Service Infrastructure for Next-generation Smart Cities

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OVERVIEW: The disassemble and reassemble approach has an important role to play in realizing smart cities. This approach involves disassembling service infrastructure, making it smarter, and then putting the required parts back together again. Hitachi believes that, when applied to smart cities, this approach will provide not only the consumers who live in them, but also others such as the businesses involved in town planning and the public and other operators of urban facilities with benefits that have not previously existed. We are currently entering an era in which overall optimization will solve social issues such as urban and environmental problems. Given these circumstances, Hitachi intends to achieve genuine coordination across different public infrastructures and contribute to realizing the various different smart city concepts in use around the world. In addition to making further enhancements to its public infrastructure systems and telecommunication technologies, Hitachi will do this not just by combining different elements of service infrastructure, but also by enhancing these in such a way that the services become fused.

INTRODUCTION

WHEN humans first started living in communities, the major factors in establishing those community living spaces were geographical. Examples include whether river flows were reliable, whether the water was clean, and whether the site was in the mountains or on a plain or island. Also, the risk of natural disasters such as earthquakes, tsunamis, storms, or tornados; the nature of the climate; and the availability of resources. People have built the infrastructure they require within the constraints of these geographical and physical conditions and gone about communal living with a degree of control over some aspects of the natural environment, but also at the mercy of others.

Cities have expanded over time, with the consequent evolution of urban functions being directed by the demands or desires that have emerged from people's ways of life. For example, taking on board the demands of different people, cities have evolved in response to factors such as religion, culture, customs, and other values inherited from the past; the needs of politics and economics driven by factors such as the spread of infrastructure, policies and systems, and the industrial structure; and the need to respond to change, such as changing demographics and employment conditions.

In modern times, however, the things that people want from cities have become more diverse and extensive, resulting in a rapidly worsening imbalance with the global environment. Recognizing this situation, Hitachi has put forward the idea of a well-balanced relationship between people and the Earth and has embarked on measures aimed at building smart cities that take account of the global environment without compromising the convenience of people's way of life.

This article describes Hitachi's approach to service infrastructure for next-generation smart cities.

HITACHI'S CONCEPT OF WELL-BALANCED IN SMART CITIES

In Hitachi's view, a well-balanced relationship between people and the Earth begins with the idea of a well-balanced relationship being maintained between eco (meaning environmentally conscious) and experience (meaning a prosperous urban lifestyle that offers peace of mind and convenience).

The concept of "well-balanced" in smart cities is not limited to thinking in terms of the balance between the global environment and urban lifestyles. Taking the achievement of both of these as a starting point, this issue of Hitachi Review shows examples of such well-balanced relationships in a range of different contexts so that the sort of smart city that is desired by all of the city's stakeholders can be realized in a sustainable way (see the "Hitachi's Vision of the Smart City" article).

In Hitachi's vision, it is possible to maintain a well-balanced situation even in large and complex

cities by having the flexibility to change with the times, which is to say, continuing to accept rather than reject change and maintaining structures that continue to evolve, while these well-balanced relationships remain in harmony. This section describes the specific mechanisms by which smart cities come about.

Disassembly and Reassembly of Service Infrastructure

Service infrastructure includes city facilities and services such as medicine and healthcare, education, administration, and finance. By disassembling and reassembling this service infrastructure, Hitachi believes it is possible to satisfy consumers' genuine needs and build cities in which service providers and other operators can deliver the services that the community demands in an optimum form.

Paradigm shift brought about by disassembly and reassembly of service infrastructure

Under the conventional view of cities, a hospital, for example, is thought of as a place at which functions are performed such as consultation, admission, the serving of meals, surgery, and the issuing of prescriptions. In other words, a place at which consultations, admission, the serving of meals, surgery, the issuing of prescriptions, and other such functions take place was called a hospital.

If hospital functions like admission and the serving of hospital meals were performed in a hotel instead, we would think of them as being equivalent to functions performed in a hotel like the provision of rooms or meals.

Also, the fundamental requirement of consumers who enter a hospital is to have their illness cured. Thus, actions like visiting the hospital, being admitted, or surgery are only steps toward this end. If the hospital management updates their check-in system to shorten waiting times, this represents an improvement in one of those steps and does not satisfy the fundamental requirement of curing the illness.

Hitachi believes that considering the locations and functions of service infrastructure separately and reassembling them based on specific fundamental requirements provides completely different insights and allows the services to be made smarter. That is, it is possible to usher in a paradigm shift in our approach to cities by separating the service delivery functions that make up the city from the conventional idea of their being places and reassembling them based on actual requirements.

Continuing with the hospital example, it is possible to satisfy medical needs in a more responsive way by providing completely new multi-function facilities that combine different types of conventional service infrastructure, such as allowing children who have been admitted to hospital to continue remotely receiving the same lessons as their classmates at school, or allowing patients to receive medical counseling at a neighborhood police or fire stations.

This approach achieves well-balanced results through a combination of services, places, and other factors.

It also allows service management and operators to deliver different types of services at a reasonable cost so that consumers are able to access various services at the same place and at an appropriate price.

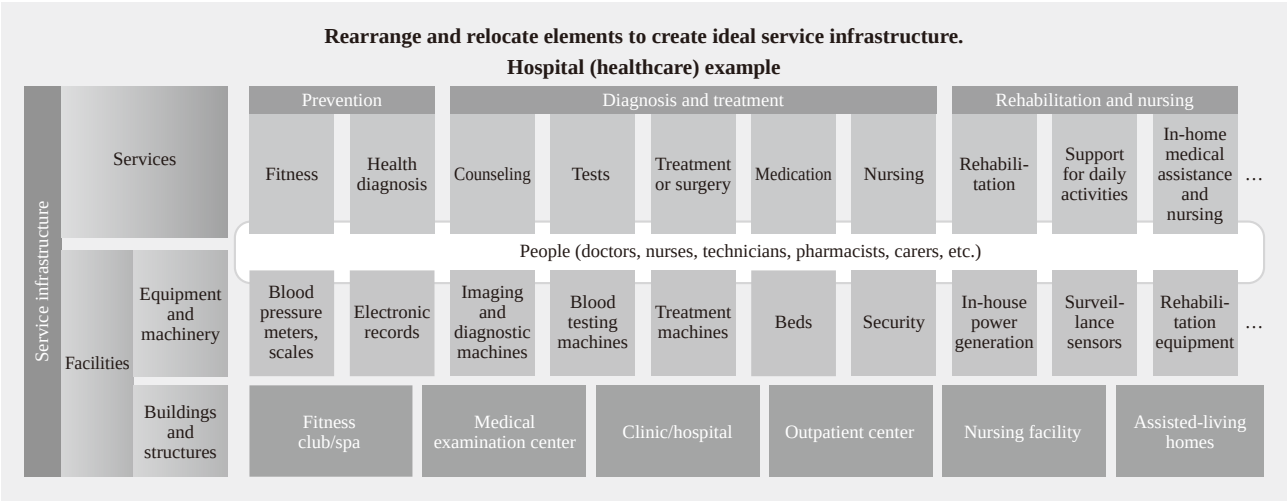

Fig. 1—Example Disassembly of Service Infrastructure.
Infrastructure is divided into buildings and structures, equipment and machinery, and services.

Methods of disassembly and reassembly

To explain how to go about the disassembly and reassembly of service infrastructure, the following section describes an example of the steps in this process.

The following describes the disassembly and reassembly of service infrastructure.

(1) Divide the service infrastructure into services and facilities.

(2) Divide the facilities into buildings or structures and equipment or machinery.

(3) Split into the fundamental needs of consumers.

(4) Sort based on whether the particular item is a procedure or objective. Sort based on factors such as whether the particular item is location-dependent or not.

(5) Make the split up functions smarter.

(6) Using the results of steps (1) to (5), reassemble the service infrastructure by bringing together the equipment and machines one by one.

In following this process, the following considerations are needed for disassembly, improvement, and reassembly.

(i) Disassembly

Divide the service infrastructure into services and facilities and then further divide the facilities into buildings or structures and equipment or machinery. Perform this disassembly based on the smallest units of urban living. As a consequence, the elements into which the infrastructure is divided become general-purpose components that can be used anywhere in the world (see Fig. 1).

(ii) Improvement

Map the functions of the individual elements to the fundamental needs and make them smarter so that they can work more reliably and efficiently. Specifically, in addition to identifying their fundamental purpose and whether they are location-dependent or not, also consider advances in technology when making them smarter, such as any technical innovations or the potential to apply technologies from other fields.

(iii) Reassembly

While the disassembled and improved parts were divided based on the smallest units of urban living, when put back together again, they are combined in such a way as to satisfy the individual elements required in a smart city. For example, it is possible to select only those functions that are required for the needs of the consumers who live there based on considerations such as the topography, culture, religion, nationality, and level of infrastructure at the place where the smart city is located. This allows the reassembly of smart service infrastructure, which only provides the functions required and which dispenses with unneeded functions.

Also, by considering the lifecycle of different facilities and equipment (planning, design and development, operation, and maintenance and repair cycle) when reassembling the various elements, the service infrastructure itself can go through cycles of growth, development, and renewal.

Smart cities have a diversity of regional needs specific to the country, region, or city and also due to ongoing changes. Similarly, the conflicts that arise among the three stakeholders, namely consumers (including both the resident and working populations), city managers (public service providers, government, real estate developers, and others), and world opinion (global-scale environmental problems), are different in different places, as are things like how to go about balancing these and where they impact. Even when these regional needs are very tightly intertwined, disassembling and reassembling the functions of service infrastructure will result in smart cities that are well-balanced in terms of their distinctive local characteristics or needs.

Anticipated Benefits of Disassembly and Reassembly

Disassembling and reassembling means dividing the service infrastructure into its component parts, making them smarter, and then putting the required parts back together again. Smart cities built based on this concept will provide not only the consumers who live in them, but also the businesses involved in town planning and the public and other operators of urban services, with benefits that have not previously existed.

(1) Smoothing workloads

By turning functions that were previously performed separately into common functions, and by taking services that were not necessarily tied to particular places and supplying them in a non-location-dependent way over a wide area, it is possible to smooth over periods of high and low demand resulting from the particular circumstances of the community and make full use of limited resources.

In particular, in the case of emergency response by hospitals that are short of doctors, rather than handling calls separately at each hospital, it is possible to use centralized coordination to make effective use of limited medical resources and smooth workloads through measures such as first taking calls at a central

call center and then directing and referring the patients who need it to the suitable emergency medical center based on factors such as whether spaces are available and whether the appropriate specialists are on hand.

(2) Efficient sharing

Sharing of equipment and machinery improves its utilization, reduces investment costs, and reduces the amount of resource usage and disposal. Because it makes it possible to select only as much machinery or other resources as is required for a particular purpose, it also contributes to reducing operation energy. In the case of car sharing, for example, if someone who only wants to make a trip in one direction shares a vehicle with someone who wants to make the same trip in the opposite direction, the vehicle's utilization increases and it only travels the distance that is really needed. Because this improved utilization allows greater expenditure on looking after and servicing the vehicle, it also leads to higher service levels.

(3) Improved efficiency by reviewing division of responsibilities

By reviewing individual roles as part of the disassemble and reassemble process, it is possible to make fundamental improvements in response to issues such as concern over long waiting times prior to being seen at a hospital or the fact that, even if you feel ill, medicine cannot be dispensed from a pharmacy without your first visiting the hospital and receiving a prescription. If greater use is made of IT (information technology) to allow things like making inquiries or payments over the network from home, or other locations away from the hospital, it will be possible to make processes like consultation and dispensing more efficient and provide a one-stop service.

(4) Energy efficiency and low carbon emissions

While there is no question of the need to encourage improvements in areas like energy efficiency and lower carbon emissions, greater benefits can be achieved by reviewing components and individual functions. As reassembly results in services that are independent of time or place and are provided in a one-stop format, it reduces carbon emissions by saving energy in areas like transportation.

NEW WAYS OF LIFE MADE POSSIBLE BY DISASSEMBLY AND REASSEMBLY

Disassembly and Reassembly Focused on Services

By disassembling healthcare in terms of the services of a hospital (considered as a type of facility) and reassembling at a different location or facility, it becomes possible to receive various healthcare services without restrictions like time or place.

For example, it would also be possible to receive remote treatment, advice, or other assistance in an emergency at locations outside a hospital, such as a police station, school, supermarket, or in-service train. Further, through collaboration with educational institutions, it would be possible for children who have been admitted to hospital to continue receiving the same lessons as their classmates at school while remaining in their ward or have doctors provide counseling to children in their homes or school without leaving the hospital (see Fig. 2).

In the field of public facilities, it is possible to review and reassemble the functions of the meeting places in each community to transform them into smart meeting places where people can receive more multi-purpose services.

These new smart meeting places would provide one-stop services for some educational, administrative, medical, and other functions, based on the nature of the town and its way of life, in a way that goes beyond those offered by conventional sites that are tied to a particular function.

Moreover, because the reassembly of functions allows a wider range of services to be provided than in the past, it strengthens the original objective of being a place where people meet and as a result can be expected to revitalize the real communication in each community.

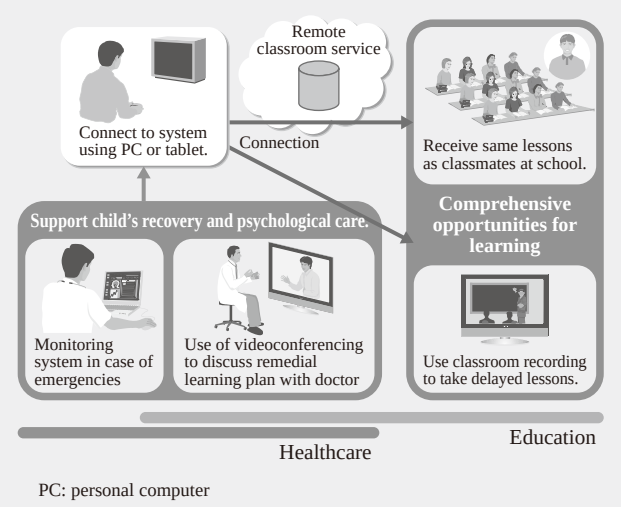

Fig. 2—How Disassembly and Reassembly Might be Used at Facilities Like Hospitals or Schools.
Coordination between medical, educational, and other services provides new services that transcend time and place.

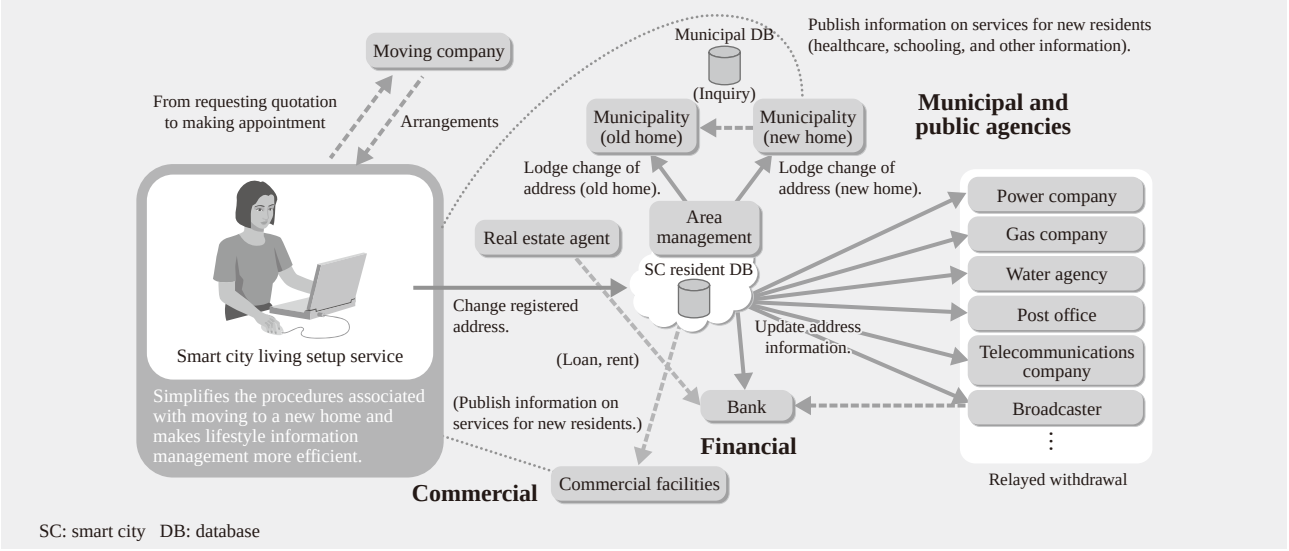

Fig. 3—How Disassembly and Reassembly Might be Used for Moving and Public Administration Services. The area management function provides smooth updating of usage information for service infrastructure services.

Disassembly and Reassembly Focused on Consumer Objectives and Actions

Reassembling city functions based around the objectives and actions of service consumers can also create a more convenient and comfortable way of life.

The following section considers the example of moving to a new home. Currently, moving requires you to undertake various separate procedures and submit forms such as a certificate of residence. It should be possible to eliminate the complex and troublesome procedures of the past by disassembling the actions required when moving to a new home in terms of services, and then reassembling them with a focus on objectives and actions so that the various services provided by different agencies work in coordination.

Specifically, having changes to personal details such as your address or telephone numbers managed by area management functions will smooth the process of keeping your information up to date, such as updating your details with public agencies and financial institutions or updating your usage information with infrastructural services such as electricity, gas, water, and telecommunications. This also allows local service providers, commercial facilities, and others to offer services to new residents that have a high level of added value (see Fig. 3).

Disassembly and Reassembly Focused on Location

By considering a railway station and reassembling its disassembled functions, it is possible to imagine what form an advanced railway station might take.

If digital signage were installed at various locations around a new railway station, it would be possible for commuters to make use of even the short time they spend waiting for a train. Examples might include three-minute English lessons with an on-line teacher, stretching exercises with an on-screen instructor, or viewing an etiquette lesson prior to visiting a customer. In this way, it is possible to construct functions that suit different needs, not just using the trains.

Moreover, the objectives for the service infrastructure in a railway station are not limited to service improvements aimed at users. In the case of power generation, for example, in addition to installing solar panels, it might also be possible to use the ground under the station to generate geothermal power. This would allow the installation of charging stands for EVs (electric vehicles) that use this power. In the event of a power shortage, it might also be possible to draw a temporary power supply from the batteries in a number of EVs.

ACHIEVING HIGH-QUALITY SERVICE INFRASTRUCTURE

One aspect of a smart city is very different to traditional urban development. Hitachi is working to achieve the following objectives while interlinking service infrastructure with this aspect of smart cities, namely their urban infrastructure like energy, transportation, water, and telecommunications (see Fig. 4). Specifically, they intend to:

(1) Generate new value through the disassembly and reassembly of service infrastructure.

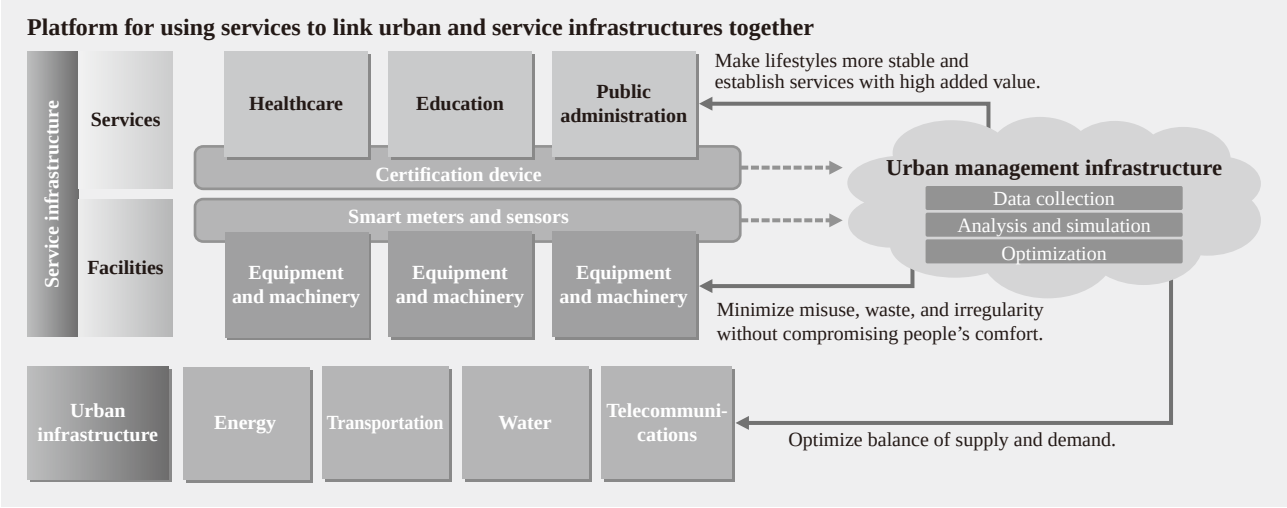

Fig. 4—Urban and Service Infrastructures Linked Together by Urban Management Infrastructure.
Hitachi contributes to various forms of value creation in smart cities by linking urban and service infrastructures together.

(2) Minimize misuse, waste, and irregularity in equipment and machinery without compromising people's comfort.
(3) Establish various services that provide consumers with a high level of added value.
(4) Optimize the balance of supply and demand in urban infrastructure.
(5) Achieve an efficient allocation of functions and coordination between national infrastructure and urban infrastructure.
(6) Development of an urban management infrastructure that supports these objectives and the development of the integrated information and control systems for data collection, analysis, simulation, and optimization that lie at their core

Specifically, in addition to making ongoing improvements to existing products and technologies, Hitachi is undertaking development of technology for new elements, validating technologies and models by conducting tests and trials in Japan and other countries or regions, and planning new products and solutions and learning about needs by being involved in urban development from the concept stage.

Hitachi has been involved for many years in the development of Japan's public infrastructure systems, which support the country's society and way of life, including power, water, transportation, and telecommunications. "Contributing to society through the development of superior, original technology and products" has been Hitachi's corporate credo since its formation, and Hitachi believes that putting this vision into action globally is its raison d'etre and its mission in the field of smart cities.

We live in an era in which overall optimization is used to solve urban and environmental problems and other challenges for society. In addition to enhancing its public infrastructure systems and information and telecommunications technologies, Hitachi believes that, by going so far as to fuse service infrastructure together rather than just combining separate parts, not only can it provide solutions in which different types of public and service infrastructure are truly integrated, but also that it can contribute to the realization of smart city concepts from around the world.

CONCLUSIONS

This article has described Hitachi's approach to the service infrastructure that supports next-generation lifestyles.

Urban development involves huge projects in which many different organizations and companies participate over a long period, from planning through to development and operation. Hitachi intends to continue working together with its partners, local businesses, and others as it seeks to achieve a well-balanced relationship between people and the Earth by contributing to smart city development globally in ways that suit local needs based on a smart city vision design.

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