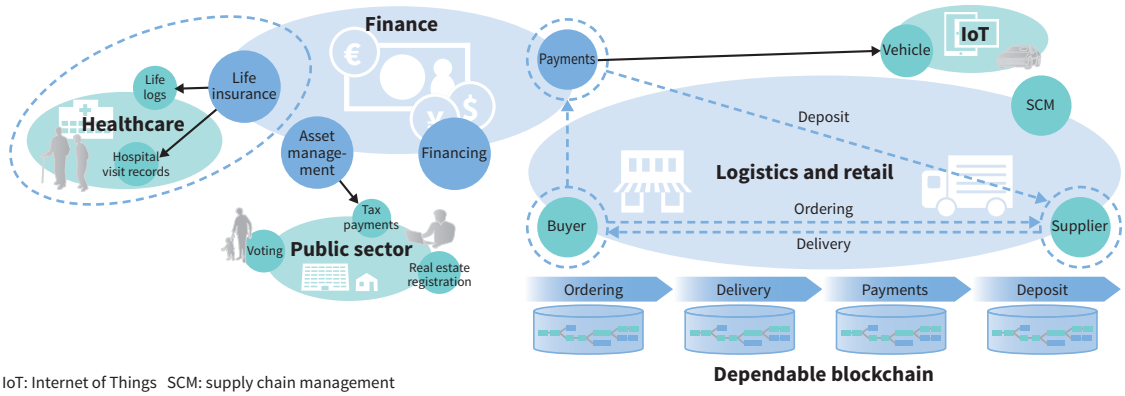
# Technology Innovation
## Finance, Public, Healthcare




IoT: Internet of Things SCM: supply chain management

**1** Cross-industry use cases for dependable blockchain

## 1 Dependable Blockchain

As societal challenges become more complex, making it more difficult to resolve them within a single industry, attention is being directed toward the use of blockchain to enable open and secure transactions that span different industries. One potential example is to use the seamless integration via a blockchain of ordering information and banking services in a supply chain as a way to provide rapid supply chain financing that improves corporate cash flow.

By developing a "blockchain pattern book" that contains 11 templates for benefits like this that are made possible by blockchain, Hitachi has sped up the development of use cases in which societal challenges are resolved through cross-industry coordination. Hitachi has also developed a dependable blockchain platform for implementing these use cases that is reliable enough for use in social infrastructure, including such features as the use of a public biometrics infrastructure (PBI) for rigorous authentication.

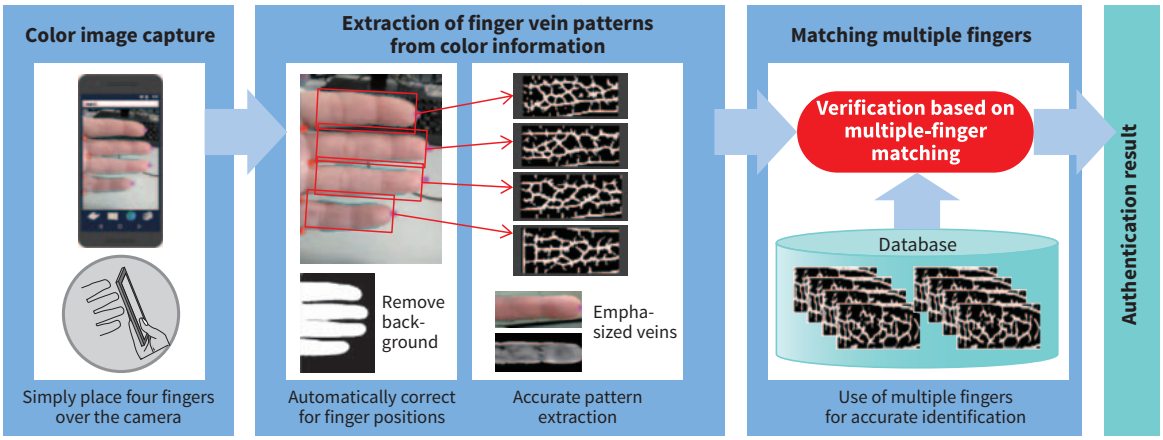
In the future, Hitachi intends to proceed with the practical implementation of use cases that involve cross-industry coordination on a dependable blockchain.

## 2 Finger Vein Authentication for Smartphones

The more smartphones are used for things like online shopping, the greater the potential losses from their unauthorized use by someone other than the phone's owner. While this makes it important to accurately identify the smartphone user, in the past this has required mechanisms such as fingerprint recognition or other special-purpose sensors, or the entry of a complicated password.

In response, Hitachi has developed a way to perform accurate finger vein authentication using the built-in camera in a smartphone, without the need for a special-purpose sensor. The technique detects fingers and identifies their vein patterns using images captured by having the user place multiple fingers over the camera. By combining the vein patterns of multiple fingers to enhance authentication accuracy, it achieves a false positive rate of only 0.0001%.

This provides a simple way to use finger veins for precise authentication on a standard smartphone. Used in conjunction with encryption techniques developed though past activities, the technology has the potential for use as a safe and reliable security measure in a wide range



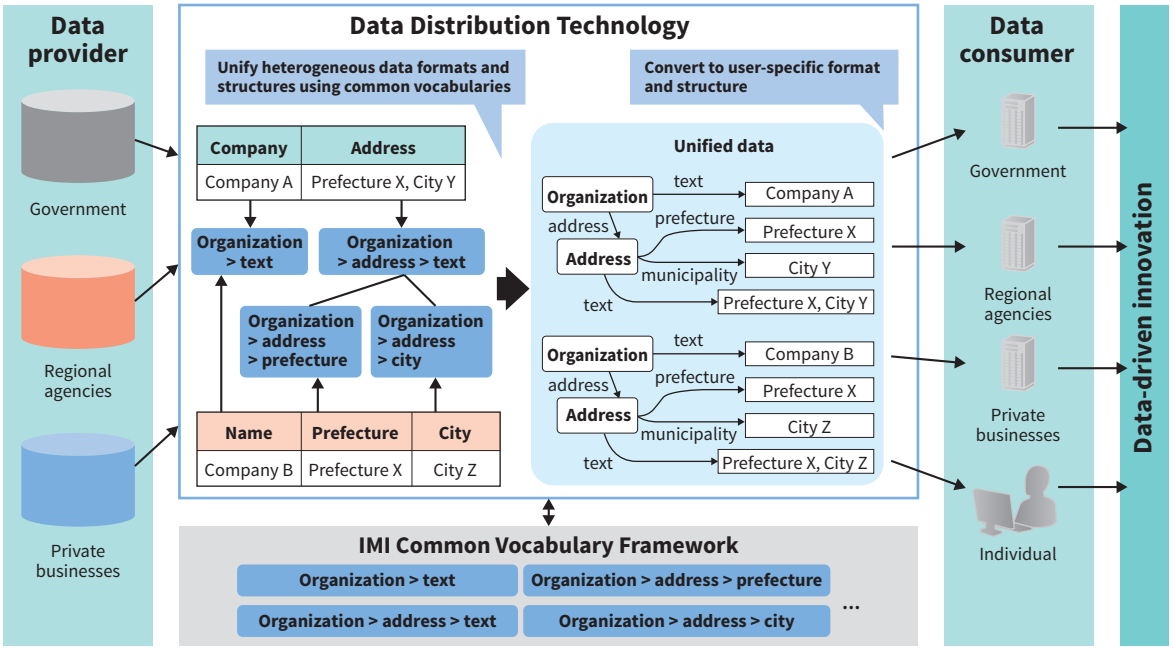

2 Principles of finger vein authentication using standard smartphone camera

of applications, including the authentication of identity in financial transactions.

## 3 Data Distribution Technology for Advancement of Public and Private Sector Data Utilization

The distribution and utilization of the diverse data held by government, regional agencies, private businesses, and other organizations so as to facilitate the public sharing of knowledge and expertise is recognized as a potential way to overcome a variety of societal challenges, such as the rapidly aging population and low birthrate. Acknowledging this need, Hitachi has developed technology for the distribution of public and private sector data that integrates different types of data and makes it available to data consumers.

The Basic Act on the Advancement of Public and Private Sector Data Utilization introduced in December 2016 made promoting the use of data held by public and private organizations one of its core measures. However, the different data structures used by providers and consumers poses a challenge for its utilization and distribution. In addition to assisting with the establishment of the Infrastructure for Multilayer Interoperability (IMI) Common Vocabulary Framework promoted by Information-technology Promotion Agency, Japan (IPA), Hitachi has developed ways of using IMI vocabularies to unify heterogeneous data structures. Hitachi is also working




IMI: Infrastructure for Multilayer Interoperability

3 Data distribution for advancement of public and private sector data utilization

on the research and development of ways to convert unified structures into ones that are suitable for each specific consumer, which will encourage inter-domain data utilization among a wide variety of data consumers.

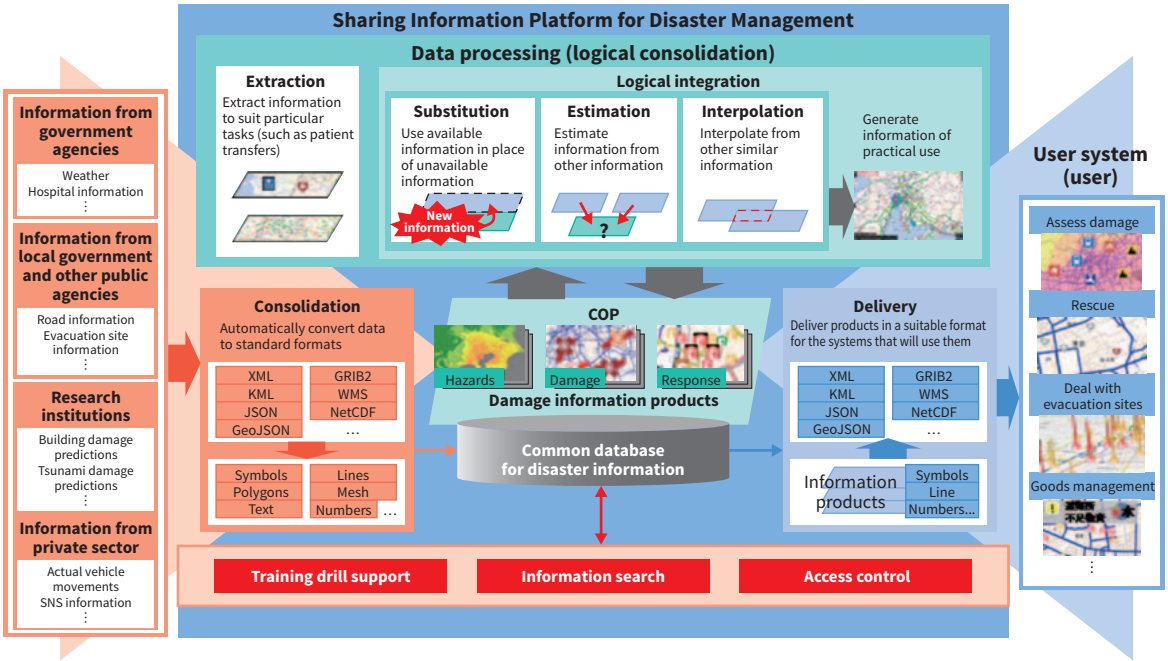
In the future, Hitachi intends to continue utilizing technology for achieving Society 5.0 by expanding the scope of application to areas such as transportation, energy, and disaster management.

## 4 Sharing Information Platform for Disaster Management

Given the potential for worsening damage from wind and flooding due to climate change and major disasters such as a Nankai Trough earthquake, improving the ability to cope with disasters is an urgent issue. Responding to a disaster requires that the relevant organizations, including central and regional government agencies, mount a rapid and appropriate response to the situation in different locations based on a consistent understanding of the extent of damage. Achieving this calls for the sharing of information from different places and across organizations, and also the provision of timely and useful information to people in the field.

In response, Hitachi is engaged in the research and development of a system for sharing disaster information between government agencies, Sharing Information Platform for Disaster Management*. The system consolidates information from various organizations and systems, processes it into a form that is useful for disaster response activities, and provides it to disaster response personnel in the format they require. In the past, deciding what actions to take in the field has been made difficult by fragmentary information, especially in the early stages of a disaster. However, it is possible to provide disaster response personnel with timely and useful information during these early stages by using logical consolidation techniques that consolidate damage information that arrives at different times and from different sources, make up for gaps and other inadequacies in the information, use estimates for information not yet available, and generate information that can serve as a basis for action. In the heavy rain disaster that occurred in northern Kyushu in July 2017, the system helped provide and share more than 20 types of information, including information about evacuation sites and damage to roads, during the first two days of the disaster.

Hitachi aims to continue promoting the use




COP: common operational picture SNS: social networking service XML: extensible markup language JSON: JavaScript* object notation
GRIB: general regularly-distributed information in binary form WMS: Web map service NetCDF: network common data form KML: keyhole markup language
* See "Trademarks" on page 148.

4 Overview of Sharing Information Platform for Disaster Management

of information that contributes to the disaster response of disaster-related organizations and private enterprises and organizations through disaster prevention technology. In addition, it also intends to contribute to safe and secure city planning that is resistant to disasters through the collaboration of both the public and private sectors across various industries, such as infrastructure, transportation, and construction.

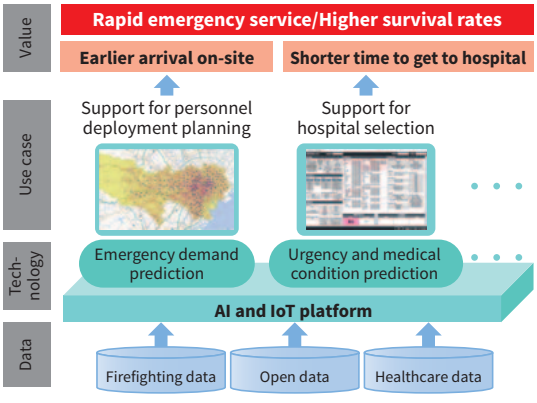
*Work is ongoing in partnership with the National Research Institute for Earth Science and Disaster Resilience as part of the Cabinet Office's Cross-ministerial Strategic Innovation Promotion Program (SIP).

## 5 Fire Fighting Emergency AI Solution for Higher Survival Rates

As Japan's population has aged over recent years, the number of 119 emergency callouts has been rising. A consequence of this is that the times taken to arrive on site and to get casualties to hospital have both lengthened by nearly 40% over the last 14 years, raising concerns about survival rates. In response, Hitachi has developed an emergency AI solution that enables the provision of faster emergency services without imposing any more work on firefighting staff, using artificial intelligence (AI) to support their decision-making.

Specifically, the solution helps shorten the time taken to arrive on-site by breaking areas down into a grid and predicting emergency demand in each area to support routine personnel deployment planning. It also helps shorten the time taken to get victims to hospital by using information such as their symptoms as a basis of predicting the level of urgency and their primary disease, and using this to help choose the right hospital. Along with the use of data held by the firefighting agency together with weather and other open data, the intention for the future is to augment this with healthcare data held by medical institutions or the individual.

In the future, Hitachi intends to verify the value of the solution in practical use with the aim of deploying it at firefighting agencies in Japan and elsewhere.



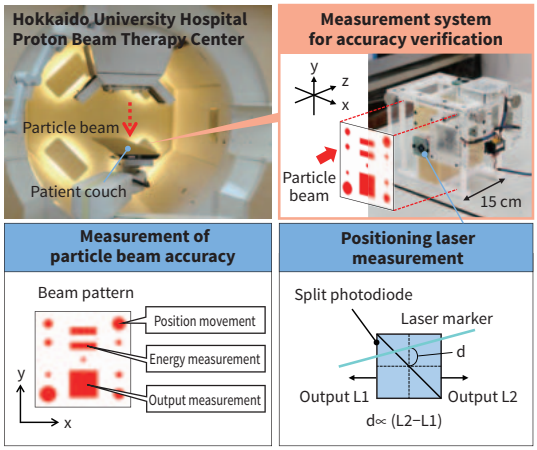

5 Concept behind emergency AI solution

## 6 Accuracy Verification for Particle Beam Therapy Systems

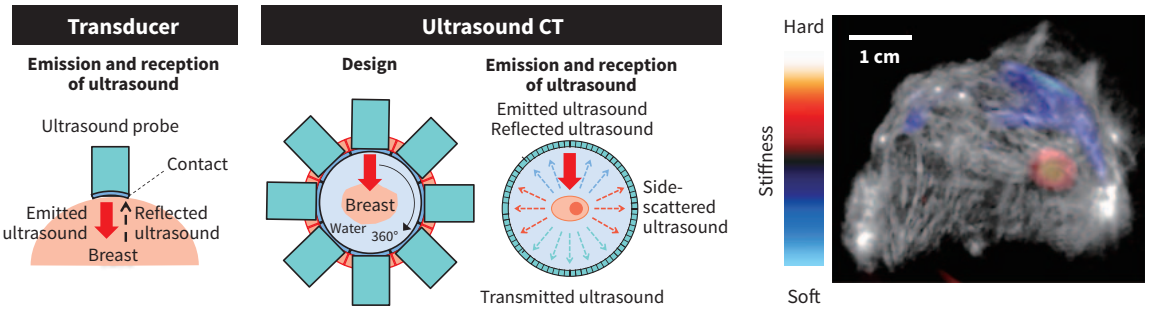
Facilities that provide particle beam therapy also need to undertake daily quality assurance (QA) to ensure that the system continues to operate reliably. As past practice involved testing the accuracy of the particle beam for a number of different beam patterns and using visual checks of laser markers to confirm patient positioning accuracy, this daily QA took around one hour to complete. Accordingly, to free up time for providing treatment by shortening the time taken for daily QA, Hitachi has developed a measurement system that includes the following features to improve efficiency.

(1) Simultaneous measurement of particle beam accuracy by scanning the beam through a number of different patterns that are separated in two dimensions

(2) Use of photodiodes for automatic measurement of the laser markers used for patient positioning




6 Measurement system for verifying accuracy of particle beam therapy systems




7 Principle of ultrasound CT and verification of its effectiveness in canine mammaries with breast cancer

Verification testing of the measurement system was conducted at the Hokkaido University Hospital Proton Beam Therapy Center, confirming its ability to measure all of the parameters to the required accuracy while also shortening the time taken for daily QA to less than 20 minutes.

In the future, Hitachi intends to continue with product development work to improve the accuracy, reduce the size, and lower the cost of particle beam therapy systems while also taking account of their ease-of-use and economics.

## 7 Accurate Diagnosis of Breast Cancer Using Ultrasound CT

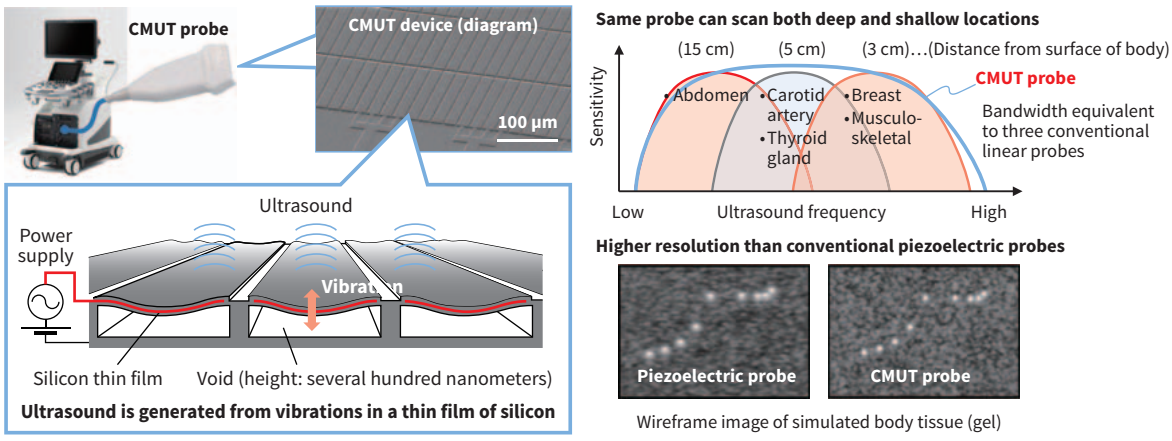
Breast cancer is a major problem throughout the world. The difficulties of existing diagnostic techniques include their being painful and that they deliver variable results, relying on examiners' skills. Accordingly, Hitachi has developed a system that uses ultrasound computed tomography (CT) and is able to measure a number of tumor biomarkers that conventional techniques could not detect, providing pain-free examination with results independent of examiners' skills.

On an ultrasound CT system, the probing ultrasound transducer has a ring configuration and ultrasonic measurements are performed inside the ring. As the probe does not come into contact with the body, it is independent of the examiner. Moreover, the ability to acquire signals from all directions (forwards, sideways, and backwards) means it is able to measure tumor indicators such as stiffness. The results of tests performed on canine mammaries with breast cancer indicated it is possible to clearly distinguish detailed biological structures and identify 5-mm-sized breast tumors from stiffness measurements.

In the future, Hitachi intends to continue its research with the aim of establishing diagnostic techniques for the early detection of cancer.

## 8 New Generation of CMUT Ultrasound Probes

Ultrasound scanning is able to acquire images from inside the body non-invasively and in real time. This has led to its widespread used in healthcare for applications that include the




8 Principle of operation and features of CMUT probe

prevention and diagnosis of disease. Capacitive micromachined ultrasound transducer (CMUT) probes manufactured using technology for semiconductor micromachining are recognized for their potential to provide higher resolution than conventional piezoelectric probes.

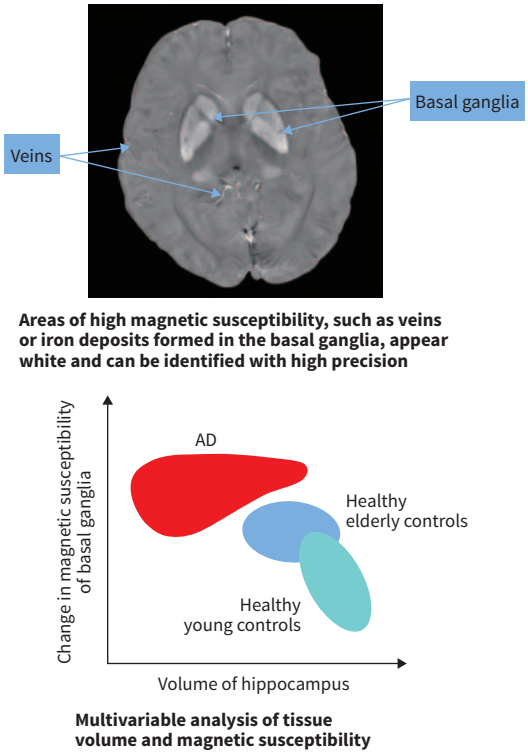
Having led the world by commercializing its Mappie linear CMUT probe for breast examination in 2009, Hitachi has now further enhanced this technology by developing the CMUT Linear SML44 Probe that is suitable for general-purpose use, not just breast examination. The new probe features significant improvements in both ultrasound emission power and reception sensitivity to provide high-resolution images from deeper into the human body. Unlike the past practice of using different probes depending on the depth of the region being imaged, the same CMUT probe can be used in all cases.

In the future, Hitachi intends to contribute to faster and more accurate medical ultrasound imaging by further improving the performance of its CMUT probes.

## 9 High-speed MRI Technique for Early Diagnosis of Dementia

The number of people suffering dementia in Japan is expected to reach around seven million in 2025, of which approximately half will have Alzheimer's disease (AD). As people with AD need to go into care once the condition becomes severe, it imposes a high cost on society. Detected early, however, its progression can be slowed by drug and other treatments, making it important that techniques for early diagnosis be established.

Along with the progression of its symptoms, AD causes the atrophy of brain regions such as the hippocampus. This is preceded, however, by a mild cognitive impairment (MCI) stage during which iron deposits that change the magnetic susceptibility of the brain form in particular regions. What this means is that there is an opportunity to make an early diagnosis at the MCI stage by combining voxel-based morphometry (VBM), a technique for assessing brain atrophy, with the use of magnetic resonance imaging (MRI) to perform quantitative susceptibility mapping (QSM), a technique that has been commercialized by Hitachi. The challenge, however, was to make the scanning process faster as existing methods took more than 10 minutes to complete.




AD: Alzheimer's disease

**9** QSM of healthy human brain (top) and predictions diagram of hybrid analysis (bottom)

Having been commissioned by the Japan Agency for Medical Research and Development to undertake a project to develop medical devices for the early diagnosis and treatment of dementia, Hokkaido University Hospital and Hitachi developed a hybrid imaging technique that simultaneously uses MRI to obtain whole-brain morphology information and also the phase information that provides the basis for calculating magnetic susceptibility. This technique succeeded in reducing the scanning time to five minutes.

Hitachi intends to continue working toward the establishment of methods for the early diagnosis of dementia, with this technique currently commencing clinical trials.