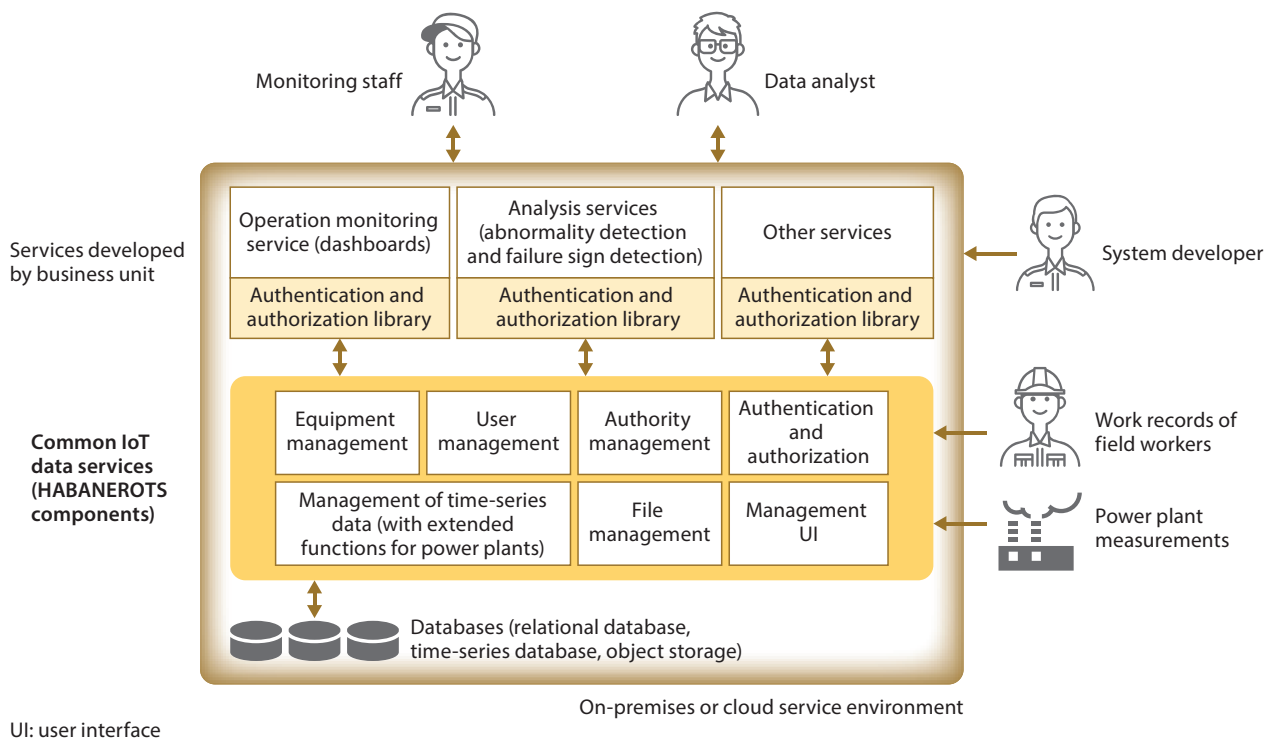


2. Digital Solutions

2.1 Expansion of Common HABANEROTS Components for IoT Platform for Energy Systems



Overview of IoT platform for energy systems

Toshiba Corporation has expanded the lineup of the common components of HABANEROTS^(*), our Internet of Things (IoT) infrastructure service realizing an IoT platform for energy systems. The main newly developed components are the following:

(1) New application programming interfaces (APIs) for power plant applications

The new APIs provide enhancements for the manipulation of measured data from plant equipment, such as narrowing down the ranges of normal values, performing enhanced statistical processing, and facilitating the acquisition of thinned data. They can be widely used to perform big data analysis and develop operation monitoring dashboards.

(2) Mechanisms for authentication and service coordination

A newly developed software library supports single sign-on (a mechanism that allows users to log into multiple services with a single ID). Single sign-on can be incorporated into services developed by each business division. In addition, we have simplified the development of services capable of accessing various types of data of power plants using HABANEROTS user accounts.

(3) Method to simplify environmental construction

We have developed new scripts to configure and install an environment for on-premises and cloud services as well as an initialization tool that enables bulk registration of power plant data such as equipment and signals.

2. Digital Solutions

All of the common components of HABANEROTS are available as in-house open-source software, including the above enhancements, so as to allow each business unit to build its own environment. Our next step is to expand the deployment of HABANEROTS for use by various business units.

- (*) An infrastructure service that provides common functions for business units so that they can launch IoT services without having to create individual systems on their own

2. Digital Solutions

2.2 VenetDCP Distributed Co-simulation Platform

Software used in the automotive industry is becoming increasingly complicated and its areas of application are expanding, making model-based development (MBD) the norm in the automotive industry. MBD is a software development methodology for simulating complex control processes, encompassing automotive components, vehicle dynamics, and traffic environments.

Since an automobile consists of a large number of diverse parts, many companies are involved in its development. However, not all development teams use the same simulator, and all companies are reluctant to disclose their own models and design data because they are typically confidential information. It is therefore difficult to collect all parts models to run a simulation at the vehicle level.

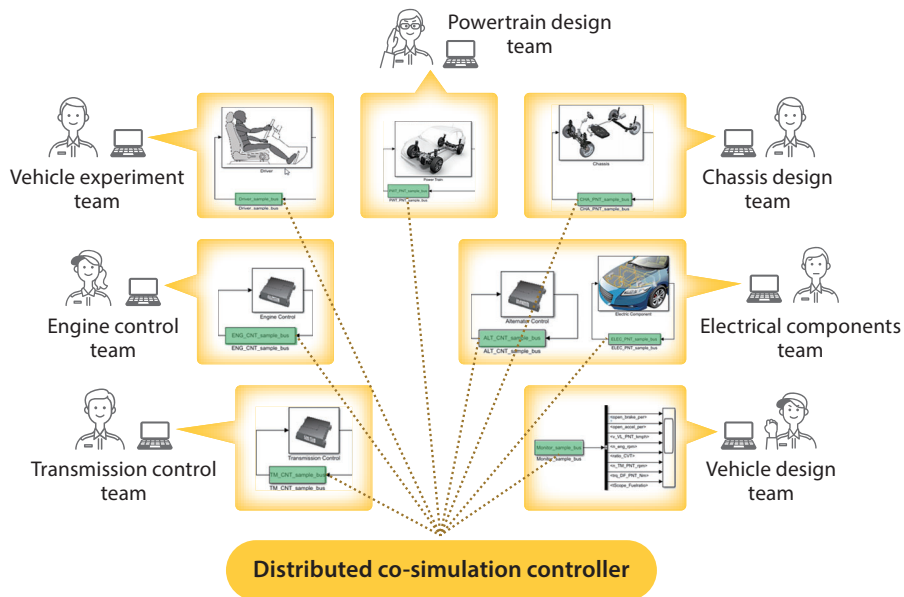
Under these circumstances, Toshiba Digital Solutions Corporation has developed VenetDCP, a co-simulation platform to automatically generate bus connectors that interconnect simulators via the Internet. VenetDCP makes it possible to perform a coupled simulation by running multiple models distributed at different sites while maintaining their confidentiality. Bus connectors emulate the actual data transmissions that occur in a real vehicle. When bus connectors are connected to the models, data are transmitted among them accurately and automatically during simulation. This also simplifies the modification of the model layout.

The bus connectors are compliant with the Functional Mock-up Interface (FMI) standard^(*) and allow multiple FMI-compliant simulators to be connected. Using these bus connectors and major vehicle model simulators, we experimented on co-simulations of a benchmark model from the Ministry of Economy, Trade and Industry (METI) of Japan compliant with its MBD guidelines. We obtained positive results from our experiments, although they revealed slight differences in interpretation of the FMI standard among the companies involved. We resolved this issue to improve connectivity.

The automotive industry has many real-time model assets in order to perform simulations in the verification phase using test benches and hardware-in-the-loop simulation (HILS). To utilize these assets, we have developed a function that allows real-time and virtual-time simulations to be mixed in the same test environment. This function detects a delay in, or synchronizes, the simulation time. We have designed this function while referring to the existing standards of the Institute of Electrical and Electronics Engineers (IEEE), the Modelica Association, and so on.

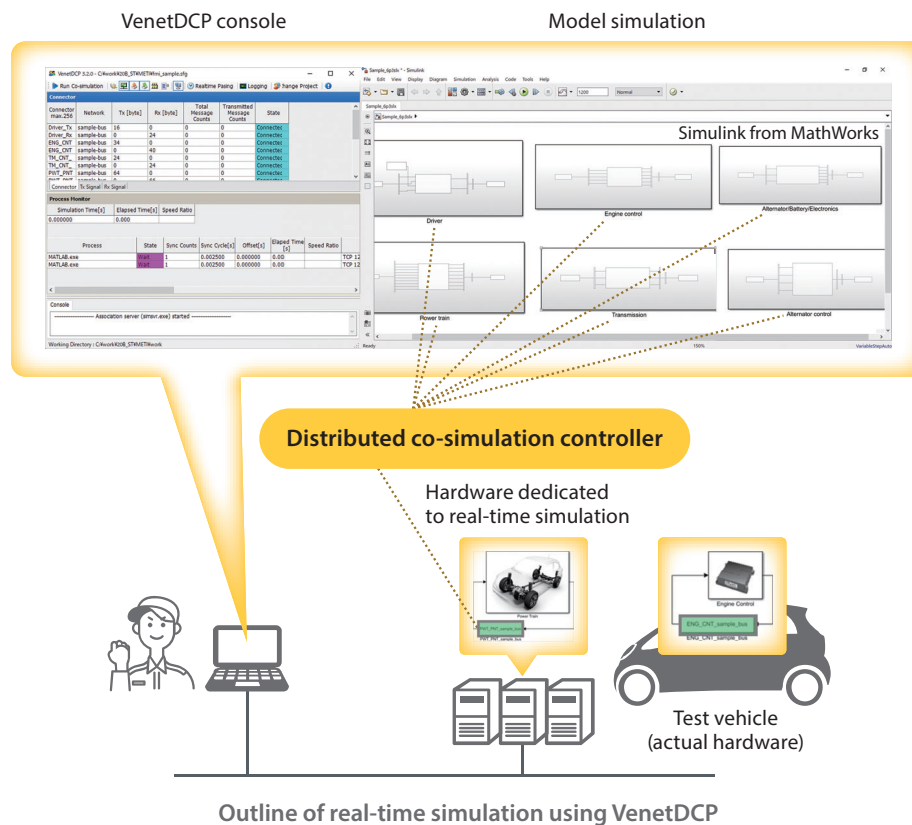
(*) An open standard developed by the Modelica Association that defines a container and an interface to exchange dynamic models using a combination of Extensible Markup Language (XML) files, binaries, and C code zipped into a single file

2. Digital Solutions



* We have experimented on connections between simulators from different companies, referring to the FMI Utilization Guide Ver. 1.0.1 and the FMI Model Exchange & Co-simulation at the JSAE FMI Working Group of the Society of Automotive Engineers of Japan, Inc. (JSAE).

Realization of distributed simulation environment by means of VenetDCP distributed co-simulation platform



Outline of real-time simulation using VenetDCP

2. Digital Solutions

2.3 RECAIUS Report Agent to Digitize Reporting with Voice Dialogue AI



Overview of voice memo function of RECAIUS Report Agent voice dialogue AI service

Toshiba Digital Solutions Corporation offers a service called RECAIUS Report Agent that allows users to deliver business reports by voice by interacting with artificial intelligence (AI) agents via smartphone applications. In response to feedback from a customer applying this service to about 1 500 sales personnel, we have now upgraded RECAIUS Report Agent to make it easier to perform reporting while they are out of the office.

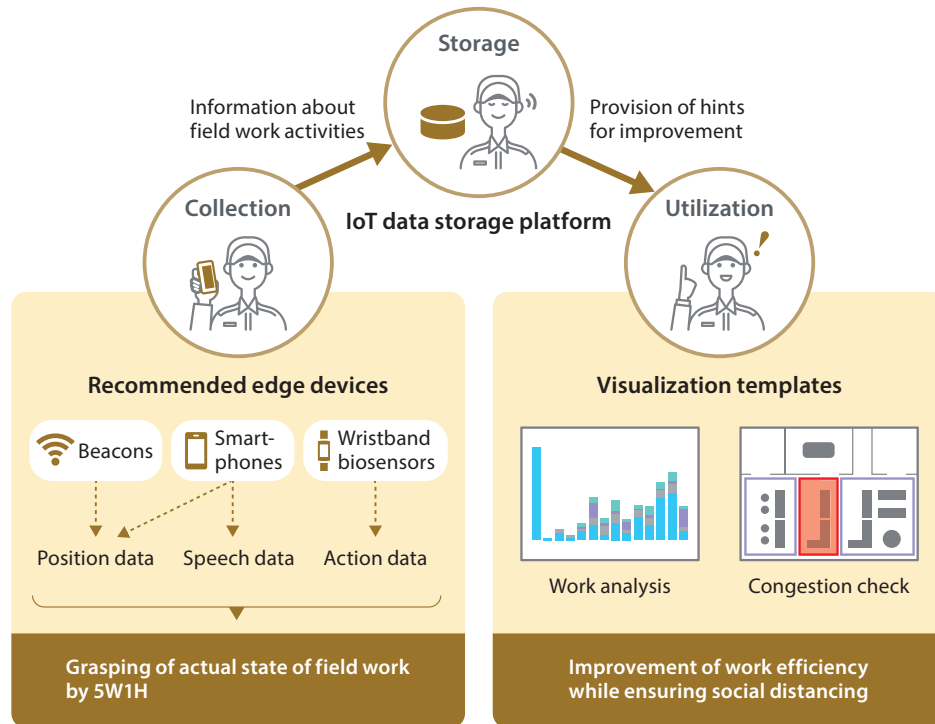
People tend to stammer or misspeak when they are thinking about what to report while on the move. Previously, poor utterances made correct speech-to-text conversion difficult, requiring considerable time for users to edit mistakes.

A newly developed voice memo function makes it easier to avoid such mistakes as it allows users to temporarily save the spoken text and rephrase it later. The converted text data are arranged by date and time and can be added by tapping the relevant input field. In addition, we have added a function to automatically remove unnecessary fillers such as “um” and “ah” that users unknowingly utter. The voice memo function allows users to set a data retention period according to their company’s policy in order to protect the security of business information stored in smartphones. The voice memo function expands the usage of RECAIUS Report Agent as users can enter the contents of a report in their spare time while traveling and organize them later at a comfortable place simply by tapping the screen.

In addition, we have updated the search function so that users can enter product names and other words while referring to a company’s master data. It is now possible to refine a search based on multiple criteria such as a department’s name when the search results based on a person’s name alone are too broad.

2. Digital Solutions

2.4 Digitization of Field Work to Adapt to New Normal



5W1H: When, Where, Who, What, Why, How

Overview of Meister Apps field work visualization package

Toshiba Digital Solutions Corporation has released the Meister Apps field work visualization package, a suite of services for visualizing various types of information concerning workers at a manufacturing site that contribute to the improvement of work efficiency while ensuring social distancing.

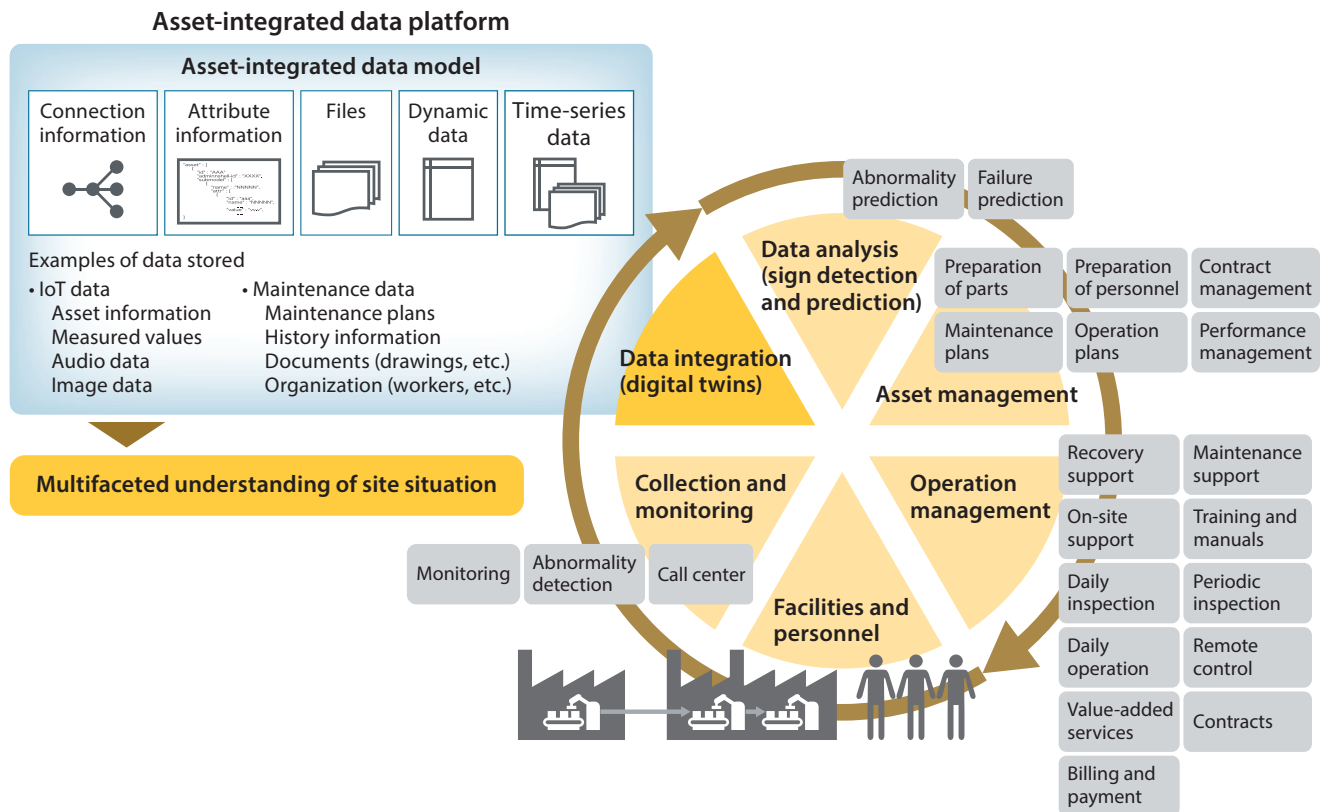
With the recent progress of IoT technology, it is becoming possible to grasp, predict, and optimize the states of factory equipment and other objects. On the other hand, it is difficult to acquire and analyze data on the conditions and movements of human workers.

The Meister Apps field work visualization package can automatically collect, digitize, analyze, and visualize various types of information such as the positions, actions, and utterances of workers by utilizing IoT and AI technologies. In addition to improving work efficiency and productivity at the manufacturing site, it can also be applied to ensure social distancing by checking the congestion of workers, sending alerts, and providing work instructions remotely.

Through this suite of services, we are supporting the realization of a new style of manufacturing adapting to the new normal.

2. Digital Solutions

2.5 New Platform to Support Factory Operation and Maintenance



Asset data platform for integration of IoT data and O&M business data

In recent years, equipment manufacturers have been incorporating remote monitoring functions into their products to support online monitoring of factories using IoT data. At many factories, however, human operators still patrol the factory floor to check the condition of running machines.

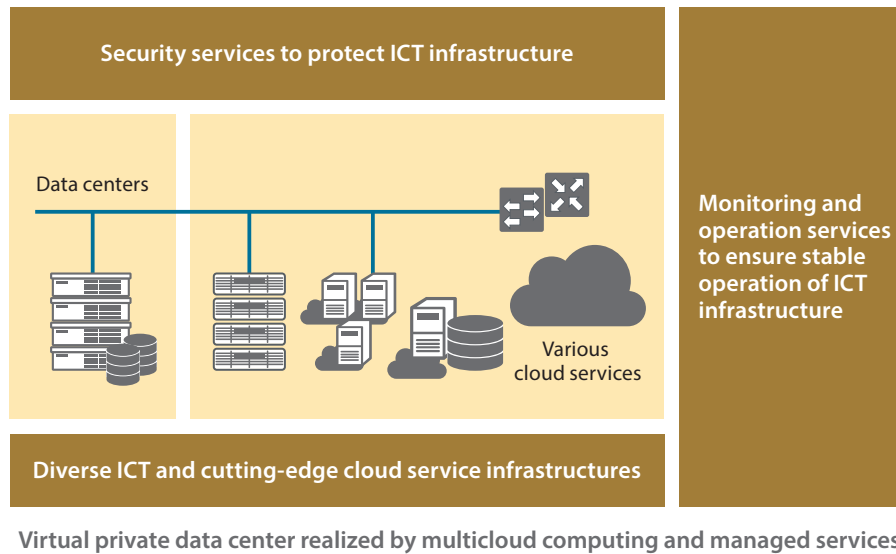
Against this background, Toshiba Digital Solutions Corporation has launched an asset-integrated data platform service that integrates IoT data and operation and maintenance (O&M) data acquired from maintenance and field services. This platform can be utilized by both factory equipment manufacturers and factory operators.

The automated remote monitoring function allows factory operators to improve their work efficiency and solve labor shortages. In addition, the reduction of labor costs helps to improve the cost competitiveness of their products while the constant monitoring of the manufacturing process contributes to enhanced product quality. Furthermore, the resulting optimization of factory operations promotes energy saving, reduction of the environmental burden, and improved work safety.

On the other hand, equipment manufacturers can expect to create a recurring high-profit business model by commercializing high-quality services that focus on extending the life and optimizing the operation of their products. As a result, the entire O&M industry will be able to achieve further computerization and automation.

2. Digital Solutions

2.6 Multicloud Operation Services for Realization of CPS



Various matters must be taken into consideration when introducing innovations in business information technology (IT) systems and realizing cyber-physical systems (CPS). Although information and communication technology (ICT) infrastructure is required to run applications, decisions on the ICT infrastructure tend to be deferred, including those on the selection of a cloud system, security policies, and system operations. As a result, the infrastructure cost often becomes a problem at a later stage when there is insufficient time to consider possible options.

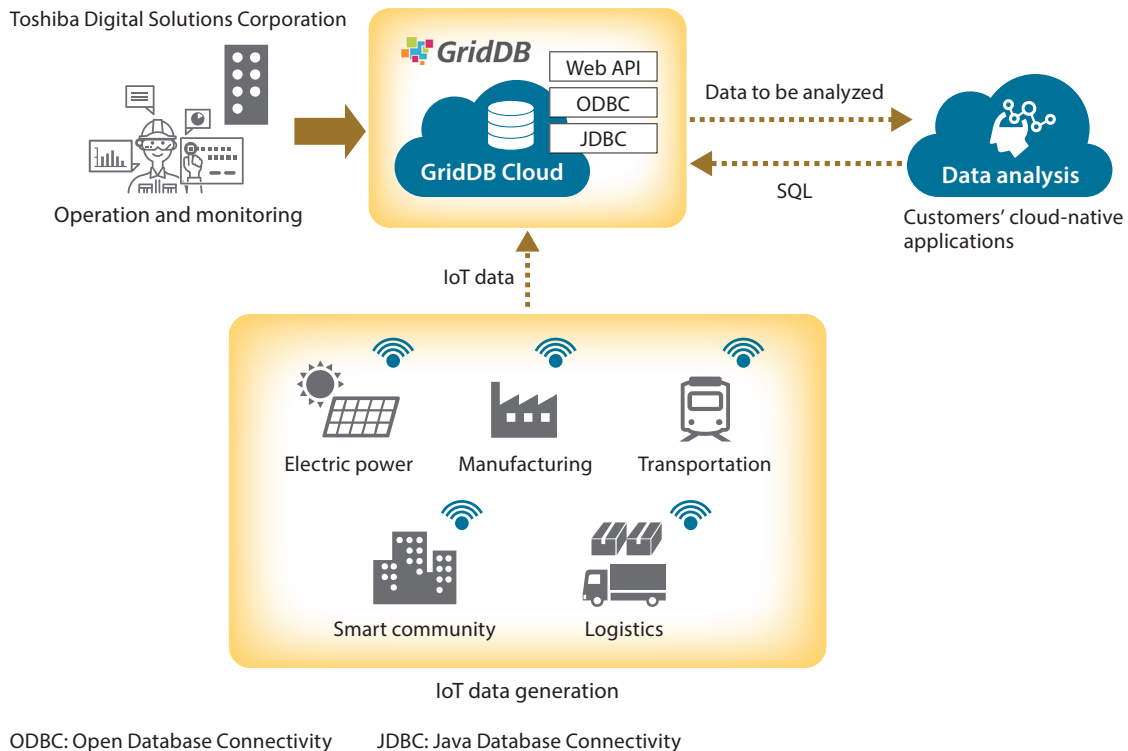
To resolve this issue, Toshiba Digital Solutions Corporation has developed a framework for virtual private data centers that can be promptly implemented as ICT infrastructure as well as cloud managed services to realize it.

In order to meet the service levels of various businesses, this framework provides standardized multicloud services for core functions as well as a service for the monitoring of a mixed environment consisting of virtual servers, on-premises systems, and containers. For security, monitoring, and operations, non-functional and execution processes are designed and automated in advance, enabling a reduction in initial and operating costs.

As a result, the ICT infrastructure can be treated as a virtual private data center, which supports agile business activities because of its minimal physical constraints.

2. Digital Solutions

2.7 Managed Service Technology for GridDB Databases for Big Data and IoT Data



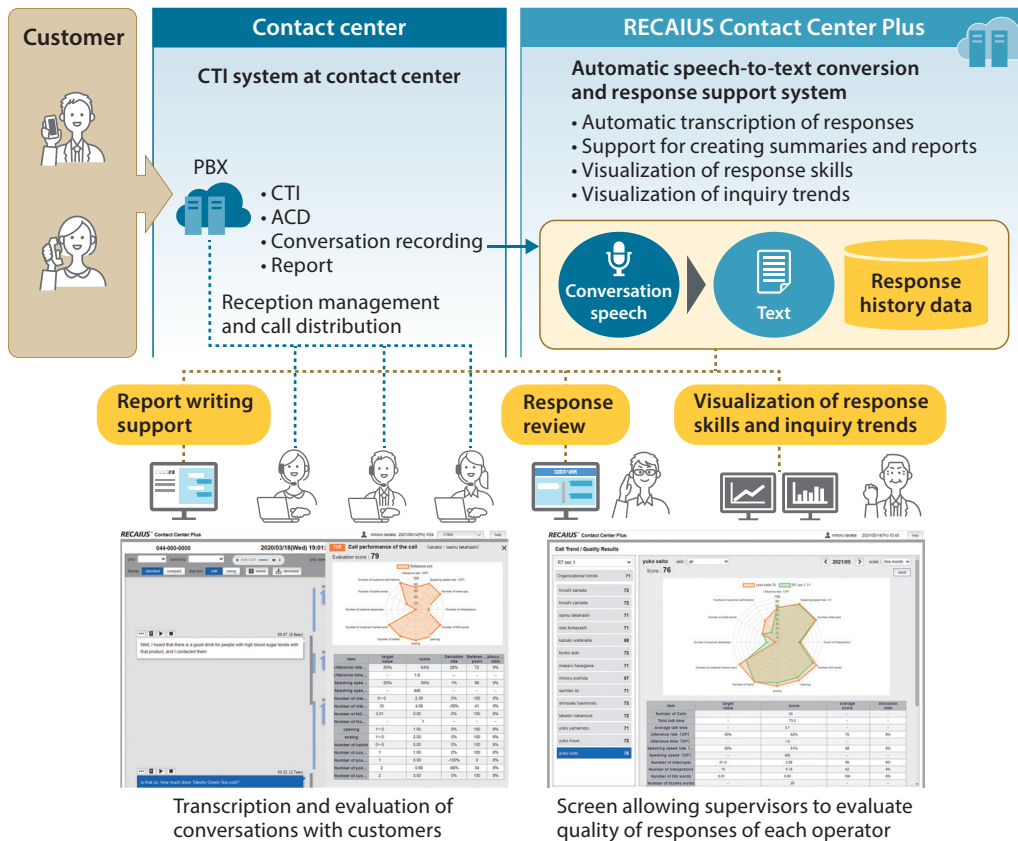
Overview of GridDB Cloud service targeted at GridDB databases for big data and IoT data

GridDB is a database that allows efficient real-time processing and management of frequently accessed large-scale time-series data. GridDB uses a unique key-container data model, an extension of the typical key-value data model of NoSQL (non/not only Structured Query Language). GridDB has both a NoSQL interface and an SQL interface, providing flexible external connectivity.

In addition to the current on-premises edition, Toshiba Digital Solutions Corporation has now developed a cloud edition called GridDB Cloud, which includes a graphical user interface (GUI) and a toolset for the operation and management of databases. GridDB Cloud simplifies initial deployment, reduces the time required for and cost of operation and monitoring, and can be easily connected to cloud-native applications. Another advantage of GridDB Cloud is that it allows continued use of conventional development methods because it provides connectivity using the same API as the existing on-premises editions. This, in turn, helps to reduce the costs that would otherwise be incurred to learn new technologies. We have also enhanced the GUI for operation and management to improve its ease of use.

2. Digital Solutions

2.8 RECAIUS Business Insight Service to Evaluate and Visualize Conversations with Customers



CTI: computer telephony integration ACD: automatic call distribution
PBX: private branch exchange (telephone system)

Overview of RECAIUS Contact Center Plus function to visualize speech quality indicators for contact center systems

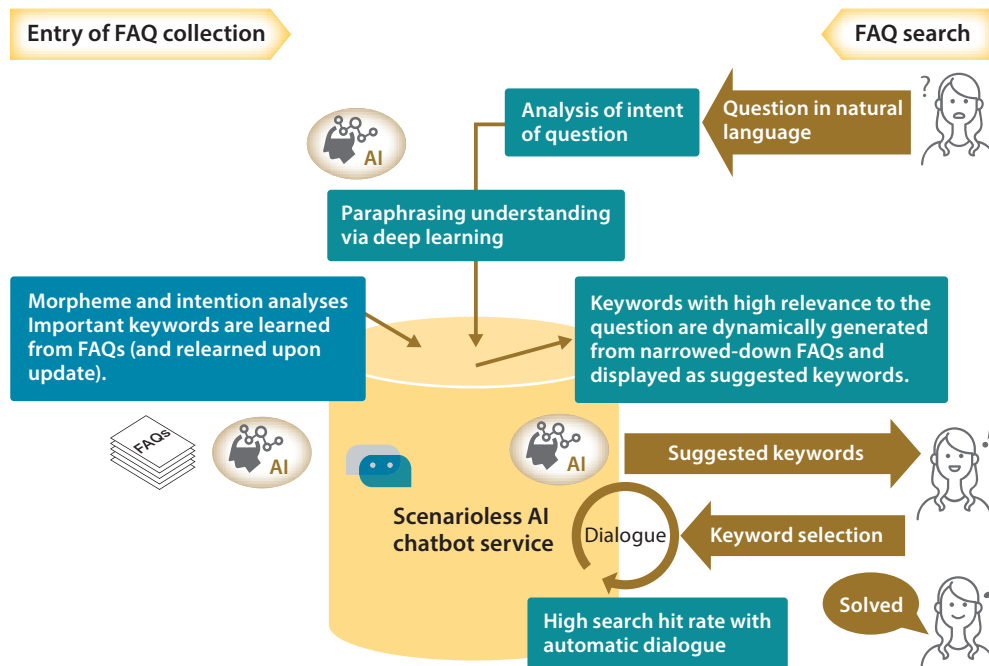
In order to improve customer satisfaction with contact center operators and the quality of operators' responses, Toshiba Digital Solutions Corporation has developed a new function for RECAIUS Contact Center Plus to analyze conversations between customers and contact center operators and visualize various indicators related to response quality.

The new function incorporates voice recognition technology to convert contact center conversations into text and measures the operators' speech rate and frequency of speech during conversations. In addition, it measures how often the operators utter pet phrases and words that should or should not be spoken and shows the measurement results on a radar chart. The supervisor can use these indicators to evaluate the quality of each operator's responses and provide convincing quantitative guidance to the operators. The operators can also use this function to review and improve their call handling in order to enhance customer satisfaction.

Our next step is to expand the application of this service to general online business negotiations and further develop it as a business insight service for promoting awareness through visualization.

2. Digital Solutions

2.9 Scenarioless AI Chatbot Service Reducing Burden of FAQ Maintenance



Mechanism of registration and updating of FAQs using scenarioless AI chatbot service

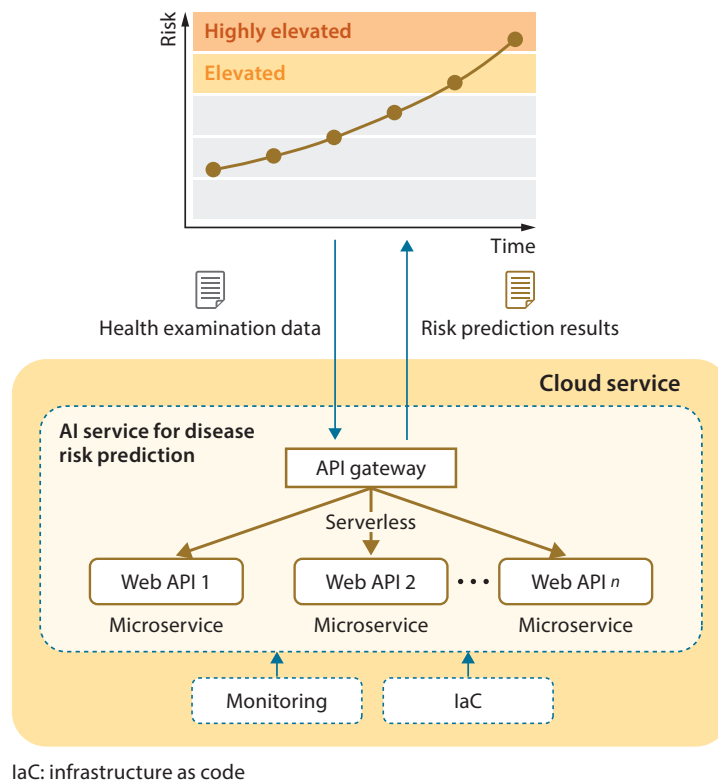
Toshiba Digital Solutions Corporation has commercialized a scenarioless AI chatbot service that significantly reduces the burden of maintaining support for frequently asked questions (FAQs). The main features of this chatbot service are as follows:

- (1) When a collection of FAQs is entered into the chatbot engine, the chatbot learns important keywords so that it can engage in dialogues automatically without any scenario setting. Even when the FAQ collection is updated, FAQ maintenance is relatively easy because all that is required for keyword learning is to re-enter the FAQ collection into the engine.
- (2) The chatbot uses deep learning to paraphrase and understand questions from users. Therefore, it provides a very high search hit rate even when questions are worded differently.
- (3) In order to help users refine a search, the chatbot guides them toward the best answer by suggesting keywords.

We will continue to expand the functions of the chatbot so as to be able to provide optimal solutions to any inquiry in any situation, including support for smartphones, interactions with a real human, direct connections with an operator service, and incorporation of analyzers.

2. Digital Solutions

2.10 AI Service for Predicting Risk of Lifestyle-Related Diseases Based on Health Examination Results



Overview of AI service for disease risk prediction

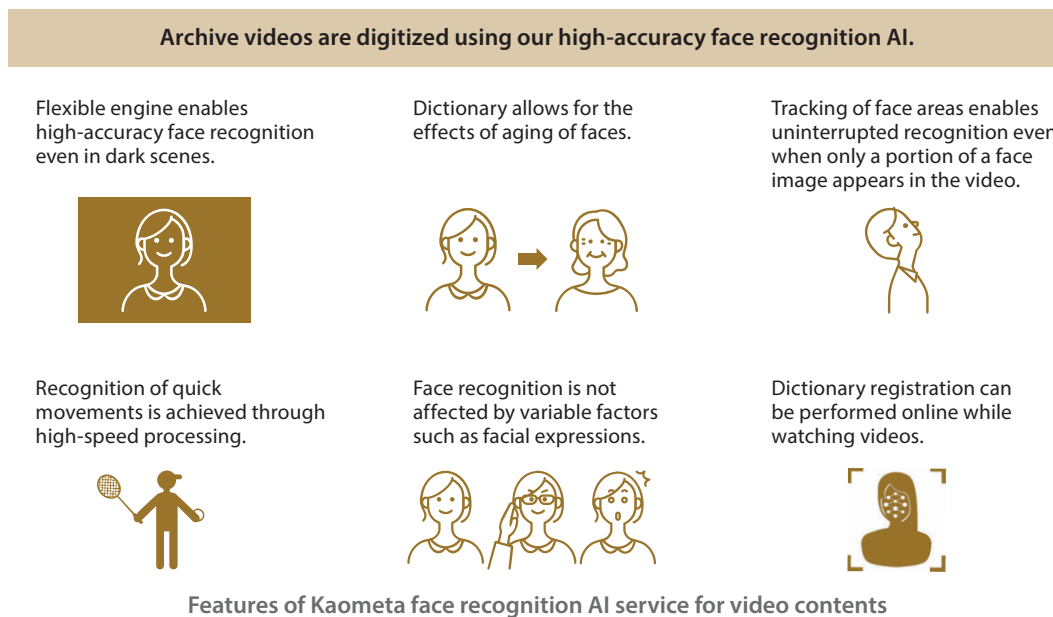
Toshiba Digital Solutions Corporation has commercialized an AI service as a web API that predicts the probability of each of the items in an individual's health examination results related to lifestyle diseases being identified as an outlier for up to six years ahead. Disease risk is predicted based on the health examination data for each individual collected over a one-year period. This AI service visualizes health risks so as to motivate people with outlier cases to modify their lifestyles. It is targeted at enterprises that promote the health of their employees to improve work efficiency, local governments that undertake organized public health efforts, and medical institutions that offer health examination services.

The new AI service consists of multiple general-purpose microservices that simply return a risk value so that the predictions of future disease risk can be represented as charts and tables in a flexible manner according to the usage scenario. In addition, we have adopted a serverless architecture that allows computing resources to be dynamically scaled according to seasonal variations in the demand for health examinations.

We are planning to increase the number of diseases handled and continually create new healthcare data services in collaboration with our partner companies.

2. Digital Solutions

2.11 Kaometa Face Recognition AI Service for Media Using High-Accuracy Face Recognition Technology



It is important for TV stations to check the identities of the people who appear in the recorded video contents of TV programs because mistaken identities could have a considerable social impact. Therefore, TV stations expend substantial time and effort to prevent misrecognition. It is impossible, however, to watch a huge archive of TV programs in order to add metadata manually.

To solve this issue, Toshiba Digital Solutions Corporation has launched Kaometa, a face recognition AI service that provides real-time face recognition with world-class accuracy^(*) using unique face recognition technology developed by Toshiba Corporation. Kaometa requires that only one face image be registered in a dictionary per person.

Kaometa supports the production of TV programs without any misidentification because it provides face recognition that is as accurate as or more accurate than that of humans. Kaometa can also be used to add metadata to archived TV programs. Since it is difficult to collect photos of the faces of hundreds of thousands of people for registration, we have released an option that is convenient when face photos are unavailable in advance.

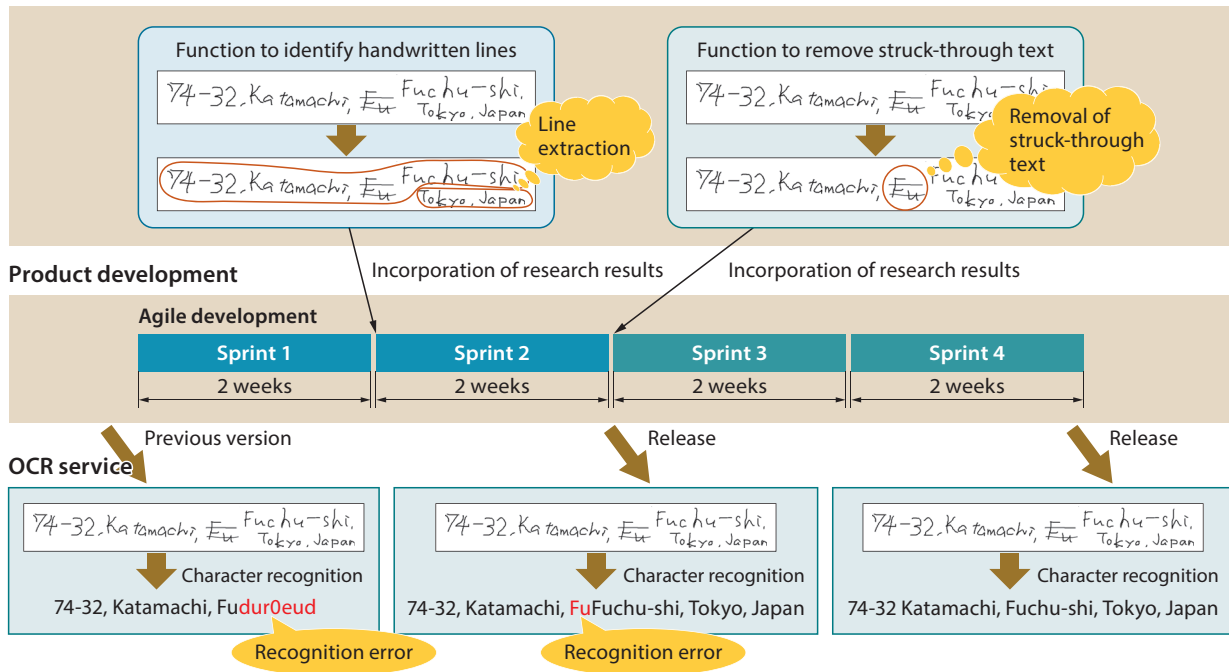
Kaometa is also effective for adding metadata to a huge archive of TV programs in order to create a list of people who appear in each program together with time codes.

(*) Toshiba Corporation ranked sixth in the “Wild” category of the Face Recognition Vendor Test (FRVT) conducted by the National Institute of Standards and Technology (NIST) in June 2019.

2. Digital Solutions

2.12 AI OCR-Based Form Recognition Service to Realize Continuous Delivery through Agile Development and DevOps

Technical research



Flow of processes to swiftly incorporate research and development results into products according to each release

Toshiba Digital Solutions Corporation offers the AI OCR^(*)-Based Form Recognition Service, a cloud service that provides considerably improved accuracy for handwritten text recognition using AI. Previously, this service utilized a waterfall development model, which often resulted in delays in long-standing research and development projects partly because uncertainties in such projects make it difficult to satisfy all of the requirements defined at the initial stage and also because design iterations often occur at the very last stage of development.

To solve this problem, we have introduced agile development techniques while automating the testing and deployment processes, thereby realizing DevOps, a set of practices that combine software development and IT operations with the aim of releasing software products and services continuously.

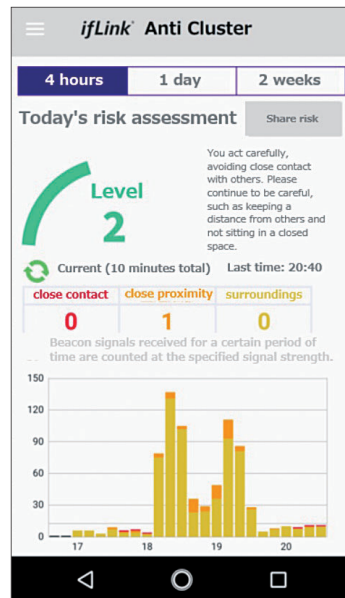
As a result, we can now incorporate line extraction, struck-through text removal, and other functions into our products and services in parallel with ongoing research. This makes it possible to continuously release products and services at an early stage. We will continue to implement automatic learning and other research results in a timely manner in order to constantly deliver services with cutting-edge features and performance.

(*) OCR: optical character recognition

2. Digital Solutions

2.13 ifLink-Based Applications to Help Prevent Spread of COVID-19

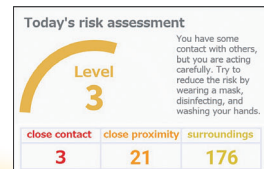
The number of people in close proximity is counted and displayed in chronological order.



Bluetooth™ beacon signals are received to determine the number of nearby people and how far away they are.



Risk is determined by counting the number of nearby people.



Personal awareness-raising

I stayed too long at that coffee shop.



Linkage with loyalty point system



Points are given to motivate people to avoid the risk of infection.

Overview of AntiCluster Personal app to visualize number of people in close proximity to user for coronavirus infection prevention

ifLink is an IoT platform that simplifies the development of useful applications with a series of if-then rules without requiring any programming. In March 2020, the ifLink Open Community was founded to popularize ifLink. As part of the activities to prevent the spread of COVID-19 being promoted by the ifLink Open Community, Toshiba Digital Solutions Corporation has developed multiple Android applications that run on ifLink.

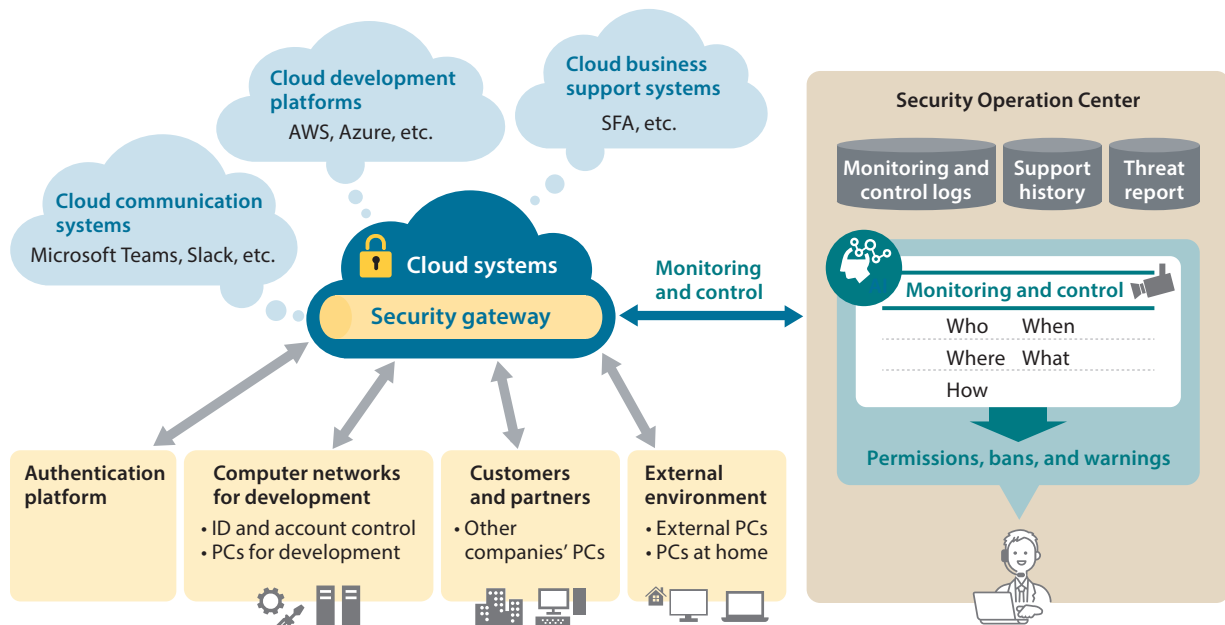
One of these applications, called AntiCluster Personal, uses Bluetooth™ beacon signals from smartphones to count the number of people in close proximity to the user and measure the distances to them based on the strengths of the radio signals received. AntiCluster Personal estimates the risk of close contact and prompts its users to change their behavior.

We have also developed AntiCluster Signage, which shows the congestion of shops and other places where many people gather; ClosedBuster, which warns of poor ventilation using carbon dioxide (CO₂) sensors; and ThermoDetector, which detects people who have a fever using thermography.

We will continue to popularize ifLink through the ifLink Open Community.

2. Digital Solutions

2.14 Construction of Zero Trust Network Environment



SFA: sales force automation

Construction of zero trust network environment

Accompanying the ever-increasing opportunities to collaborate with partner companies, external consultants, and customers on innovation activities, new network architectures are required for secure and effective software development.

In addition, because of the ongoing trend toward workstyle reform and the occurrence of the COVID-19 pandemic, people are increasingly required to use teleworking and access cloud systems directly from home and outside the office.

Against this background, Toshiba Digital Solutions Corporation has constructed a zero trust network based on the following three concepts:

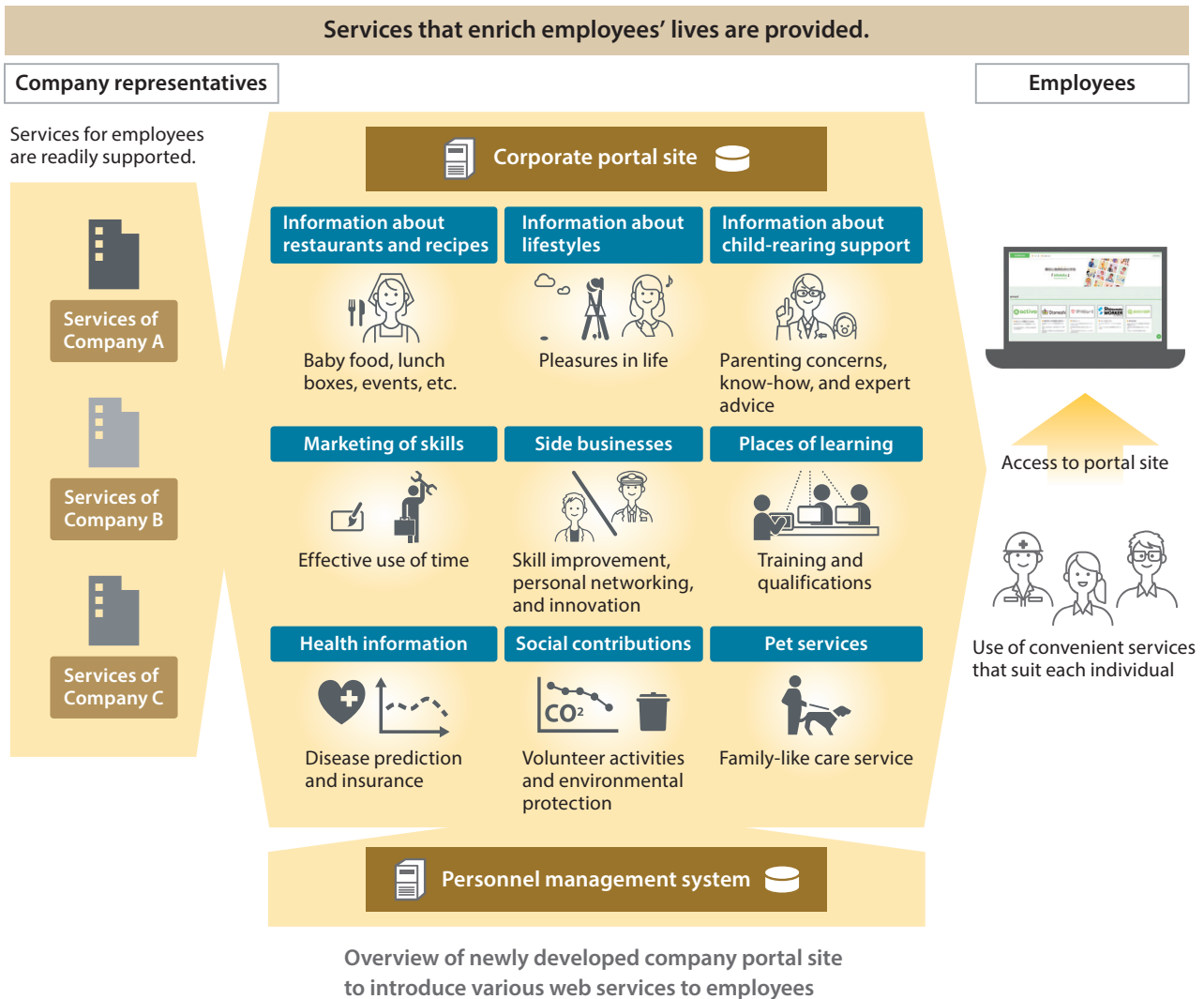
- (1) A fundamental design that distrusts all networks and emphasizes access control and monitoring
- (2) The ability to securely access networks anytime, anywhere, and by whatever means available
- (3) Monitoring and management of user IDs, devices, and locations combined with application control.

The newly developed zero trust network provides a secure environment for all PCs regardless of where they are located while retaining the scalability and flexibility of cloud systems.

At present, we are deploying zero trust networks in the in-house development environment, which will come online from 2021 onward.

2. Digital Solutions

2.15 Company Portal Site to Introduce Various Web Services That Support Diversifying Workstyles



The ongoing reform of people's ways of working and the COVID-19 pandemic are driving the diversification of workstyles and values. To improve employee satisfaction, businesses are required to provide various services in response to employee requests.

Against this background, Toshiba Digital Solutions Corporation has newly developed and released a company portal site to introduce various web services to employees. This portal site provides employees with access to useful web services that are difficult to come by in their daily lives. In addition, it can be linked with corporate personnel systems to automatically set employees' personal information such as names, addresses, and family information.

The newly developed company portal site makes it possible to seamlessly connect corporate personnel systems to web services via its application programming interface (API), regardless of whether the system is set up on-premises or in the cloud. In the future, we will expand the range of services so as to further enrich employees' lives.