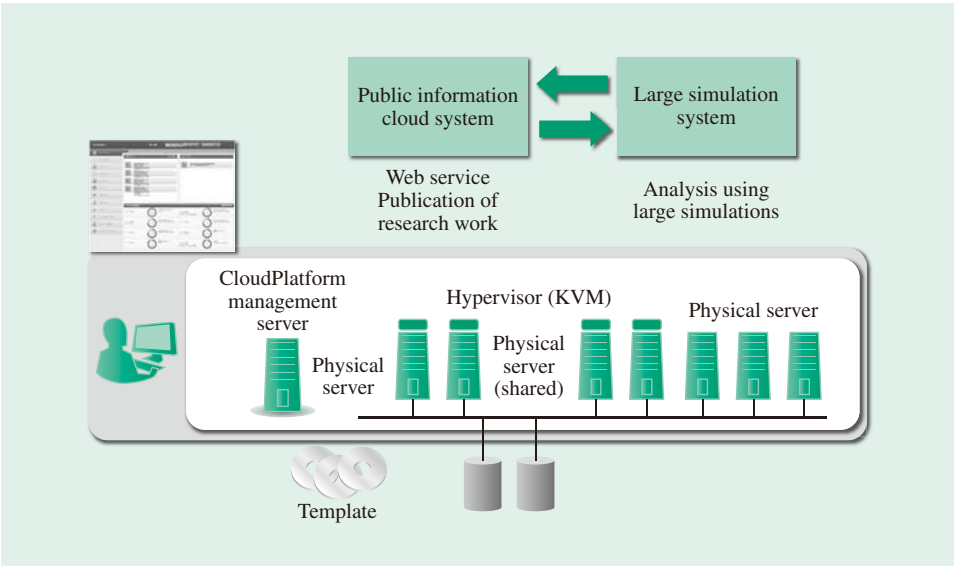


Fig. 5—Disaster Prevention Information System of National Research Institute for Earth Science and Disaster Prevention.
The integrated management of computing resources at the research institute helps optimize its overall computing resources by providing them as and when required to systems that have different demand peaks.

Deployment of IaaS and DaaS in Local Government Markets

Hitachi intends to provide two forms of private cloud to local government markets: common application platforms for hosting core business systems in their entirety, and virtual desktop platforms for hosting office PCs and dedicated terminals for accessing the core business systems.

Because the business systems hosted on a common application platform will be administered by different departments, the platform can benefit from multi-tenant functions (delegation of administration rights, provision of IT space on a tenant-by-tenant basis). Furthermore, by using the common platform (IaaS) management system to deploy the virtual desktop (DaaS), spare resources on the desktops, which significantly outnumber the servers, can be reassigned between servers and desktops as needed.

By reducing the amount of IT investment required to deliver services to residents, this enables the focus to shift toward application development and has the potential to also save on the investment needed for a trial and error approach to providing new resident services.

Deployment of High-performance DaaS at Research Institutions

Hitachi will supply research institutions with high-performance desktop clouds that utilize graphic processing units (GPUs). The shift to a cloud configuration will allow computer-aided design (CAD) and computer-aided engineering (CAE) work conducted on high-end workstations to be undertaken in tandem with overseas facilities while keeping the data in Japan.

As the high-performance screen transfer software that is particularly important in this field is a more mature technology than virtual desktop software, Hitachi is looking at the possibility of providing this high-performance screen transfer software on private clouds.

Hybrid Clouds

One of the requirements of the public sector is the ability to offload processing load during times of peak activity. Hitachi intends to add functions to support hybrid clouds that can offload processing from information systems on private clouds by providing a proprietary function for automatically scaling up based on the load and also integrating it with the federated cloud function of Hitachi Cloud.

CONCLUSIONS

This article has described how private clouds can overcome the limitations of virtualization to help optimize IT systems and enhance their efficiency. Hitachi intends to continue utilizing private cloud technologies in the future to provide IT platforms that can respond to change.

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Featured Articles

Work on Cybersecurity Measures for Collaboration between Organizations

Masato Terada, Dr. Eng.
Masashi Fujiwara
Akiko Numata
Yukari Nishikawa
Ruiko Kuba

OVERVIEW: Cyber-attacks continue to evolve, with a growing diversity of security incidents due to attacks and severe consequences for social infrastructure built using the Internet and based on information systems and control systems. In addition to leading cybersecurity countermeasures at Hitachi through its incident operations work, the HIRT is also working on a new problem-solving approach to cybersecurity measures whereby it seeks to obtain an overview of malicious activity by sharing information with CSIRTs at other organizations.

INTRODUCTION

LOOKING back, 2014 was a year for rethinking measures for countering vulnerabilities, including Heartbleed, Shellshock, and Padding Oracle On Downgraded Legacy Encryption (POODLE). These are names for different vulnerabilities that attracted attention because of their widespread impact. These vulnerabilities made it clear that social infrastructure built using the Internet and based on information systems and control systems is confronted with the challenges they pose as threats with the potential to lead to security incidents. They also demonstrate the need to deal, through daily work on cybersecurity measures, with the challenges posed by vulnerabilities with the potential to become new threats.

The Hitachi Incident Response Team (HIRT) helps provide safe social infrastructure and keep customers and other parts of society secure by protecting Hitachi as a whole from potential security incidents resulting from new threats and by responding promptly if an incident does occur. This article describes the HIRT's work on cybersecurity measures for collaboration between organizations.

TRENDS IN SECURITY INCIDENTS

Overview

The nature of cyber-attacks using malware continues to undergo major changes as the technology evolves. Around 1999, this included viruses sent as e-mail attachments; around 2001, there were network worms that exploited vulnerabilities; and around 2004, remotely controlled bots were being circulated. Web-based infections that exploited vulnerabilities in the plugins or other applications used by browsers began appearing around 2008, and 2011 saw the emergence of targeted attacks that combined e-mail and remote control tools to break into organizations' internal networks. The infection mechanisms used by malicious activity have broadened in step with the available communications infrastructure, including e-mail, web access, and social networks.

One of the topics of cybersecurity in 2014 was the emergence of the problem of vulnerabilities that pose threats with the potential to cause various security incidents involving social infrastructure (see Table 1). Among the characteristics of security incidents are the increasingly serious damage caused by malicious

Table 1. Typical Examples of Vulnerabilities Reported During 2014
Here "vulnerability" means the security defects that have the potential to cause a loss of performance or other functionality in the event of an attack such as unauthorized access or malware.

Date	Summary of vulnerabilities
April 2014	Heartbleed OpenSSL* issue
September 2014	Shellshock Bash issue
October 2014	POODLE SSL 3.0 issue
January 2015	GHOST GNU C Library (glibc) issue
March 2015	FREAK Export-grade RSA key issue

SSL: secure sockets layer
POODLE: padding Oracle on downgraded legacy encryption
FREAK: factoring attack on RSA-EXPORT keys
* OpenSSL is a registered trademark of the OpenSSL Software Foundation, Inc.

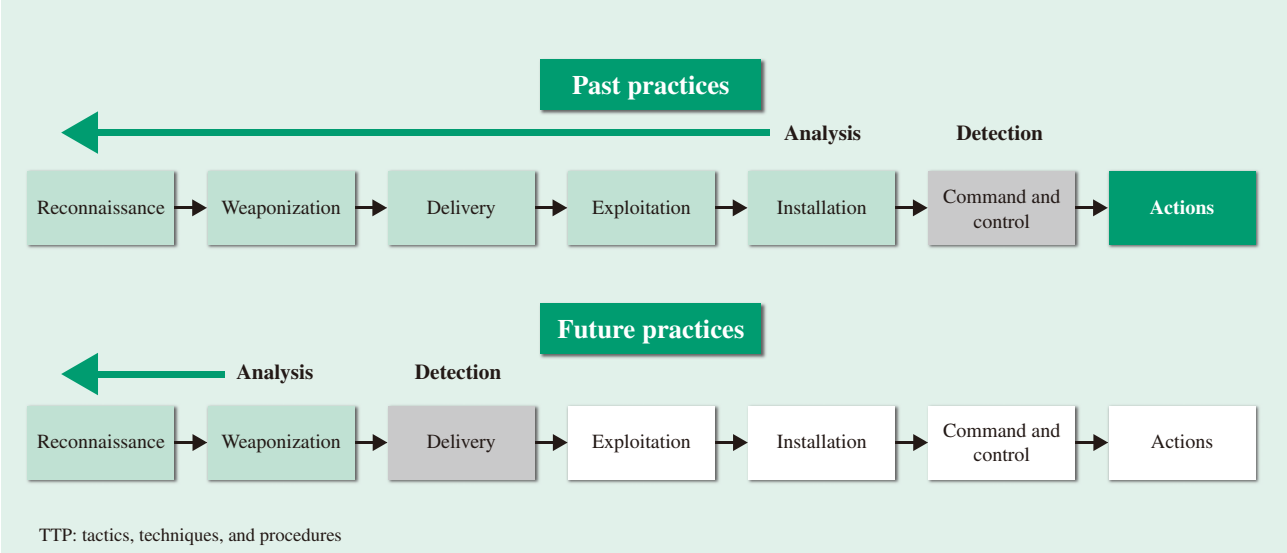

Fig. 1—Undertaking Countermeasures at an Early Stage.
The top row shows the past practices and the bottom row shows how countermeasures will be handled in the future. Future practices will include detection during the delivery stage and analysis during the weaponization stage or earlier, and a need for campaign analysis to identify the attacker's intentions and behavior patterns, actions, and TTPs.

programs that target Internet banking, and the fact that cases of damage caused by malware-based cyber-attacks, such as targeted attacks or website intrusions, have become routine. In the case of cyber-attacks against websites, in particular, password list attacks have become commonplace. These attacks involve the creation of a database of account information that can be used to attempt unauthorized login to numerous sites. There has also been a rise not just in cyber-attacks on their own, but also a rise in malicious activity in which the attacker demands money in exchange for halting an attack, such as a denial of service (DoS) amplification attack that exploits the amplification of request/response messages, and ransomware that holds personal computer (PC) files for ransom. Ransomware is the general name for malicious programs that encrypt files on a PC and then demand money in return for decrypting them. Because of the potential for ransomware to encrypt important business files and to directly impact business continuity, measures for preventing cyber-attacks now need to deal with the destruction of information as well as its exploitation.

Modeling of Cyber-attacks

To counter cyber-attacks that are becoming more diverse and ingenious, attempts are being made to investigate countermeasures by modeling this activity. In the case of targeted attacks, for example, which involve malicious activity that is both targeted (chooses a method that suits the organization being attacked) and covert (uses the organization's internal network as the platform for the attack), there are models that consider the stages in this process[1, 2]. Hutchins et al.[2] proposed a "cyber kill chain" that applies the find, fix, track, target, engage, and assess (F2T2EA) "kill chain" concept of the U.S. Air Force to cyberspace in order to model attacks from a countermeasures perspective (see Fig. 1). This model includes seven stages: reconnaissance, weaponization, delivery, exploitation, installation, command and control (C2), and actions. It also notes the need for measures that target the early stages of an attack through detection in the delivery stage or analysis of the weaponization and earlier stages, and for campaign analysis to clarify the attacker's intentions and behavior patterns, actions, and tactics, techniques and procedures (TTPs).

Along with modeling the stages of a cyber-attack, how to use information for campaign analysis is also a subject of study. The structured threat information expression (STIX) language[3] developed by The MITRE Corporation of the USA is an extensible markup language (XML) specification for describing the process of a cyber-attack from the attack to the countermeasures. Work on the specification began with the exchange of information about attacks between the United States Computer Emergency Readiness Team (US-CERT) and the CERT*/Coordination Center

* CERT is a registered trademark of Carnegie Mellon University.

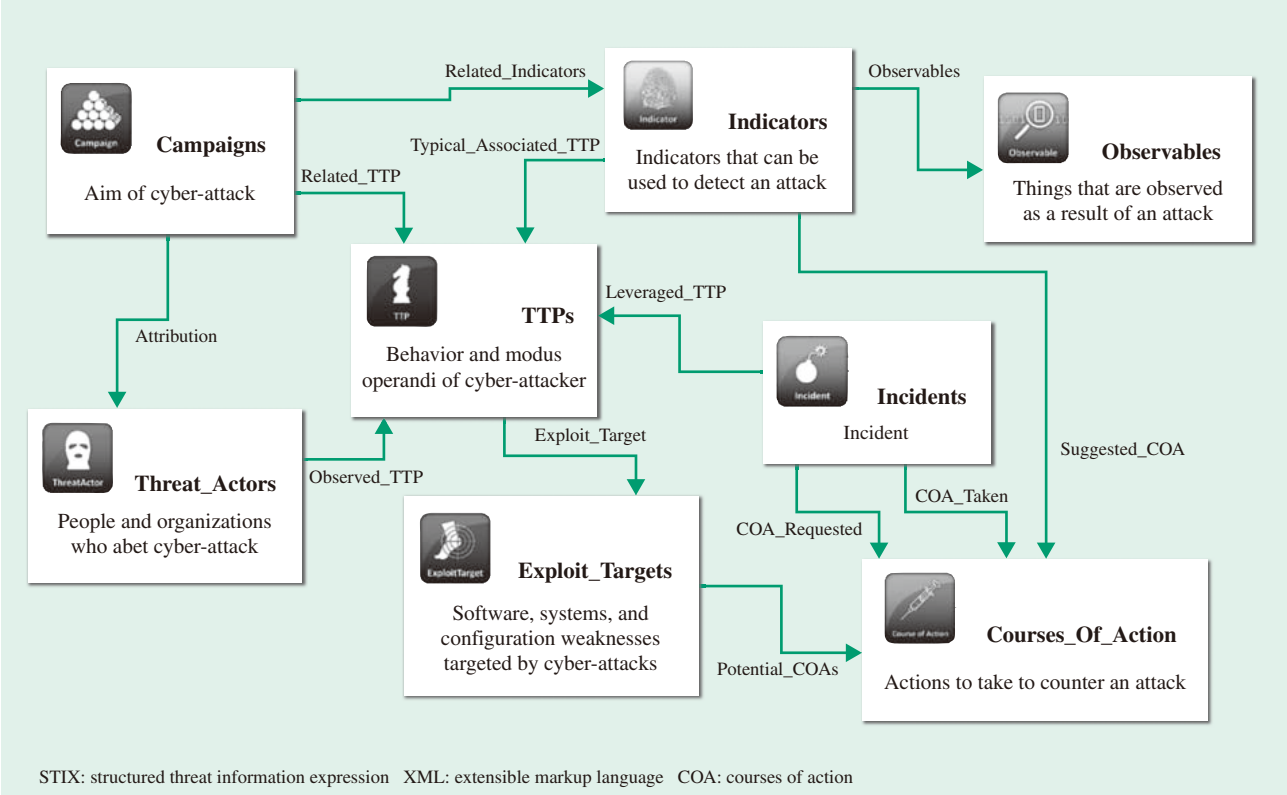

Fig. 2—Use of STIX to Define Structure of Threat.
STIX is an XML specification for describing the process of a cyber-attack from the attack to the countermeasures.

(CERT/CC) in 2010, and the release of version 1.0 in April 2013. STIX aims to establish the structure of cyber-attacks in order to link together not only the circumstances for detecting cyber-attacks, namely the software, systems, and configuration weaknesses targeted by cyber-attacks, but also the behavior and modus operandi of attackers and the people and organizations who abet cyber-attacks (see Fig. 2).

This modeling and structural analysis of cyber-attacks has attracted attention as a way for organizations to work together on cyber countermeasures through the sharing of information on "observables" (things that are observed as a result of an attack) and "indicators" (things that can be used to detect an attack), and attempts are underway to apply it at various sites.

HITACHI CSIRT ACTIVITIES

CSIRT

Interest in Computer Security Incident Response Teams (CSIRTs) and the functions performed by CSIRTs has grown in Japan since 2012. One of the main activities of these teams is incident response, meaning responding to any incidents that occur in accordance with a predetermined plan that was devised through the sharing of information about the causes of incidents and how to respond to them. Up until around 2005, seeking to resolve problems by having CSIRTs belonging to different organizations inform each other about their practices was an effective approach to incident response. However, the changing nature of cyber-attacks and other security incidents influenced the thinking of those whose job it was to respond, leading to calls for CSIRTs from different organizations to resolve problems by working together to obtain an overview of malicious activity. This meant there was a need to adopt the higher level approach of cyber-attack campaign analysis in order to counter cyber-attacks that were becoming more diverse and ingenious (see Fig. 3).

HIRT

HIRT commenced operation in April 1998 as a research project for establishing a CSIRT for Hitachi. This work included setting the requirements for HIRT to function as a CSIRT, namely, establishing capabilities for "predicting and adjusting to threats from a technical perspective," "conducting technical collaboration activities," and "liaising with external communities on technical aspects" when engaged

in activities such as countering vulnerabilities and responding to incidents. HIRT's mission is to draw on its experience in incident operations (the security actions taken to predict and prevent the damage caused by an incident and to minimize the spread of damage once an incident has occurred) to "catch any signs of future threats and take action as early as possible." Given these capabilities and mission, HIRT has the role of acting as a point of contact for CSIRT matters on behalf of Hitachi.

To counter cyber-attacks that are becoming more diverse and ingenious, HIRT is engaged in dynamic observation focusing on attacker identification ("attribution") to use observations of attacker actions in the campaign analysis of cyber-attacks.

DYNAMIC OBSERVATION FOCUSING ON ATTACKER ATTRIBUTION

Objective

In the field of cyber-attacks, "attribution" means determining the identity or location of an attacker or an attacker's intermediary[4]. To date, the static and dynamic analysis of examples of malware has focused on malware behavior. For example, the emphasis has been on things like determining the presence of functions such as C2 server connections, information theft, and backdoors, and assessing their behavior, with few instances of performing assessment or other analyses in terms of the attacker's actions, such as which of these functions the attacker used. In many cases, the response has involved static and dynamic analysis based on the assumption that the actions of the attacker and the behavior of the malware are the same thing. In the case of campaign analysis of targeted cyber-attacks involving malicious activity aimed at organizations' internal networks, however, as noted in relation to defining the structure of cyber-attacks, it is necessary to keep in mind the existence of the attacker. Accordingly, as part of the attribution process, the dynamic observation of activity aims to characterize threats in terms of the attacker's actions by considering not only malware behavior but also what actions the attacker performed, what sort of files were accessed, and so on.

Behavior Observable System

For the dynamic observation of activity, Hitachi has set up an observation environment that simulates in-house networks (see Fig. 4). This environment is a system for observing cyber-attacks launched against an organization's internal networks by an attacker

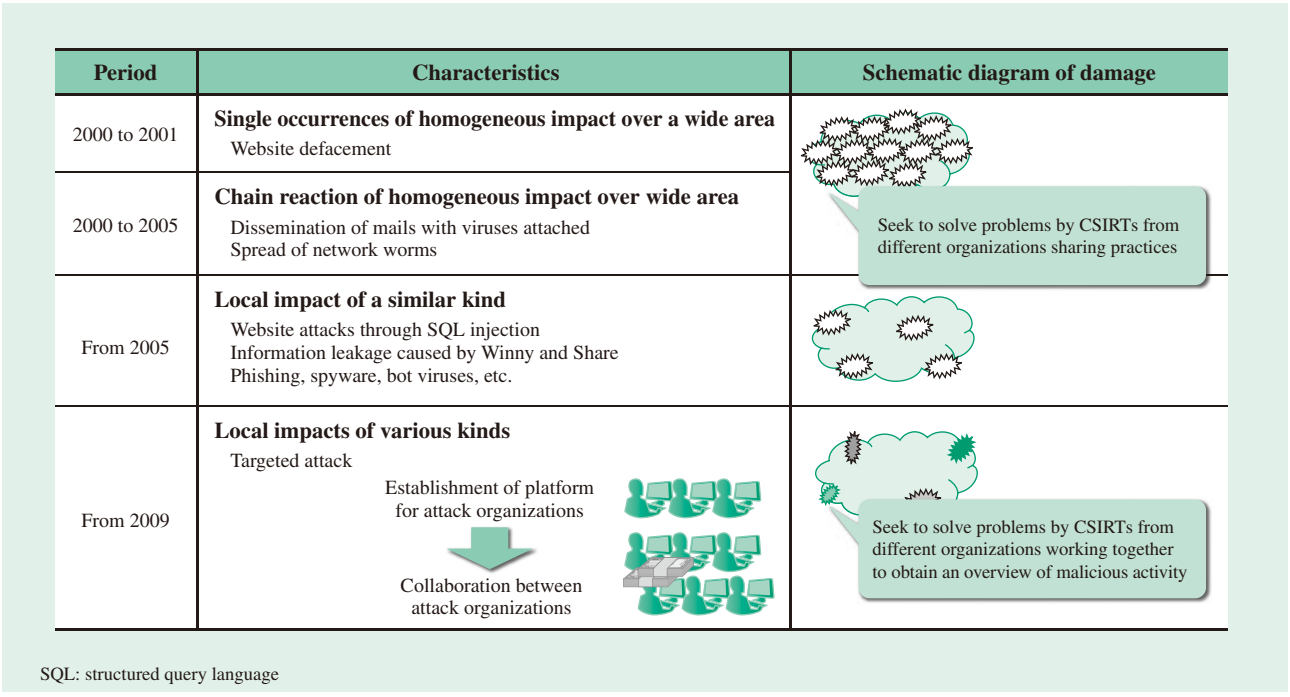

Fig. 3—Evolution of Security Incidents and Cyber-attacks.
Because of the changing nature of security incidents and cyber-attacks, collaboration between the CSIRTs of different organizations is shifting from an approach based on seeking to overcome problems by sharing practices to one based on seeking to overcome problems by obtaining an overview of malicious activity.

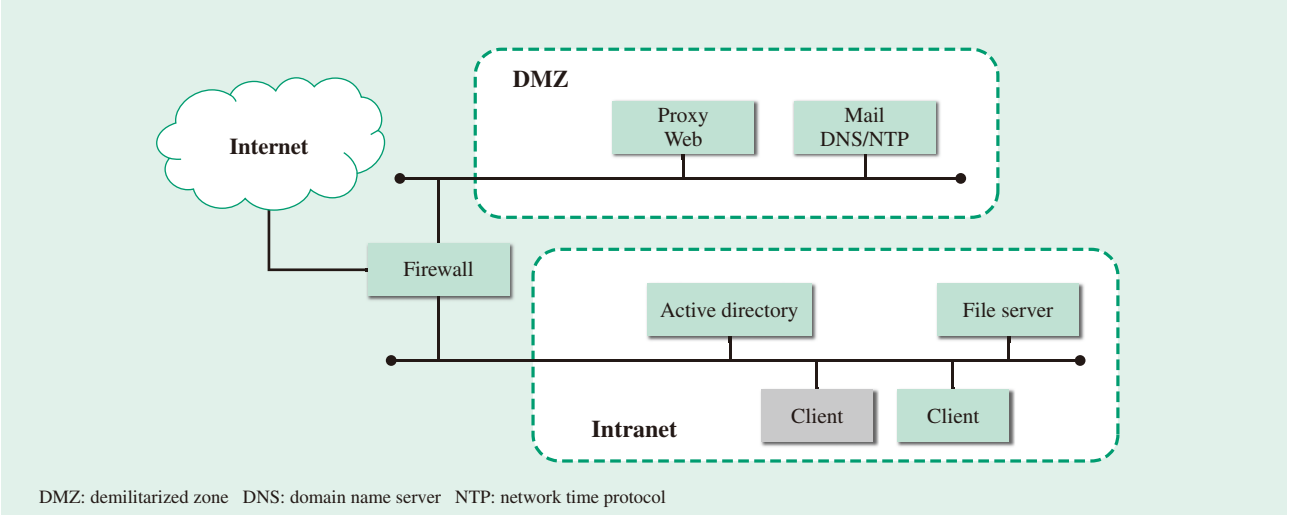

Fig. 4—Overview of Behavior Observable System.
The behavior observable system provides an environment that simulates an organization's internal network and can be used to observe the progress of cyber-attacks launched in the internal network by an attacker.

on the Internet and is intended for looking at what happens from the point when a PC on the internal network becomes infected by malware (in other words, the exploitation stage in the model of the stages of a cyber-attack). The client is a PC that executes a malware program received as an e-mail attachment (targeted attack), and is able to access the real Internet either with or without a proxy.

Example Observations

This describes observations made of a fake e-mail sent out in mid-September 2014 that claimed to be a medical bill. The fraudulent e-mail, which was made to look like the billing e-mails sent by health insurers and other agencies, attempted to infect user PCs with a malicious program ("Emdivi") that could control the PC remotely.

The file attached to the medical bill e-mail contained a malicious program that was presented as a document icon despite being an executable. On the observation system, an attacker started engaging in malicious activity approximately seven hours after the PC became infected, with a total of three hours of activity spread over three periods occurring during the 12 days until the activity ceased. The observed activity included viewing system configuration and directory information and stealing files from the infected PC and elsewhere (see Fig. 5).

While this dynamic observation of activity was only at the prototype stage, by providing information on the actions of the attacker and the nature of cyber-attacks, Hitachi believes it has the potential for uses such as cyber-attack campaign analysis and countermeasures against targeted attacks.

Involvement with anti-Malware engineering WorkShop

Dynamic observation also has another purpose, which is to enable CSIRTs from different organizations to work together to resolve problems by sharing information and obtaining an overview of malicious activity.

To achieve this, Hitachi is sharing information through the organizational committee of the anti-Malware engineering WorkShop (MWS) set up by the Computer Security Group of the Information Processing Society of Japan in the form of the Behavior Observable System (BOS), a research dataset of communication and process data collected through the dynamic observation of malware activity. By making datasets available for research use, the sharing of research results, and providing a venue for mutual assistance, the MWS acts as a place where practices can be developed and provides a framework for action based on a cooperative community of industry, academia, and government for fostering researchers, engineers, and practitioners with knowledge of malware.

CONCLUSIONS

While damage continues to occur from known threats, damage is also resulting from the emergence of new threats from cyber-attacks. Recognizing this state of affairs, HIRT seeks to implement countermeasures quickly as part of the process of identifying new threats.

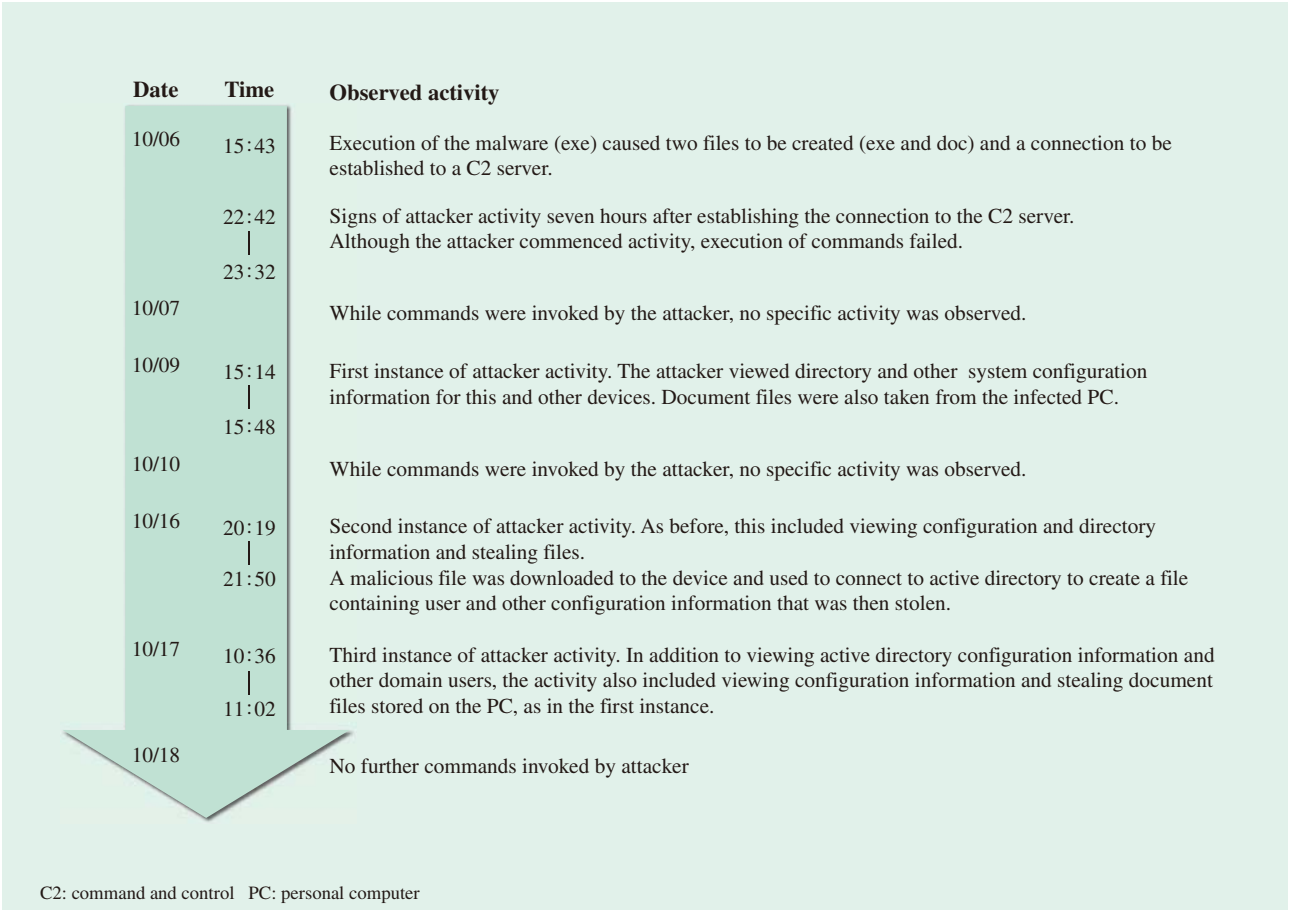

Fig. 5—Example Observations Using Behavior Observable System.
In a total of three hours of activity spread over three periods occurring during the 12 days until activity ceased, the attacker engaged in activities that included viewing system configuration and directory information and stealing files from the infected PC and elsewhere.

With respect to implementing countermeasures in particular, Hitachi aims to take the initiative in having CSIRTs from different organizations work together to resolve problems by sharing information and obtaining an overview of malicious activity. Specifically, this means countering cyber-attacks through the sharing of information by collaboration between organizations using "observables" (things that are observed as a result of an attack) and "indicators" (things that can be used to detect an attack) based on modeling that considers the different stages of a cyber-attack and defining the structure of attacks.

Hitachi also aims to contribute to making social infrastructure safe and secure through involvement in training of personnel in the academic sector to foster the next generation of the CSIRT community, including MWS.

ACKNOWLEDGMENTS

The dynamic observation of activity was conducted under contract with a field experiment project run by the Ministry of Internal Affairs and Communications to practice exercises for the analysis of and practical models for defense against cyber-attacks. The authors wish to express their sincere gratitude for the valuable advice and assistance received while conducting the dynamic observation of activity.

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Featured Articles

Overseas Deployment of Japanese-style Public-sector Solutions that Contribute to the Development of Emerging Economies

Takumi Hayashi
Tatsuya Okubo
Makoto Kudo
Kenichi Masaki

OVERVIEW: Among the important challenges associated with the sustainable growth of emerging economies include not only providing physical infrastructure, but also providing institutional infrastructure such as laws and systems. Recognized as being ahead of other nations in having to deal with certain issues, Japan is highly regarded around the world for its technologies and public institutions, and for encouraging the export of its excellent infrastructure systems as an important part of the government's growth strategy. Along with an increasing awareness that furthering the widespread adoption of Japanese-style infrastructure systems will require aid that covers both physical and institutional aspects, there is also rising demand in public-sector IT for solutions as well as for hardware. Against this background, Hitachi is working hard on the overseas deployment of public-sector solutions that are suited to local needs. This article describes the directions being taken in this work along with solutions on which work has already started.

INTRODUCTION

PROVIDING social infrastructure such as electric power, water, transportation, and communications is essential to the economic growth of emerging economies. The provision of infrastructure that has supported national development to date in emerging economies such as Brazil, Russia, India, and China (the "BRIC" countries) and the members of the Association of Southeast Asian Nations (ASEAN) has primarily focused on physical infrastructure.

In addition to physical infrastructure, however, the challenges associated with sustaining growth in these countries also include providing institutional infrastructure such as laws, systems, and human resource development.

Against this background, Hitachi is seeking to expand in the global market with a focus on Social Innovation. In emerging economies, Hitachi is seeking to contribute to the development of these economies by drawing on its experience in Japan to supply information technology (IT) solutions that balance both physical and institutional considerations.

NEW FORM OF AID FOR EMERGING ECONOMIES

Japan has led the world in having to deal with such issues as an aging population, falling birth rate, and environmental pollution. The provision of institutional infrastructure such as government, education, healthcare, and social security is an important challenge for emerging economies, and it is believed that establishing Japanese-style institutions that draw on experience and know-how from Japan offers a highly significant opportunity to help maintain the long-term growth of emerging economies.

Japanese Government Initiatives

Encouraging the export of Japan's excellent infrastructure systems forms an important part of the government's growth strategy. The Ministerial Meeting on Strategy Relating Infrastructure Export and Economic Cooperation set up to study this issue agreed on an Infrastructure Systems Export Strategy[(1)] in May 2013. The content of this strategy was also reflected in the Japan Revitalization Strategy[(2)] that

was agreed on in June 2013. Furthermore, whereas past overseas aid, such as Official Development Assistance (ODA), has focused on physical infrastructure, there is a growing awareness that encouraging the wider adoption overseas of Japanese practices in the form of Japan's excellent technologies and institutions will require aid that covers both physical and institutional aspects, with an increasing amount of overseas aid being provided in the form of solutions rather than just equipment procurement.

Hitachi Initiatives

Hitachi is working hard on the deployment in emerging economies of public-sector solutions that are suited to local needs, with an ultimate objective that extends beyond installation to include the establishment of practices that will enable the sustainable use of systems. Hitachi engages in dialog with the stakeholders in the country concerned, such as central government, regional government, local companies, and local Hitachi subsidiaries, to identify local needs, and strives to supply solutions in a form that suits conditions in the country in collaboration with Japanese government agencies including the relevant ministries, the local Japanese embassy, and the Japan International Cooperation Agency (JICA).

The following section describes three initiatives in which Hitachi is currently engaged in emerging economies.

ROAD TRANSPORTATION SECTOR INITIATIVES

Hitachi Transportation Solution

Chronic traffic congestion is a societal problem that is common in emerging economies experiencing rapid economic growth. To alleviate traffic congestion, it is important to engage in ongoing work on traffic control measures that deal with traffic congestion and accidents in realtime based on an accurate understanding of current traffic conditions, and road planning that utilizes the information collected by these activities to help improve the road network from a long-term perspective (see Fig. 1). The following are two solutions to be applied in this work.

(1) Probe technology

Probe technology is a technique that uses global positioning system (GPS) data collected by taxis and other vehicles to identify the roads they are driving on and calculate traffic information such as the mean speed they travel at different times of the day. The calculation results enable realtime monitoring of the level of congestion across an entire city and can be utilized in traffic control and various other activities and services.

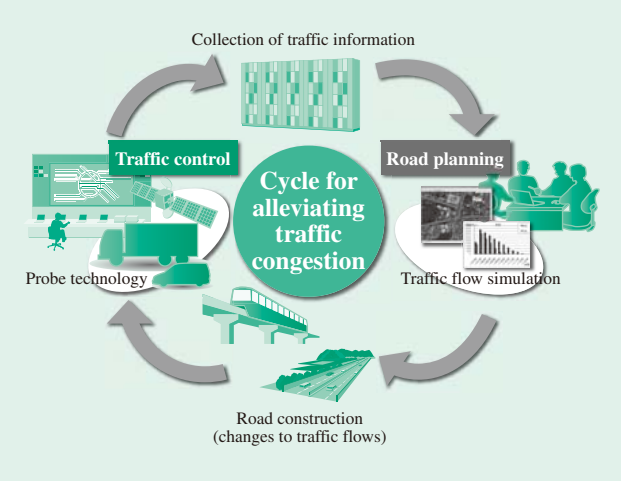

Fig. 1—Cycle for Alleviating Traffic Congestion.
The alleviation of traffic congestion requires both traffic control measures that operate in realtime and road planning that utilizes the information collected by these activities.

(2) Traffic flow simulation

A traffic flow simulation recreates the traffic flow in a particular area based on information such as road layouts and traffic volumes. The technique can be used to estimate the benefits of constructing a new intersection, for example, by simulating how it will affect traffic flows. This helps achieve efficient road planning by providing quantitative preliminary assessments of planned measures before starting on actual road construction.

Traffic Solution Pilot Project in Myanmar

The alleviation of traffic congestion has become a pressing concern in the city of Yangon in Myanmar, which has experienced a rapid rise in the number of vehicles on its roads over recent years due to economic growth and other factors.

Hitachi has participated in a pilot project using probe technology and traffic flow simulation since September 2014 in collaboration with the local government through a JICA program for disseminating private-sector technology to promote the social and economic development of developing countries.

This pilot project demonstrated the ability to monitor traffic conditions in Yangon by using Hitachi's probe technology to generate traffic information from GPS data collected from approximately 100 taxis (see Fig. 2). It also demonstrated how traffic

flow simulation could predict the change in traffic conditions in the vicinity of a bridge constructed during the pilot project.

In addition to the future adoption of the two technologies trialed in this pilot project, which will enable traffic conditions in the city to be monitored at comparatively low cost, it is also anticipated that they will enable more sophisticated traffic control. It is also expected to facilitate efficient road planning and help avoid road construction being undertaken sequentially.

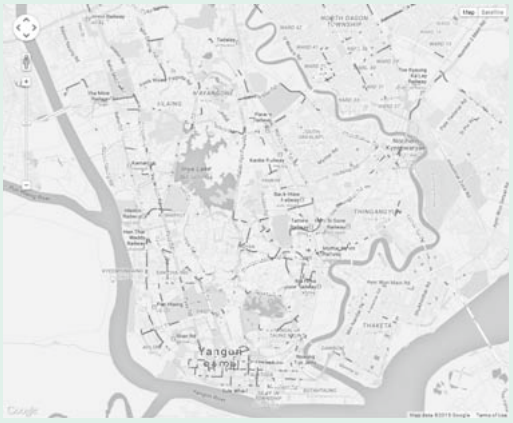

Fig. 2—Use of Probe Technology for Visualizing Traffic Conditions in Yangon.
The traffic conditions in Yangon at any given time can be determined for each section of road.

SOCIAL SECURITY SECTOR INITIATIVES

Japan's Social Security System

Since Japan passed its first law providing health insurance for employees (workers) in 1922, a variety of social security schemes have been introduced covering public pensions, medical insurance, workplace accident compensation, and employment insurance. The employee pension system was introduced in 1944 to provide an environment in which workers could be confident of their livelihood in old age as well as in the event of sickness or serious injury. In this way, economic growth was underpinned by an environment in which providing social security systems enabled workers to focus on working rather than other concerns. Furthermore, coverage was extended from workers to the general public with the establishment of insurance schemes covering the entire population during the period of rapid economic growth.

Hitachi Initiatives in Japan

Hitachi has contributed to the implementation and operation of information systems that support the administration of a variety of social security schemes, including medical insurance, public pensions, and workplace accident compensation. In the case of the public pension schemes, Hitachi has been involved in the implementation and maintenance of the information systems that support the National Pension, Welfare Pension, and Mutual Aid Pension schemes for over half a century. The pension payment system for the National Pension and Welfare Pension schemes, for example, is a very large system with a high level of public interest that pays out more than 50 trillion yen each year to approximately 40 million pension recipients throughout Japan[3].

These information systems contribute to the accurate and timely operation of such activities as scheme enrollment, contribution payments, and pension payments through the appropriate management of information on tens of millions of scheme members over a period of decades.

Social Security Schemes in ASEAN Nations

Providing social security schemes has become a matter of urgency for ASEAN nations against a background that includes: (1) longer life expectancies and aging populations, (2) the breakdown in practices of caring for the elderly, which was previously a matter for the family or community, accompanied by a trend toward nuclear family structures, and (3) growing disparities caused by economic development.

ASEAN nations are also forecast to experience rapid economic development in the future, with a combined gross domestic product (GDP) expected to grow to approximately four trillion US dollars in 2020, roughly the same as that of Japan[4].

Given this background, it is clear that ASEAN nations will seek to establish and extend social security schemes as their economies develop.

Initiatives Aimed at Deployment in ASEAN Nations

The international deployment plan in the Japan Revitalization Strategy cites the export of infrastructure systems as a strategic initiative for establishing overseas markets.

To implement this national strategy, Hitachi aims to utilize the knowledge and technologies for information systems it has built up from more than half a century of work on social security schemes to deploy social security information systems in ASEAN

nations that will contribute to the establishment of social security schemes in these countries and their accurate operation.

As social security schemes for workers in ASEAN nations are established by learning from initiatives in developed economies, their operation will be supported by the provision of information systems. It is anticipated that this will boost the economic development of ASEAN nations. Furthermore, in the future Hitachi intends to contribute through information systems to the provision of fine-tuned social security schemes such as universal social security schemes and social welfare in ASEAN nations.

Not only will this initiative assist with the progress of ASEAN nations, it is also anticipated that, once social security schemes are in place, they will assist Japanese companies moving into ASEAN by facilitating stable industrial relations and long-term employment. Activities aimed at deploying social security systems in ASEAN nations can be expected to deliver benefits to both these countries and Japan in the future.

POSTAL SERVICES SECTOR INITIATIVES

Export of Postal Systems

One of the system export areas where the government is promoting the export of infrastructure systems is the postal system. Improvements to postal services in Myanmar by Japanese postal experts commenced in FY2014 following the signing of a memorandum of understanding on collaboration in the postal services between Myanmar's Ministry of Communications and Information Technology and Japan's Ministry of Internal Affairs and Communications. Japan's postal technology is top class compared to the quality of other nations' postal services, and the export of high-quality Japanese practices has benefits for both nations, including encouragement for Japanese companies to set up operations as well as improving services to the public in Myanmar and contributing to economic development.

Japan Post Initiatives

Initiatives undertaken by Japan Post Co., Ltd. in FY2014 included sending postal experts to Myanmar, hosting training for Myanmar Post in Japan and providing technical instruction, and also preparing service manuals, establishing service counters, and postmark deployment. As a result, the time taken to send express mail between three cities (Naypyidaw, Yangon, and Mandalay) fell from between two and three days to an average of 1.1 days, and delivery rates rose from 87.8% to 99.3%. As work practices still include sorting mail manually and using handwritten ledgers, it is difficult to measure improvement. For further operational improvements, the adoption of IT will be essential if greater efficiency and accuracy are to be achieved, with a need for the installation of IT for things like electronic ledgers, forms printing, and information collection. So that the same number of staff can continue to cope even if the volume of mail increases as the economic development of Myanmar progresses, investigations are being undertaken into the use of IT for tasks that cannot be performed manually (see Table 1).

TABLE 1. Comparison of Postal Service Size in Myanmar and Japan

Myanmar has a very small number of post offices and transactions compared to Japan.

		Myanmar	Japan
Land area (×10,000 km^2)		67.6	37.7
Population (×10,000)*1		5,141	12,706
Postal service operator		Myanmar Post	Japan Post Co., Ltd.
Number of post offices		1,380*2	24,168*3
Number of transactions (million/year)	Mail	14*4	18,188*5
	Parcels	0.69*4	3,846

DEMS: domestic express mail services
*1 As of 2014
*2 As of 2014
*3 As of May 2015
*4 As of FY2013 (parcels, including DEMS)
*5 Actual data for FY2014

IT Initiatives

Hitachi is involved with Japan Post Co., Ltd. in a wide range of IT areas, and is drawing on its experience in the postal services to pursue marketing activities that serve the purpose of piloting the use of IT in Myanmar Post's money transfer service (see Fig. 3).

Because the money transfer service has problems such as reading or entering information incorrectly due to the use of handwritten ledgers, it has decided to adopt IT to improve accuracy and speed. The process consists of the amount and recipient being recorded in a database at the accepting office, and the payment form and cash being handed over to the recipient at the target office in accordance with the recorded information. In addition to providing greater convenience for the public of Myanmar, it is expected that this will also reduce the staff workload for the money transfer service by providing functions for searching and for collating daily and monthly totals.

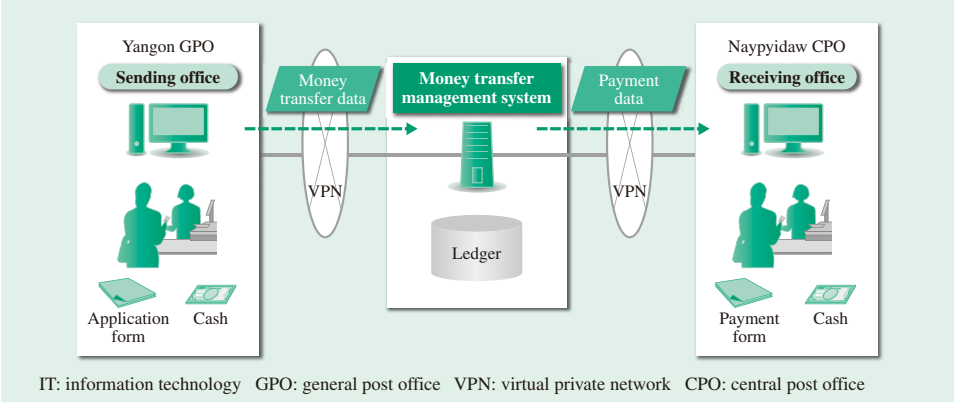

Fig. 3—Overview of IT Use in Money Transfer.
IT has been adopted for the recording in ledgers of money transfers between two offices in Yangon and Naypyidaw.

Another area being investigated for the adoption of IT in the future is the management of mail delivery. It is anticipated that service can be improved by the acquisition of data about the trucking of mail, including identifying bottlenecks in delivery so that they can be alleviated, and providing information on delivery completion.

CONCLUSIONS

This article has described the importance of providing institutional infrastructure in emerging economies, actions taken by the Japanese government to encourage the export of infrastructure systems, and how these serve as background factors in Hitachi's work on the overseas deployment of Japanese-style public-sector solutions.

In the future, Hitachi intends to contribute to the progress of various nations by providing functions that take account of local culture and other requirements, with the adoption of Japanese practices playing a pivotal role in providing institutional infrastructure and systems in emerging economies.

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Topics

Comprehensive Lifestyle Support Service Using IT and TV for Bidirectional Communication

The comprehensive lifestyle support service uses IT and the transmission of data to TVs for bidirectional communications with specific individuals and service providers such as private companies and government institutions. Uses for the service include disseminating information, advertising, and conducting surveys, with the collected information also available for use. This article describes the functions of the service and how it works, and the plans for its future.

INTRODUCTION

A challenge faced by service providers (private companies and government institutions) that use only the unidirectional distribution of information is the inability to determine customer needs due to inadequate communications with them. The Japanese government, meanwhile, has encouraged the use of information technology (IT) for bidirectional communications in its "Declaration to be the World's Most Advanced IT Nation."

These background factors mean there is a growing demand for services that provide bidirectional communications with specific individuals. In response, Hitachi has proposed a service based on providing bidirectional communications using IT and television (TV), a medium familiar to everyone regardless of age.

SERVICE DETAILS

The service delivers information to service providers and subscribers via a bidirectional communications service platform system supplied by Hitachi. Subscribers who receive information from a service provider can respond to it using their TV remote control. Service providers can also designate a service operator and use the system to link subscribers to that service operator, providing a means to use TV data transmission to inform subscribers about all sorts of different services (such as beauty, food, information, travel, and health services) (see Fig. 1).

HOW THE SERVICE WORKS

The platform system receives area information to enable content to be split by region and sent to subscribers via broadcast by having subscribers

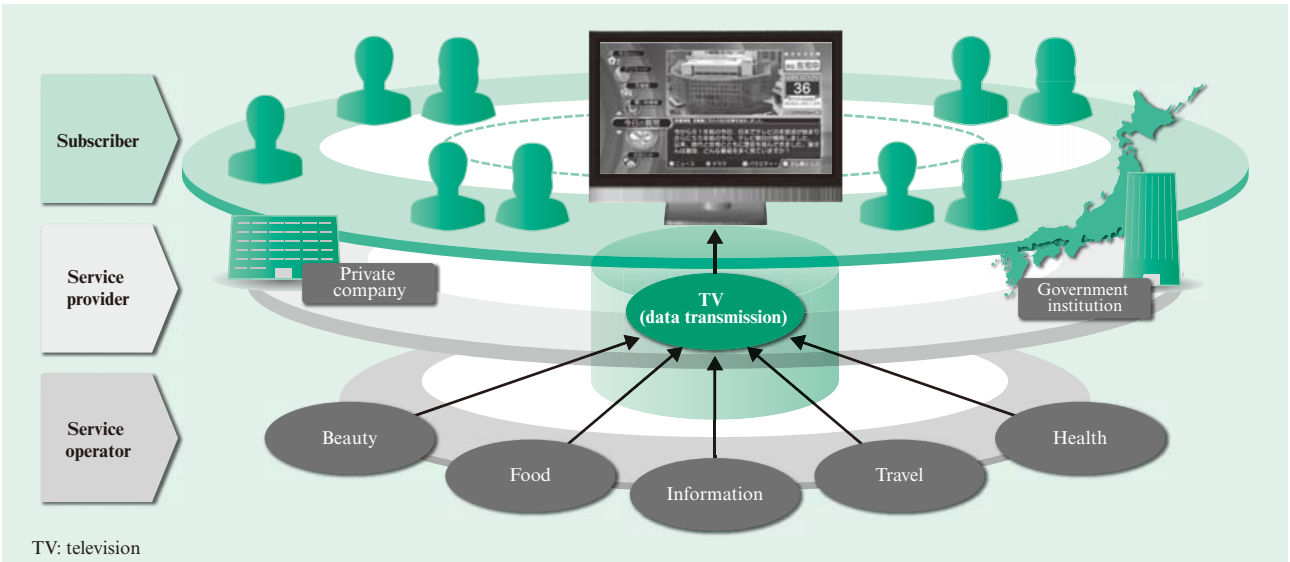

Fig. 1—Service Overview.
Service providers can use the service to implement bidirectional communications services. Service operators can send information to subscribers.

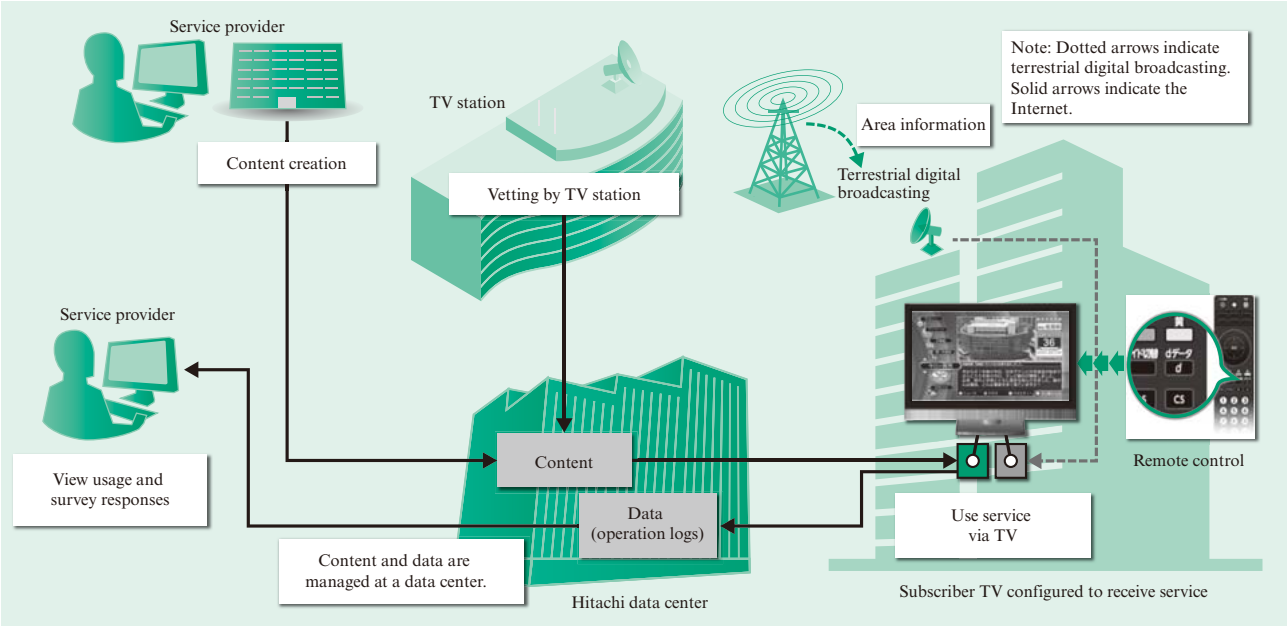

Fig. 2—How the Service Works.
Services are provided by using data transmitted via the Internet in conjunction with participating terrestrial digital broadcast channels.

select a channel that supports the service on a TV that is configured to use the service. Based on the area information, the content specified by a service provider is displayed on the TV's "data broadcast" screen via the Internet. Subscriber usage and responses are collected at a data center and are available to the service provider (see Fig. 2).

The platform system uses Hitachi Cloud to provide a highly reliable and secure environment. And, because on-demand services are available, system resources can be progressively expanded to keep up with changes in the number of subscribers.

MAIN SERVICE FUNCTIONS

Providing Information

Service providers can display information on the service's screen of the subscriber's TV by specifying when they want the information to appear. Similarly, the service operator can display the information it chooses.

Surveys

Service providers can survey subscribers by using the system to input a question to present to subscribers and providing four options for the answer. For subscribers, responding to the survey is simply a matter of using the color buttons on their remote controls.

Using Information

Service providers, service operators, and others supply information and collect subscribers' responses to surveys.

This information can be used to improve customer satisfaction by identifying latent demand and supplying services that are closely matched to needs.

EXAMPLE USES FOR SERVICE

Example Use of Service to Provide Information

Service providers of membership schemes can use the service screen on the TV to provide information

to their subscribers (members), such as a members' magazine or information about home renovation.

They can also use the survey function to leverage subscriber preferences data.

If a survey is about health conditions, it can be used to assess subscribers' health. As the latest information can be displayed in tickertape format, functions are provided to prevent subscribers from missing out on seeing something. To keep subscribers from losing interest, points can be awarded for answering surveys as a way of encouraging service use.

Providing Shopping Information

Service operators can deliver coupons or other forms of advertising for products or services to the service screens on the subscriber's TV. By displaying a quick response (QR) code or uniform resource locator (URL), the service can act as a prompt to subscribers to use a smartphone or other device to connect to the Internet and visit a site with more detailed information. This has the potential to be used as a marketing tool that can ultimately encourage subscribers to visit the actual store that is running the campaign or other initiative being hosted by the service operator.

Other Example Applications

Another example application is surveillance whereby service providers can view the TV operation logs of subscribers. If so configured, family members can also use a smartphone or other device to check on TV operation logs.

FUTURE OUTLOOKS

Hitachi plans to make enhancements to the platform system in the following ways.

Integration with Digital Devices

In accordance with the growing diversity of user needs and improved literacy, Hitachi will strengthen the integration of information through multi-channel, smartphones, wearable devices, and other media.

New Business Models

The big data collected by the service includes data on subscribers (logs, reactions, and responses). Hitachi aims to develop business models for utilizing this data in marketing and promotion by analyzing it and presenting it in terms of the behavioral characteristics of subscribers.

Global Activities

Hitachi intends to establish ways of using bidirectional communications to provide information, conduct surveys, and so on in the form of a new business model and deploy it first in Asia, and then throughout the world.

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Topics

Future Issues Facing Municipalities and Future Outlooks for Hitachi Municipality Solutions

As the underpinnings of the social infrastructure in their communities, municipalities in Japan are being called on to respond promptly to a variety of issues, including introducing the ID number system and providing administrative services that can adapt flexibly to a changing social environment that includes an aging population, a low birth rate, and advances in IT platforms. Hitachi municipality solutions utilize IT and draw on the knowledge of Hitachi to overcome these issues facing municipalities. This article considers the future issues facing municipalities and Hitachi's plans for its municipality solutions.

INTRODUCTION

THIS article looks at what will be required of future municipalities from the perspectives of their residents and of social infrastructure, and describes the future directions and plans for municipality solutions, particularly Hitachi municipality solutions, so that they can contribute to next-generation town planning.

RESIDENT PERSPECTIVES

Improving Convenience and Maintaining Security

Among the things sought by residents are improvements in security and in the convenience of administrative services. In the past, residents wanting to make any kind of application or undertake some other administrative procedure have had to visit a town hall or branch office. The rise of information technology (IT) platforms in recent years, however, means that requests for official documents such as a certificate of residence, certificate of official registration of a seal, or family registers can now be handled more conveniently at places such as a railway station or convenience store. On the other hand, there is also demand for further improvements in convenience by making it possible for residents to perform procedures using devices such as smartphones or tablets, or to complete them without needing to present official documents. Furthermore, in addition to convenience, there is also a need to maintain security, including ensuring a high level of confidentiality for resident and other personal information when processing applications.

Protection of Personal Information

The top priority for residents is that their personal information be protected. To achieve this, measures for preventing leaks of personal information include having municipalities operate closed networks (such as the use of an intranet or leased lines), and using a dedicated network for communications between national government and municipalities (such as the network used for the residents' register). Individual municipality entities also implement security measures, with an increasing number adopting finger vein and other forms of biometric authentication to verify the identity of staff when they access administrative systems.

Disaster and Other Emergency Response

There is a very high level of awareness among residents of the direct impact on life and wellbeing that results from the shortages of essential goods that occur during natural disasters such as typhoons, heavy rains, earthquakes, or tsunamis. Accordingly, municipalities are expected to respond appropriately to such emergencies. For example, municipalities can call on "disaster management radio communications," smartphones, digital signage, and other such measures to provide residents with prompt, accurate, and detailed information. Work on municipality clouds and data centers is also progressing as part of business continuity planning (BCP).

SOCIAL INFRASTRUCTURE CONSIDERATIONS

Coordinating Information across Sectors

Along with municipalities being called on to encourage the adoption of the social security and tax number system [identification (ID) number system] in Japan, the use of information through interaction

between the public and private sectors is also essential. There is also a need to coordinate information through the use of IT with social infrastructure such as energy, transportation, and water in order to make communities better places to live.

Regional Revitalization

To get people working together in the local community, including local companies and volunteers as well as residents, there is a need to energize communities to facilitate activities that make them easy to live in.

WHAT IS REQUIRED OF MUNICIPALITIES

The demands being placed on future municipalities in terms of residents' expectations and social infrastructure can be summarized by the following three points.

(1) Improve the convenience and security of administrative services
(2) Disaster prevention measures and BCP
(3) Dealing with social infrastructure

The following chapters describe Hitachi's plans for municipality solutions with reference to these points.

HITACHI MUNICIPALITY SOLUTIONS

Hitachi municipality solutions are a suite of IT products and services that Hitachi supplies to municipalities to deal with the diverse issues they face (see Fig. 1).

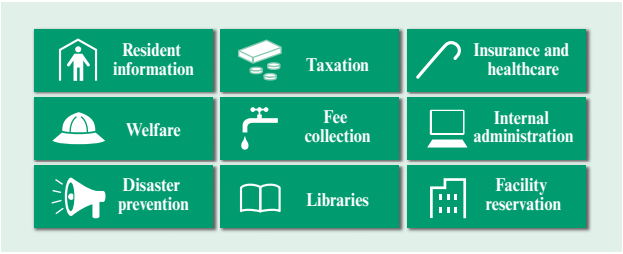

Fig. 1—Business Activity Structure in Hitachi Municipality Solutions.
Business activities are divided into nine categories.

Through Hitachi municipality solutions, Hitachi draws on its comprehensive capabilities to contribute to municipalities based on the concept of an evolving solution that links people and communities to the future. Hitachi municipality solutions deliver value in the following three ways[(1)].

(1) Flexible support for improving resident services and municipality management
(2) Systems designed to be easy for residents and staff to use
(3) Trustworthy security measures and a comprehensive support system

Hitachi municipality solutions support a wide range of municipality activities, including making official documents available through convenience stores, or issuing them automatically through core business systems for resident information, financial management, and long-term care insurance. It also supports the ID number system that was introduced this fiscal year. In addition to security products such as finger vein authentication, Hitachi is also deploying products such as a centralized system for disseminating disaster information and the maintenance management solution for working with the private sector on social infrastructure such as roads and bridges.

FUTURE OUTLOOKS FOR MUNICIPALITY SOLUTIONS

With regard to the matters discussed above, Hitachi believes that future municipality solutions will need to include the following three points.

(1) Solutions that consider convenience and security
(2) Assisting in providing dependable administrative services
(3) Solutions that enable interoperation with social infrastructure

While it can be difficult to achieve both convenience and security at the same time, Hitachi intends to work with its research and design groups

and those divisions that deal with social infrastructure systems for things like transportation and finance to implement solutions and services for creating towns and cities that residents will find comfortable and secure (1).

To provide dependable administrative services, Hitachi will support the creation of mechanisms for collecting information in realtime during emergencies and for providing residents with prompt, accurate and detailed information. To achieve this, Hitachi will utilize familiar IT devices such as smartphones and televisions to enhance solutions that take account of matters such as coordinating disaster prevention and the elderly (2).

The enabling of interoperation with social infrastructure needs to be undertaken in parallel with the use of IT, involving collaboration with the private sector on things like integrated community care and open data, and coordination with the social infrastructure platforms used for essential services such as electric power, water, and gas. Something else that needs to be put in place in the future are mechanisms for establishing the plan, do, check, act (PDCA) cycle for identifying potential improvements and taking steps to deal with them based on the results of the implementation of various policies by municipalities (3).

In addition to the use of IT, Hitachi also intends to contribute to overcoming the various issues facing municipalities by drawing on its business know-how and consulting capabilities in a wide variety of industries.

CONCLUSIONS

As the population ages further and the birth rate continues to decline, municipalities will be expected to provide administrative services that are more efficient and fine-grained. Based on the underlying concept of an evolving solution that links people and communities to the future, Hitachi intends to contribute to the creation of communities that are easy to live in and in which people will feel secure by acting as a partner to municipalities, not only by responding promptly to various different institutional systems, but also by providing solutions and services that incorporate convenience and security.

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Topics

Operation and Maintenance Solution for Social Infrastructure such as Roads

As many bridges and other social infrastructure throughout Japan were constructed during the era of rapid economic growth, a large number of them are now deteriorating. Prompted by events such as the Sasago tunnel accident, the Ministry of Land, Infrastructure, Transport and Tourism is working on allocating responsibility for the inspection and diagnosis of social infrastructure, and on establishing maintenance cycle practices. Hitachi Systems, Ltd. supplies a one-stop solution for the operation and maintenance of social infrastructure targeted at highways and local government agencies. The solution includes: (1) centralized management of ledgers, (2) use of deterioration prediction for maintenance planning, and (3) support for field work. Hitachi Systems also provides associated services that include support for creating initial ledgers, business process outsourcing (BPO) of inspection work, and positioning (using radio-frequency identification tags or color coding). Hitachi Systems intends to expand progressively into new areas of activity by combining Hitachi Group's products and services to provide comprehensive support for the operation and maintenance of social infrastructure.

INTRODUCTION

APPROXIMATELY 70% of the 700,000 or so bridges in Japan are on municipal roads and so are managed by local government agencies. Like other social infrastructure, many of these bridges were built since the period of rapid economic growth in the 1960s, meaning that an increasing number will be nearing 50 years of age.

It has been reported that local government agencies find it difficult to take adequate steps to deal with the deterioration of social infrastructure due to a lack of budget, human resources, and technology[(1)]. Approximately 90% of Japan's municipalities have expressed concerns about safety due to a lack of funds for dealing with deteriorating infrastructure. Furthermore, approximately 50% of towns and 70% of villages lack any civil engineering staff to work on bridge maintenance. Approximately 80% of local government agencies are reported as having issues with the quality of inspection work, with their bridge inspection requirements specifying remote observation only rather than a close visual inspection[(1)].

Prompted by the 2012 ceiling panel collapse in the Sasago tunnel, the Ministry of Land, Infrastructure, Transport and Tourism is taking steps to deal with deteriorating social infrastructure, including investigating whether to have road managers conduct routine inspections, soundness calculations, and repair planning based on standardized criteria, and whether to provide subsidies or offer other funding schemes to local government agencies that take appropriate steps.

This article describes a solution supplied by Hitachi Systems, Ltd. for the operation and maintenance of social infrastructure in relation to measures for dealing with deteriorating social infrastructure.

SOLUTION FOR OPERATION AND MAINTENANCE OF SOCIAL INFRASTRUCTURE

Hitachi Systems supplies a one-stop solution for the operation and maintenance of social infrastructure, with features that include (1) centralized management of infrastructure ledger data (infrastructure details, inspections, repairs), (2) calculation of long-term repair costs and repair planning based on predicting the deterioration of infrastructure, and (3) functions for supporting inspections and other field work (see Fig. 1).

The ledger database provides centralized management of collected data that includes details of the infrastructure (name, location, coordinates, jurisdiction, date of entering service, structure, and so on), inspection records (date, materials, status, presence of abnormalities, type of problems, assessment, and so on), and repair information (date, location, method used, and so on).

This data is used as the basis for deterioration prediction and lifecycle cost (LCC) calculation to produce a long-term management plan that includes a list of the repairs to perform in each fiscal year.

It is also intended to improve efficiency by providing functions that use a tablet computer for

things like outputting of work instructions, displaying of relevant data, and uploading of inspection data. Hitachi Systems also offers a data entry outsourcing service for things like infrastructure details and inspection records.

Formulation of a Long-term Management Plan

This section describes a function for utilizing data to formulate a long-term management plan based on information such as infrastructure details and inspection records[(2)].

A deterioration model is used to predict the future value of the soundness index for each item of infrastructure based on its soundness index as determined by inspection.

Scenarios are defined in advance of the LCC calculation indicating the value of soundness index at which repair work is triggered for each item of infrastructure. This can be used to obtain the repair costs that need to be funded in each fiscal year by estimating the future value of the soundness index, including the improvements that result from repairs.

A long-term management plan is then formulated by totaling up the repair costs in each fiscal year for all of the infrastructure administered by the local government agency and then making adjustments such as deferring maintenance to later years in order to fit within the available budget.

This maintenance planning process is designed, at the system level, to provide a common platform that is not specific to any one type of social infrastructure or local government agency, and to be customizable.

Furthermore, because it is possible to specify for each item of infrastructure which model to use, Condition Based Maintenance or Time Based Maintenance, a hybrid approach can be adopted for infrastructure that includes equipment of different types, such as civil engineering structures, machinery, and electrical equipment.

Screen Output Example

Fig. 2 shows an example of screen output for bridges that shows a repair plan that satisfies budget constraints. The left side of the screen shows a graph of the total bridge repair costs for each fiscal year and another of the distribution of soundness index values for the bridges. The center part of the screen displays a list of all of the bridges. The right side of the screen shows the LCC trend graph for the bridge selected in the list together with a list of the repairs required in each fiscal year.

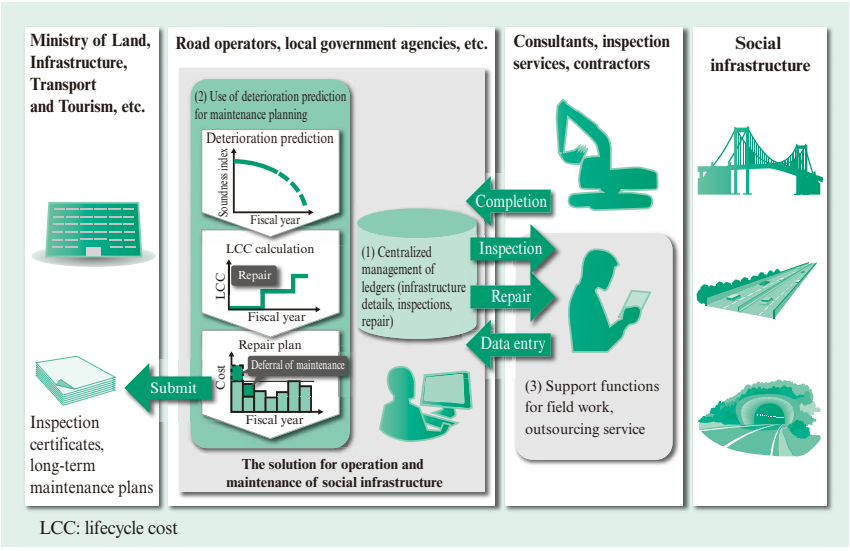

Fig. 1—The Solution for Operation and Maintenance of Social Infrastructure. It supports road operators, local government agencies, inspection services, and other organizations by providing a one-stop solution for the maintenance of social infrastructure.

LCC: lifecycle cost

Fig. 2—Screen Output Example for Bridges.
The screen shows a graph of the total bridge repair costs for each fiscal year and the distribution of soundness index values (left), a list of all bridges (center), and an LCC trend graph for the specified bridge and a list of the repairs for each fiscal year (right).

FUTURE OUTLOOKS

While the ledger function and the functions for using data are currently provided as an on-premises system, Hitachi Systems is also planning to make a cloud service available.

Meanwhile, by sharing information as much as possible with neighboring local government agencies, there is also scope for achieving highly accurate deterioration prediction and consistency in repair planning over a wide area.

CONCLUSIONS

This article has described the one-stop solution for operation and maintenance of social infrastructure that provides functions for managing maintenance in ways that deal with the deterioration of social infrastructure, including: (1) centralized management of ledgers, (2) use of deterioration prediction for maintenance planning, and (3) support for field work.

In the future, Hitachi Systems intends to combine the products and services of Hitachi, Ltd., Hitachi Industry & Control Solutions, Ltd., Hitachi Solutions, Ltd., and other companies with the aim of delivering multifaceted services that include peripheral services. Hitachi Systems also intends to contribute to the ongoing progress of society by expanding its work for highways and local government agencies.

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Topics

IT Solution for Campus Supporting System-wide Optimization and Faster University Reform

The issues associated with achieving the Ministry of Education, Culture, Sports, Science and Technology's policy for stronger and more extensive university governance include recruiting students while seeking to improve the quality of university services, education, and research, and, beyond this, providing stable management. Hitachi is working toward strengthening governance through the comprehensive optimization of university systems, with activities that include providing systems that are appropriate to all levels of education. Hitachi also supports the provision of environments for putting appropriate governance measures into practice by proposing IR that supports the analysis of university information and strategy formulation for shifting IT to the cloud and increasing the value of universities. This article describes Hitachi's IT Solution for Campus, which is based on this basic concept.

INTRODUCTION

IN response to societal trends such as the aging population, declining birth rate, and globalization, the Ministry of Education, Culture, Sports, Science and Technology formulated the University Reform Action Plan in 2012 that specified the direction that these reforms were to take in order to achieve a new type of university development, involving two main pillars "to reconstruct universities to be capable of handling drastic societal changes," and "to enrich and strengthen university governance." Universities, meanwhile, are seeking to improve services, education, and research as they deal with issues such as student recruitment and management stability.

To address these issues, Hitachi is developing and marketing a variety of solutions aimed at the next generation of university information systems in order to create an attractive model for universities that enables their ongoing development in step with the modern world.

WORKING TOWARD SYSTEM-WIDE OPTIMIZATION

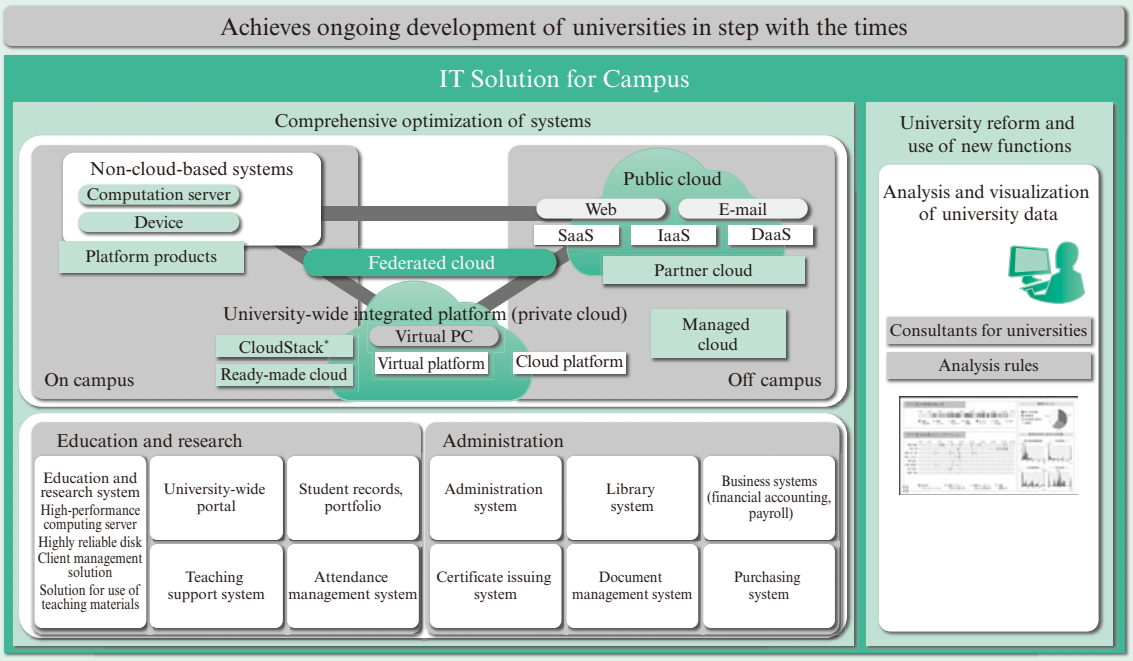
In the past, each university department installed its own information systems, and upgraded its own systems to improve functions and performance, resulting in systems that are only partly optimized at the department level. The problems that have arisen as a result include a large amount of duplication, with little progress having been made on improving systems from a university-wide perspective that encompasses multiple departments.

Hitachi offers comprehensive optimization for university information systems from the perspective of the entire university. Universities have large numbers of systems to meet the diverse needs of individual departments. From a system perspective, there is a need to provide integrated platforms that can support the operation of these systems. In addition to making effective use of resources and reducing administration work by making good use of public clouds and other integrated platforms to achieve optimal positioning of systems on and off campus, this also means that physical location is no longer a consideration for systems. In terms of functions, Hitachi offers system integration achieved by a service-oriented architecture (SOA) using the simple object access protocol (SOAP). This encourages system interoperation by making the data and other functions used by each system available without duplication of effort. In this way, the comprehensive optimization of university systems in terms of both systems and functions enables stronger governance, including the reallocation of resources from the perspective of the entire university.

FASTER UNIVERSITY REFORM

With the decline in the number of 18-year-olds, recruiting new entrants and minimizing dropouts will be important to the survival of universities. Achieving this will require universities to become more distinctive and attractive, improving the quality of education so that they can turn out graduates who can contribute to society.

Given this need to reform universities to make them



IT: information technology PC: personal computer SaaS: software as a service IaaS: infrastructure as a service DaaS: desktop as a service
* CloudStack is a registered trademark or trademark of The Apache Software Foundation.

Fig. 1—Overview of IT Solution for Campus.
The IT Solution for Campus achieves university reform and comprehensive optimization of university systems by providing Hitachi's information system packages for universities and various cloud environments.

more distinctive, one aspect of university reform that has attracted attention is institutional research (IR) for supporting decision making through the collection and analysis of different forms of data from the campus.

Utilizing systems that have been optimized at the campus level to achieve interoperation, Hitachi is offering to identify the data required for IR and to build databases (DBs) for its collection and analysis. Hitachi is proceeding with proposals for solutions that perform analyses from a variety of perspectives by combining various different forms of campus data based around the student data that is held as part of the basic university information managed by Hitachi's academic information system packages for universities. Hitachi is also offering IR environments that use business intelligence (BI) tools for performing analysis in conjunction with other data from campus and related sources. This includes working on support for decision making in order to take advantage of the distinctive characteristics of each university by extracting data from multiple systems and performing multifaceted analysis on restructured and integrated information. This practice of undertaking IR for the objective circumstances in which universities find themselves is important for putting appropriate governance measures into practice.

TYPE OF SYSTEM THAT IT SOLUTION FOR CAMPUS AIMS TO CREATE

Hitachi believes that its concept for the next generation of university information systems should be structured around the idea of comprehensive optimization that can make effective use of the required information by providing systems that are appropriate from the viewpoint of the entire university

and that take the needs of each department into consideration, as noted above. The objective for the IT Solution for Campus is to achieve this. Hitachi is also seeking to establish an information environment that facilitates the fulfillment of a clear vision under the leadership of the people at each university responsible for managing information.

Based on the concept behind its IT Solution for Campus, Hitachi is supplying a variety of cloud environments and offering its information system packages for universities (see Fig. 1).

CHALLENGES FOR THE FUTURE

Hitachi is considering two major approaches to adapting its information system packages for universities for the global market. The first is its plan to include support for quota systems and the addition of a multilingual capability to its information system packages for universities to support the globalization of universities. As stated in its University Reform Action Plan, the Ministry of Education, Culture, Sports, Science and Technology is promoting the globalization of universities, which includes calling for the provision of environments that accept overseas students. In response, Hitachi intends to expand functions that support overseas students at Japanese universities.

The second approach is to look at the global deployment of Hitachi's information system packages for universities, targeting overseas markets. Currently, FPT University in Da Nang, Vietnam is installing Hitachi's information system packages for universities, using a version that has been localized in Vietnamese. Hitachi hopes to utilize this know-how to deploy the system overseas.

CONCLUSIONS

This article has described Hitachi's IT Solution for Campus, which is marketed as a solution for universities struggling to survive amid intensifying competition.

In the future, Hitachi intends to continue expanding and marketing its IT Solution for Campus and information system packages for universities, which contribute to reforms aimed at creating attractive universities that will continue to develop in step with the times.

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