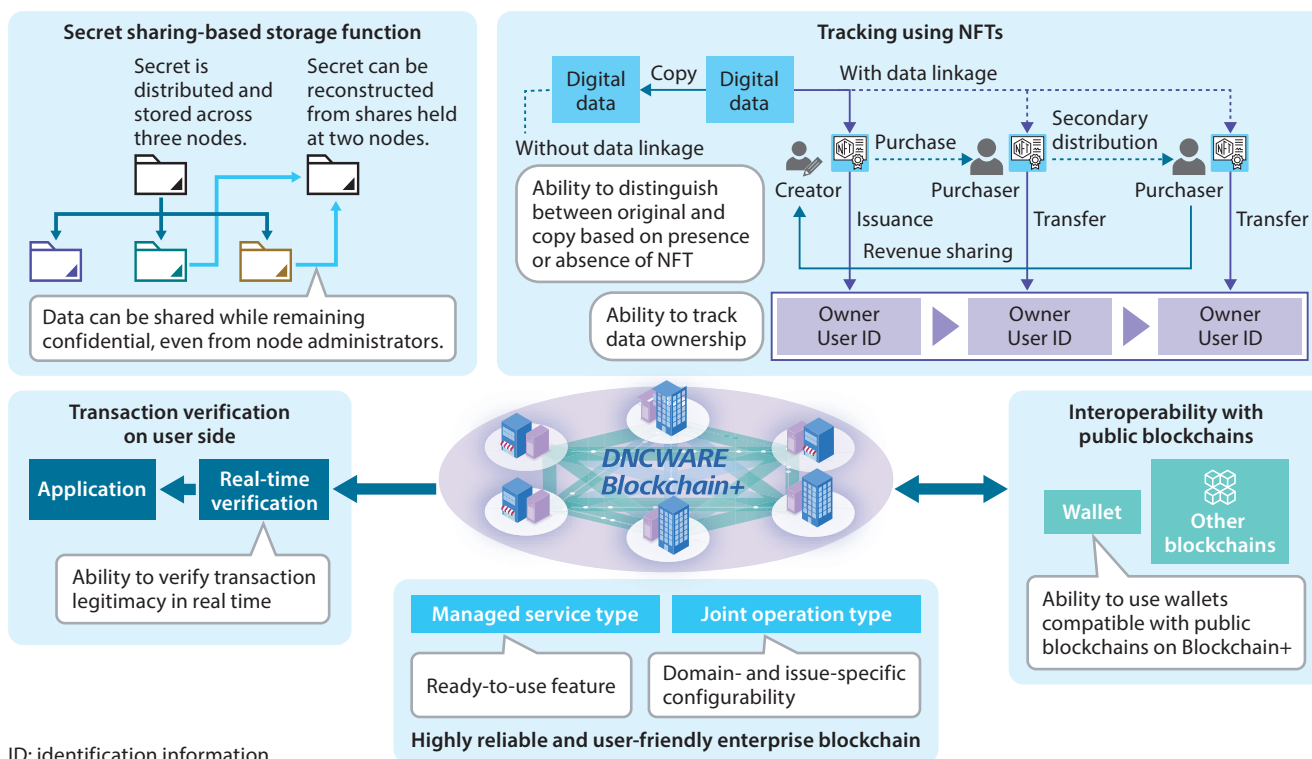


5. Digital Solutions

5.1 DNCWARE Blockchain+ V3 Enabling Inter-Enterprise Data Sharing and Distribution



ID: identification information

DNCWARE Blockchain+ V3 features

DNCWARE Blockchain+ (hereinafter “Blockchain+”) is an enterprise-oriented blockchain developed based on the proprietary cluster technology of Toshiba Corporation. Its latest version, Blockchain+ V3, introduces a new decentralized data distribution infrastructure that enables reliable inter-enterprise data sharing and distribution.

In contemporary society, inter-enterprise collaboration across industry boundaries to co-create social value is accelerating. At the core of this trend lies data, and the integration of diverse datasets held by different organizations enables challenges that are difficult for individual organizations to solve on their own to be addressed. However, ensuring data reliability remains a major challenge in realizing inter-enterprise data sharing and distribution.

Conventional systems operate on the premise of trusting a specific managing entity and are therefore subject to its judgments and operational policies, resulting in limitations on data verifiability and operational continuity. To address this issue, a decentralized architecture that does not rely on a specific managing entity is essential. Blockchain+ V3 strengthens this decentralized architecture through the following three enhancements:

(1) Enhanced data reliability through real-time verification

Blockchain technology ensures tamper resistance and data authenticity. In addition, a new function has been introduced that enables users to verify transaction legitimacy in real time, thereby further enhancing trustworthiness.

5. Digital Solutions

(2) Secure data storage via secret sharing

Data are encrypted, partitioned into multiple shares, and distributed across multiple nodes using secret sharing technology. The shares cannot be decrypted even by node administrators, thereby ensuring confidentiality.

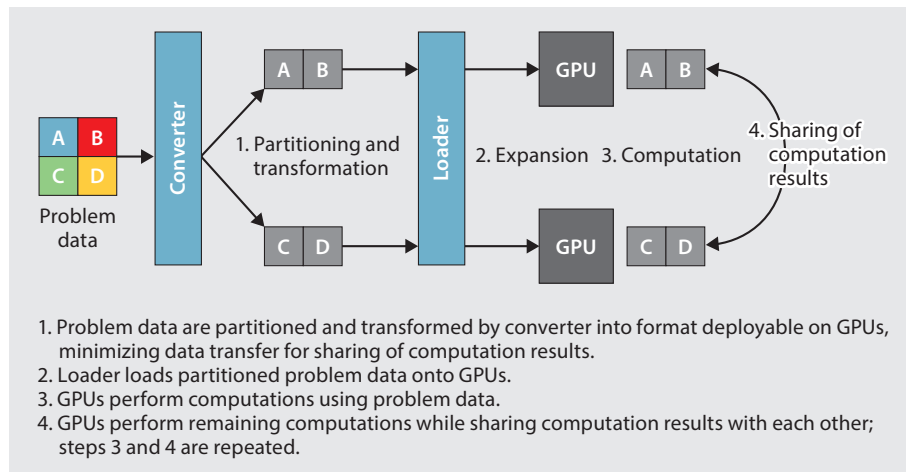
(3) Data value circulation through non-fungible tokens (NFTs) and interoperability

The use of NFTs enables the traceability of data ownership and transaction history. Furthermore, interoperability with public blockchains has been introduced, facilitating broader circulation of data value.

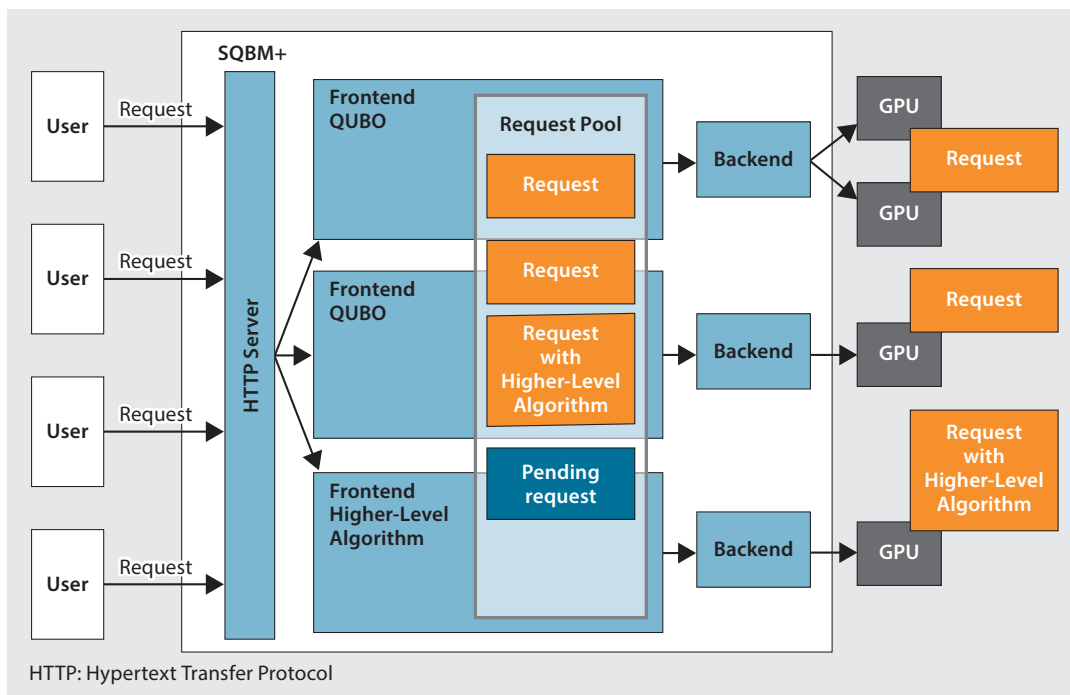
Through these enhancements, Blockchain+ V3 realizes the concept of “data distribution and value creation via blockchain” in a more practical and scalable form. It is expected to serve as a core technology supporting reliable inter-enterprise data sharing and value creation in areas such as government digital transformation (DX), the integration of logistics and payments, carbon credits, and the secondary use of batteries.

5. Digital Solutions

5.2 SQBM+: Quantum-Inspired Optimization Solution for Large-Scale Problems with Up to One Billion Variables



Large-scale problem processing via problem partitioning



Flexible GPU resource allocation through front-end separation

Combinatorial optimization problems with vast numbers of possible combinations are pervasive across society and industry, and their efficient solution is directly linked to operational efficiency and value creation. SQBM+ is a quantum-inspired optimization software solution developed by Toshiba Corporation for rapidly deriving practical solutions. To enhance its scalability and practical applicability, the following challenges needed to be addressed:

5. Digital Solutions

(1) Scaling to support problems with one billion variables

For example, when grouping small-lot financial assets for risk mitigation, variables are required for each combination of assets and groups. A case involving one million assets and 1 000 groups results in one billion variables. Problems of this magnitude are prohibitively difficult to process and represent a domain in which the capabilities of quantum-inspired technology are rigorously evaluated.

(2) Flexible utilization of graphics processing units (GPUs)

Previously, SQBM+ prioritized computational speed by dedicating all GPUs on a server to a single request. However, efficiently supporting multiple users while achieving both high computational performance and improved throughput presents a significant challenge.

(3) Ease of interface extension

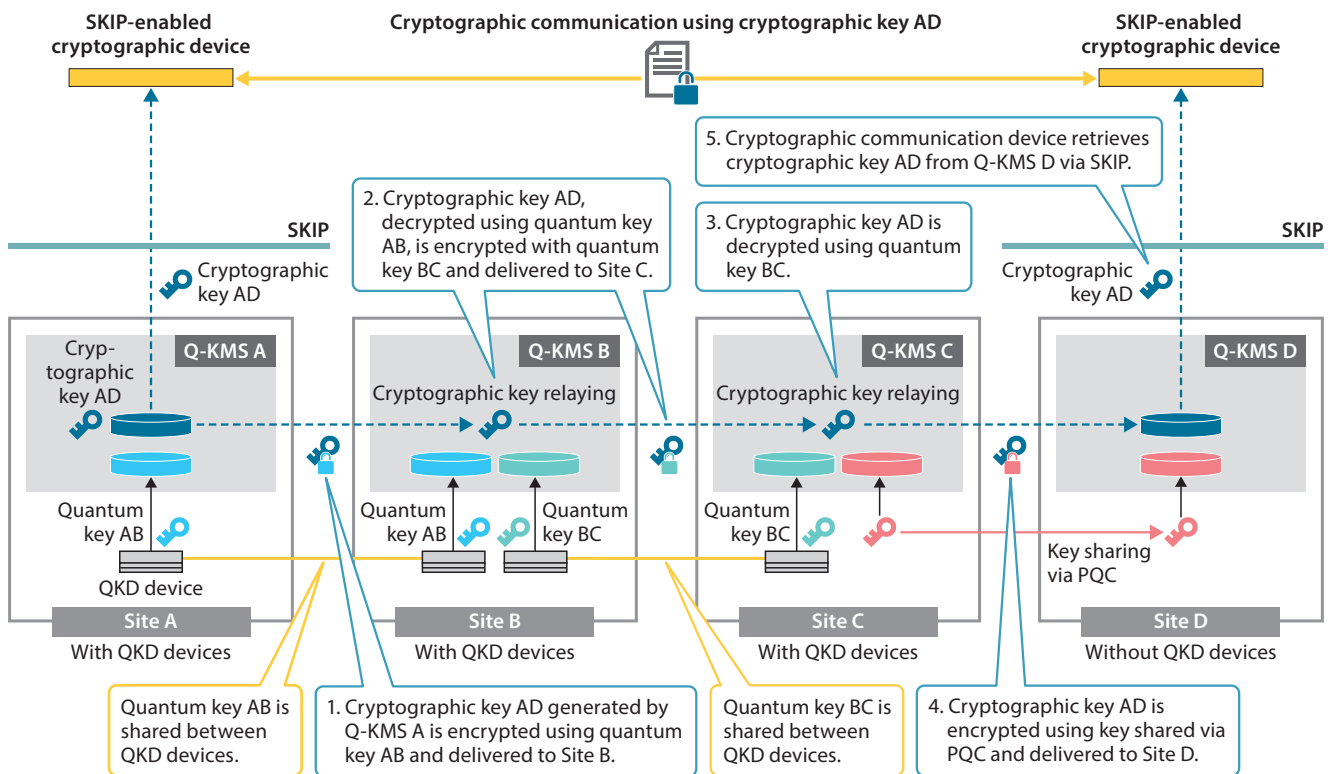
The fundamental interface of SQBM+ is based on quadratic unconstrained binary optimization (QUBO). However, real-world applications require integration with higher-level algorithms, making extensibility a key challenge.

We have addressed these challenges through two approaches. First, GPU-oriented scaling was introduced to address the first challenge by dividing problem data into blocks, thereby reducing inter-GPU data transfer and optimizing memory access and synchronization. Second, front-end separation with dynamic GPU allocation was introduced to address the second challenge. This separation also enabled the adoption of a microkernel architecture, which facilitates the addition and replacement of higher-level algorithms, thereby addressing the third challenge.

As a result, it was confirmed that the proposed system is capable of handling problem instances with one billion variables and ten billion non-zero elements, while maintaining extensibility.

5. Digital Solutions

5.3 Quantum Key Management System with Enhanced Support for Diverse Network Environments



Quantum key management system (Q-KMS) overview

Quantum key distribution (QKD) enables the secure sharing of cryptographic keys by leveraging the principles of quantum mechanics, which allow reliable detection of any eavesdropping. For the practical deployment of QKD, a key management system (KMS) is essential for managing and distributing the generated cryptographic keys.

A KMS uses quantum keys shared between QKD devices via optical fibers or other transmission media to relay cryptographic keys across multiple sites. This enables secure key distribution even among sites not directly connected by QKD devices. In addition, the KMS manages key validity and usage status and ensures a stable supply of cryptographic keys by pre-generating and storing a large volume of keys.

To accommodate diverse network environments, Toshiba Corporation has expanded the functionality of its existing quantum key management system (Q-KMS). First, as an interface for cryptographic communication devices, Q-KMS has been enhanced to support the Secure Key Integration Protocol (SKIP), which is widely supported by networking equipment manufactured by Cisco Systems, Inc., in addition to the existing European Telecommunications Standards Institute (ETSI) Group Specification (GS) QKD 014 standard. Support for SKIP enables the development of cryptographic communication systems using existing Cisco equipment.

5. Digital Solutions

Furthermore, Q-KMS incorporates a new key distribution function based on post-quantum cryptography (PQC), a class of cryptographic techniques based on mathematical problems that are difficult to solve even with powerful quantum computers expected to emerge in the future. This feature enables cryptographic key sharing even at sites where the installation of QKD devices is impractical due to geographical or other constraints. By combining QKD and PQC, it is possible to enhance quantum resilience across the entire network while maintaining a balance between cost and security.

Going forward, we will continue to pursue further functional enhancements in response to evolving market needs.

5. Digital Solutions

5.4 Secure Large-Scale Control and Service Operations Using HABANEROTS IoT Platform

As Internet of Things (IoT) and cyber-physical system (CPS) services leveraging cloud technologies become increasingly sophisticated, (1) secure and reliable communication with a large number of devices and (2) continuous analysis and monitoring of services and their security have become essential requirements.

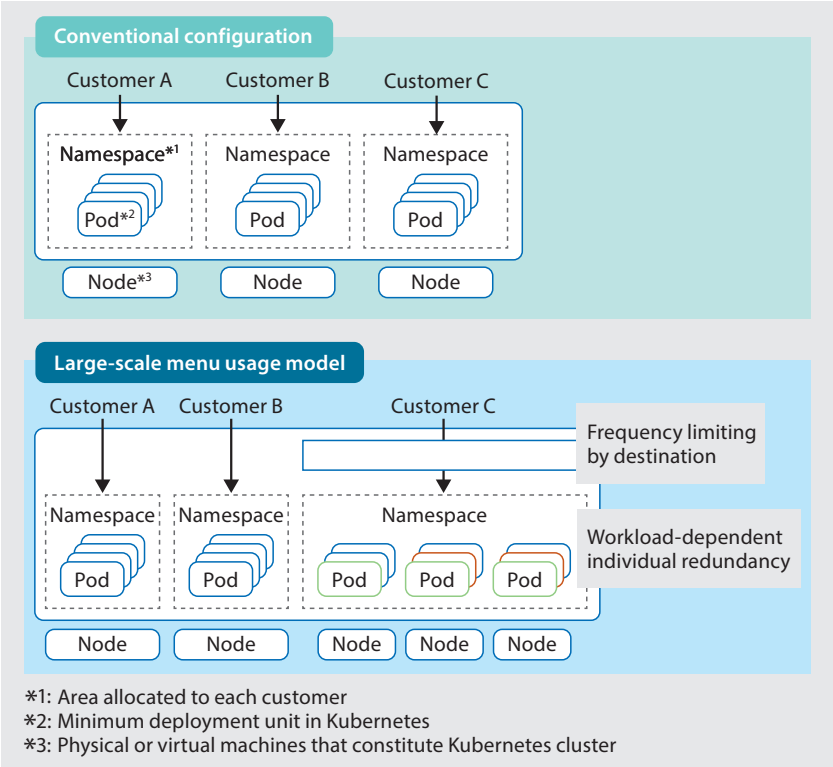
Previously, each business unit of the Toshiba Group built and operated its own cloud environment. This approach, however, incurred high costs and substantial operational burdens, limiting the rapid deployment of services. To address these challenges, Toshiba Corporation has been developing HABANEROTS, an IoT platform service.

In addition to essential capabilities for service implementation, including application programming interfaces (APIs) and authentication and authorization functions, HABANEROTS provides a secure, highly redundant application execution platform leveraging cloud technologies such as Kubernetes. This platform enables each business unit to focus on developing business-specific applications and reduces workloads associated with IoT and CPS services by approximately 70%.

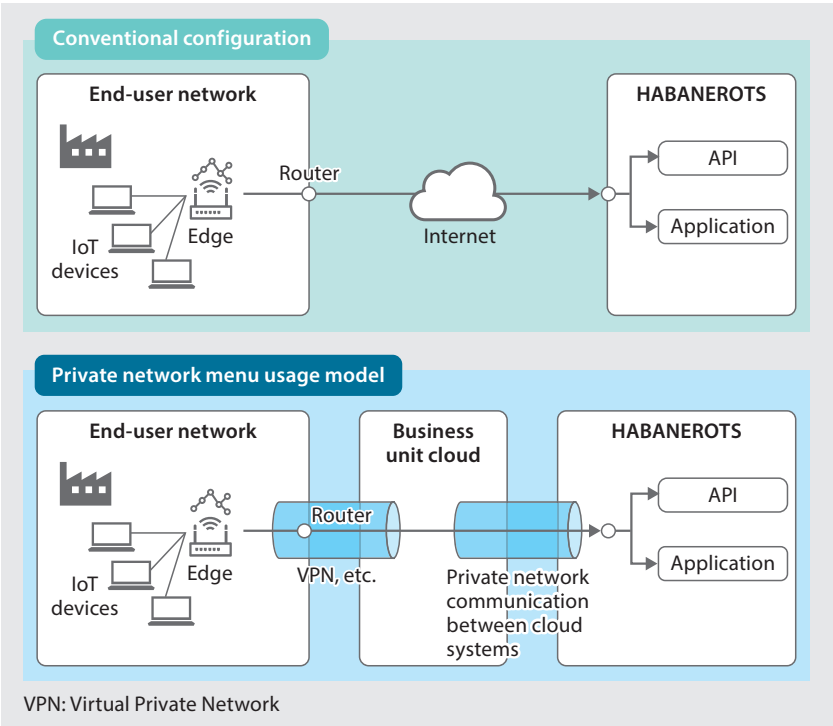
To address diverse requirements related to large-scale device connectivity, HABANEROTS now offers two new service options: a large-scale menu and a private network menu. The large-scale menu incorporates cloud-based load control and optimized placement of processing resources to support use cases involving tens of thousands of devices and high-frequency API requests, delivering stable, high performance while minimizing costs. The private network menu enables access to HABANEROTS from end-user environments via private networks, thereby satisfying more stringent security requirements.

Furthermore, the dashboard functionality has been enhanced to enable real-time monitoring of application operational status, resource usage, logs, service usage trends, and vulnerability detection results. This capability allows business units to quickly identify service issues, thereby improving reliability and cost efficiency. Moving forward, we will continue to enhance the functionality and usability of HABANEROTS in response to emerging use cases, contributing to the further development of IoT and CPS services across the Toshiba Group.

5. Digital Solutions



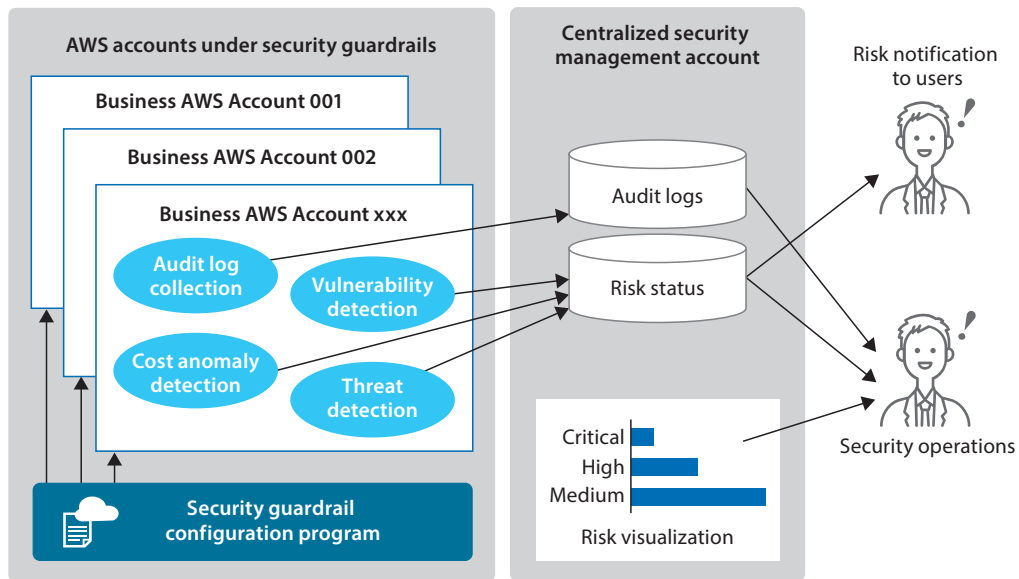
Large-scale menu usage model



Private network menu usage model

5. Digital Solutions

5.5 Secure and Efficient Cloud Operations Applying Security Guardrails



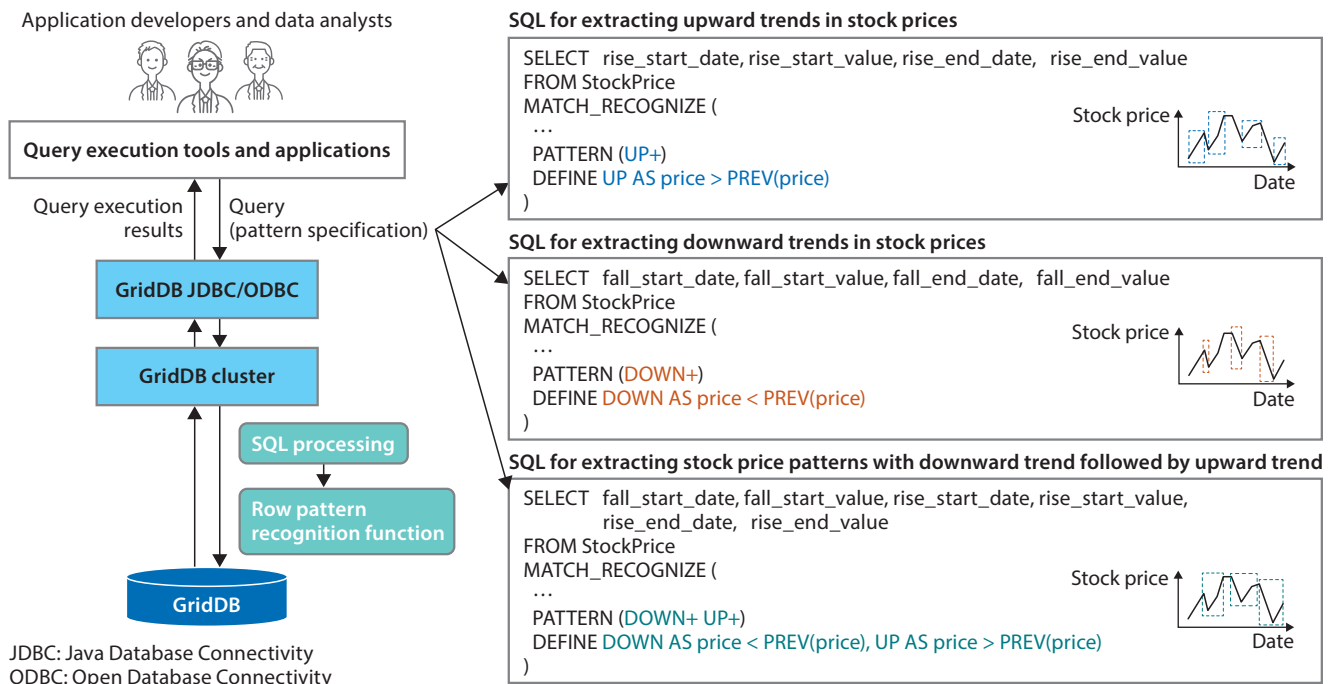
Organizational cloud operation with security guardrails

With the rapid expansion of public cloud services, effective countermeasures against security risks have become increasingly complex, and addressing these risks has emerged as a critical issue that directly affects business continuity. To address this challenge, Toshiba Corporation has developed “Toshiba Security Guardrails for AWS,” a framework designed to consistently apply standardized security configurations across multiple Amazon Web Services (AWS) accounts widely used within the Toshiba Group. By leveraging AWS-native security services and APIs, Toshiba Security Guardrails for AWS automates the configuration of audit log collection, vulnerability and threat detection, and cost anomaly detection, thereby reducing the risk of human error. It ensures the consistent enforcement of mandatory security controls for cloud-specific identity and access management, storage, network firewalls, and application vulnerability monitoring. As a result, AWS users are relieved of the burden of designing individual security controls, enabling them to focus on their core business activities.

Furthermore, by utilizing a centralized security management account that aggregates security-related data, Toshiba Security Guardrails for AWS enables organization-wide visibility, continuous monitoring, and remediation of security risks across a large number of AWS accounts. It can be applied not only to newly created accounts but also semi-automatically to existing environments. We will continue to enhance the framework to further strengthen organization-wide security and governance in cloud operations.

5. Digital Solutions

5.6 GridDB 5.9EE for Automating Anomaly Detection and Trend Extraction Using Time-Series Data



Time-series pattern recognition using GridDB 5.9EE

In recent years, there has been a growing need to automate anomaly detection and trend extraction through the application of pattern recognition to fluctuating time-series data, such as IoT sensor data and stock prices in financial markets. In response, Toshiba Corporation has implemented the row pattern recognition feature defined in the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 9075:2016 standard (also known as SQL:2016) in GridDB 5.9EE, a database designed for big data and IoT applications. This feature enables the extraction of continuous value changes and user-specified patterns, such as uptrends, downtrends, and cyclic behavior, using only Structured Query Language (SQL), without the need for external tools.

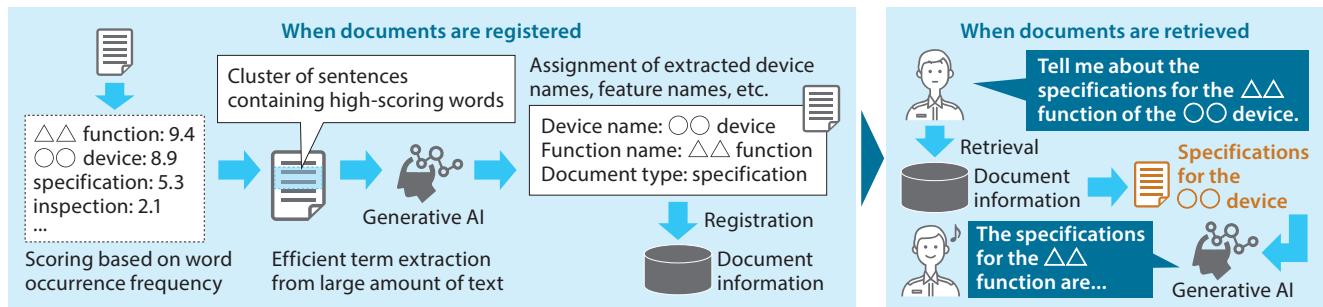
User-defined patterns are encoded in a format suitable for regular-expression processing, and matching segments within time-series data are efficiently extracted by combining high-speed sorting with streaming processing. Specifically, the sorting step prepares the data for sequential evaluation, while the streaming processing step scans the data to extract the segments that match the specified pattern. By leveraging a regular-expression-based pattern matching algorithm together with proprietary in-memory processing technology, GridDB 5.9EE achieves high-speed, memory-efficient pattern recognition even for large-scale time-series datasets.

Going forward, we will continue to expand support for a wider range of time-series analyses and further improve performance.

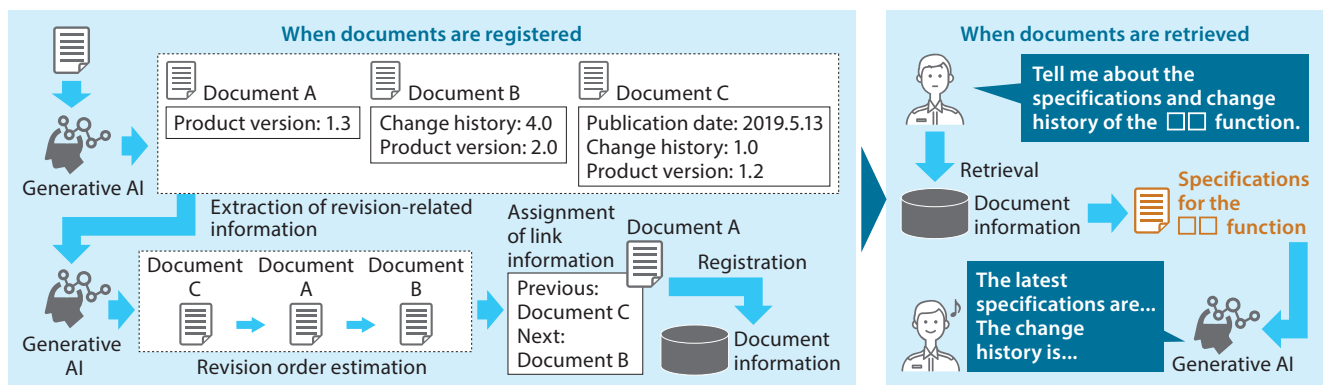
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5. Digital Solutions

5.7 Document Filtering Technologies for Improving RAG Accuracy



Automatic key phrase extraction from documents



Document revision order estimation

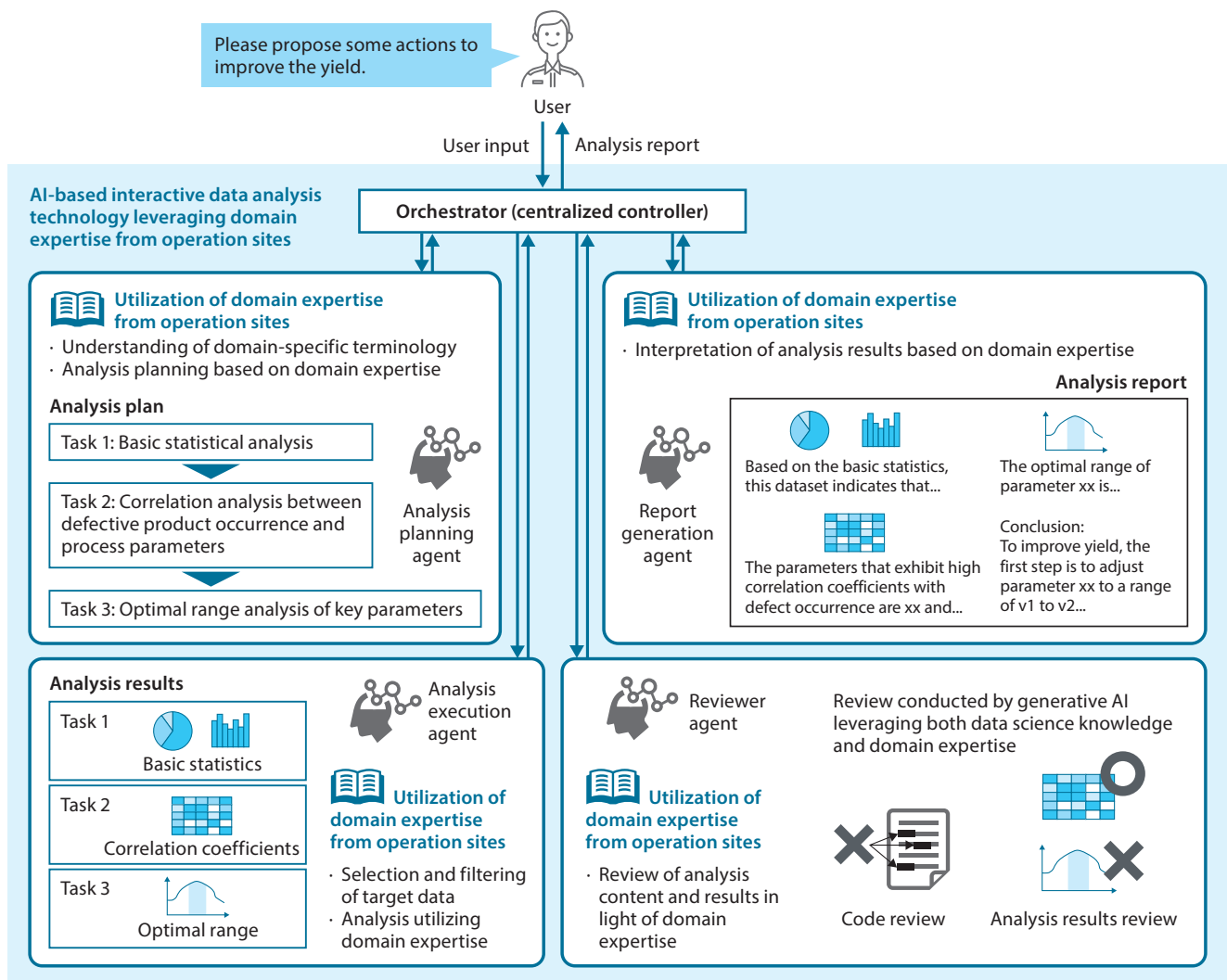
In recent years, efforts to improve work efficiency have been accelerating through the application of emerging generative artificial intelligence (AI) technologies that extract knowledge and know-how from accumulated corporate documents. However, improving the quality of generative AI responses requires the accurate extraction of relevant information from vast volumes of documents, which is difficult to achieve with simple full-text search methods.

To address this issue, Toshiba Corporation has developed two document retrieval technologies based on retrieval-augmented generation (RAG) to improve information retrieval accuracy, thereby enhancing the relevance of results returned in response to user queries. The first technology identifies sections of documents in which key terms (such as device and function names) frequently appear, automatically extracts these terms, and attaches them to the documents as tags. This enables retrieval of only those documents containing the specified terms. The second technology estimates the chronological order of updates across different document revisions based on related information within the documents (such as publication dates and change histories), and attaches this information as links, enabling access to the latest information and change details.

Going forward, we will verify the effectiveness of these technologies in real-world business operations and expand their deployment to generative AI applications provided by the Toshiba Group.

5. Digital Solutions

5.8 Generative AI–Based Interactive Data Analysis Leveraging Domain Expertise from Operation Sites



Overview of interactive data analysis technology powered by generative AI

In the manufacturing and social infrastructure domains, a wide variety of data are collected daily from operation sites. However, due to a shortage of specialized personnel, such data are not fully utilized through business intelligence (BI) tools, and many manufacturing and infrastructure operations still rely heavily on tacit knowledge.

To address this issue, Toshiba Corporation has developed an interactive data analysis technology that applies generative AI, enabling users to assess on-site conditions using natural language and to identify deviations from normal conditions as well as obtain key insights. An AI agent autonomously performs the entire analysis process, from planning through execution. Consequently, users are not required to possess specialized data analysis expertise or design analytical procedures, and can perform analyses using simple, high-level instructions.

Furthermore, the new system leverages domain-specific knowledge accumulated at opera-

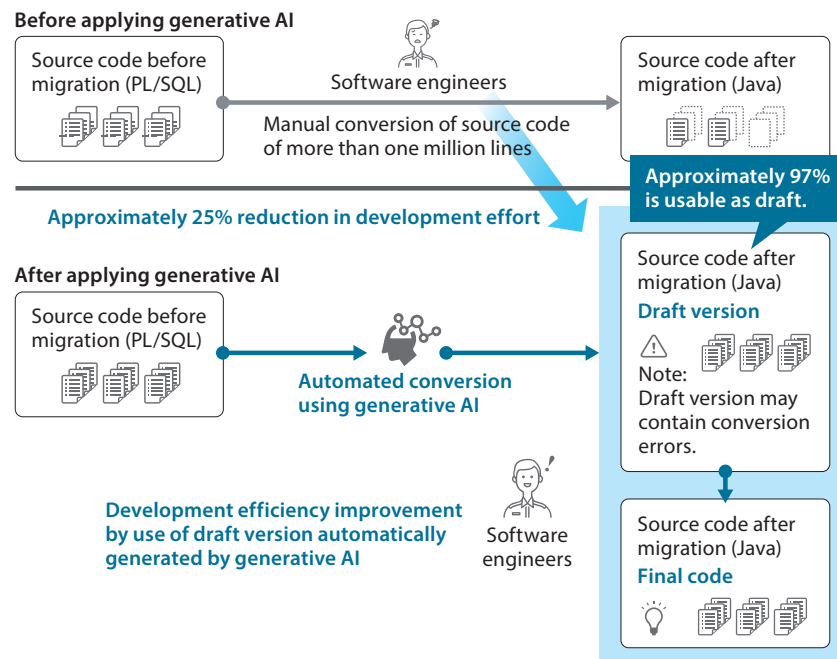
5. Digital Solutions

tion sites, such as manuals and reports, through RAG, and incorporates it into both the analysis process and the explanation of results. This enables the system to deliver more convincing analysis outcomes and provide explanations that better support decision-making.

Going forward, we will apply this technology to use cases such as factory data visualization and contribute to advancing DX in the manufacturing and social infrastructure domains.

5. Digital Solutions

5.9 Improved Efficiency in Large-Scale Package Software Migration Using Generative AI



Application of generative AI to software migration development

The Toshiba Group has been advancing the development and deployment of technologies that leverage generative AI to streamline software development processes and has conducted various hypothesis-driven evaluations to date.

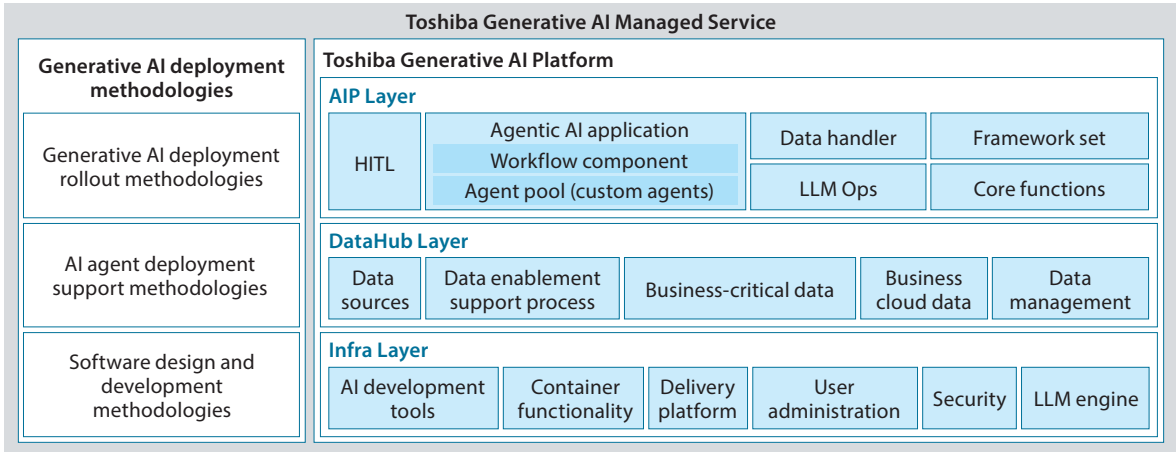
One use case of such technologies is software migration, which involves transferring existing systems and source code to new environments. In general, software migration requires substantial effort due to the need to rewrite large volumes of legacy source code. To address this issue, we applied generative AI to automate source code conversion and improve the efficiency of code rewriting. As a preliminary evaluation, we conducted a case study involving the conversion of source code written in PL/SQL, a procedural programming language used in Oracle Database, into Java. The results indicated that approximately 97% of the source code generated by generative AI was of sufficient quality to be used as a draft version, and that the use of generative AI can potentially reduce the development effort required in the implementation phase by approximately 25%.

This technology is currently being applied to the migration of our in-house large-scale package software to improve development efficiency.

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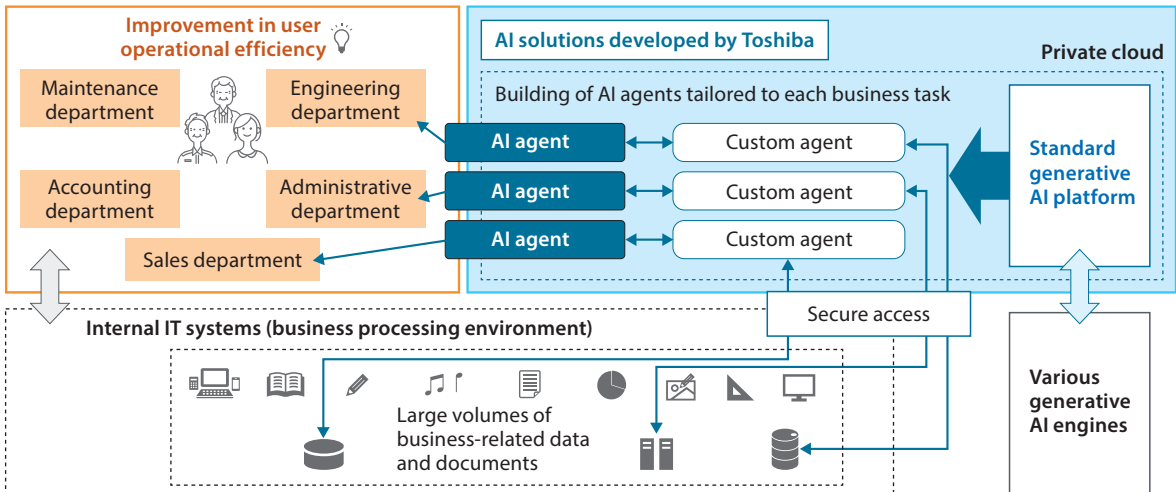
5. Digital Solutions

5.10 Toshiba Generative AI Platform for Rapid Implementation of DX Solutions



HITL: human-in-the-loop LLM: large language model Ops: operations

Architecture of Toshiba Generative AI Platform and Toshiba Generative AI Managed Service



Examples of solution implementations using Toshiba Generative AI Platform

In recent years, demand for a wide range of business support applications utilizing generative AI has rapidly increased, including business process automation, knowledge transfer, frequently asked question (FAQ) generation, and document search and summarization. These applications leverage generative AI in conjunction with diverse data sources, including internal information technology (IT) systems and cloud environments.

To address these needs and enable the rapid and secure promotion of enterprise DX, Toshiba Corporation has developed the Toshiba Generative AI Platform, which consists of three layers: (1) the AI Platform (AIP) Layer, which provides functions for implementing generative AI solutions; (2) the DataHub Layer, which enables centralized data management; and (3) the Infra Layer, which provides core capabilities and tenant-specific execution environments. The

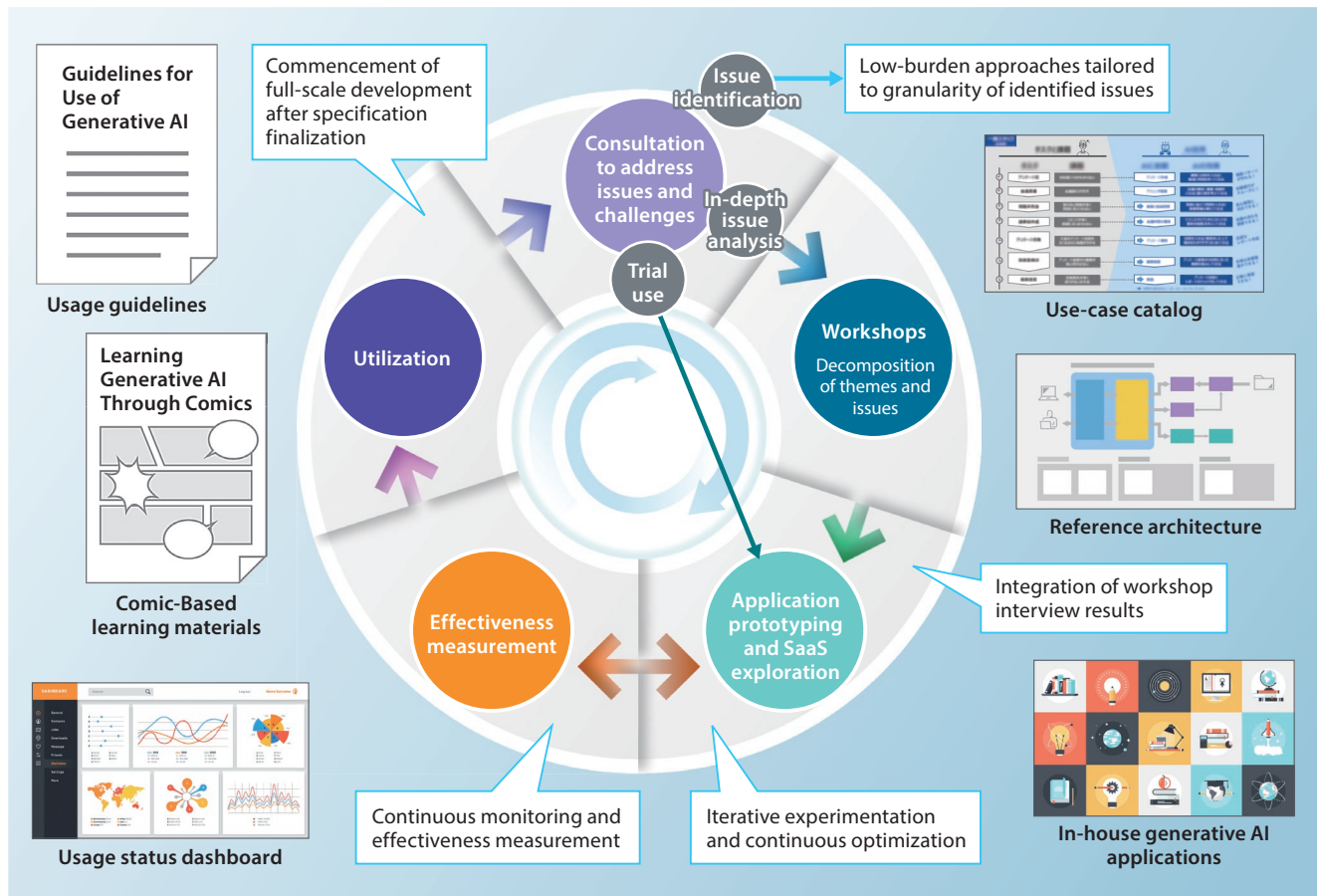
5. Digital Solutions

platform enables the development and execution of AI agent applications tailored to target business operations by utilizing no-code/low-code tools and pro-code environments.

By leveraging the Toshiba Generative AI Platform and generative AI deployment methodologies, we provide the Toshiba Generative AI Managed Service, enabling the rapid and sustainable delivery of AI solutions tailored to customers' business needs and existing systems.

5. Digital Solutions

5.11 Initiatives to Accelerate Adoption of Generative AI



SaaS: software as a service

Generative AI utilization lifecycle

To realize the “Toshiba Revitalization Plan” and thereby enhance profitability, the Toshiba Group has deployed a generative AI service to support the business operations of its approximately 20 000 employees. In addition, we have launched a generative AI promotion project under the vision of “supporting safe, secure, and sustainable social infrastructure through the integration of diverse data and knowledge enabled by generative AI,” thereby driving business transformation and improving productivity and creativity.

This project has been designed to provide a toolset across the product lifecycle for piloting generative AI, based on iterative experimentation and continuous optimization. Starting with consultations for user departments, the project organizes workshops to formalize solutions to company-wide challenges, and has developed more than 40 applications that leverage generative AI and are tailored to internal business expertise (hereinafter “in-house generative AI applications”). The effectiveness of these applications has also been verified.

For example, a document-checking tool interprets specifications in requests for proposal (RFPs) and is expected to reduce the workload required for preparing quotation responses by approximately 20% compared with conventional methods. A form-reading application auto-

5. Digital Solutions

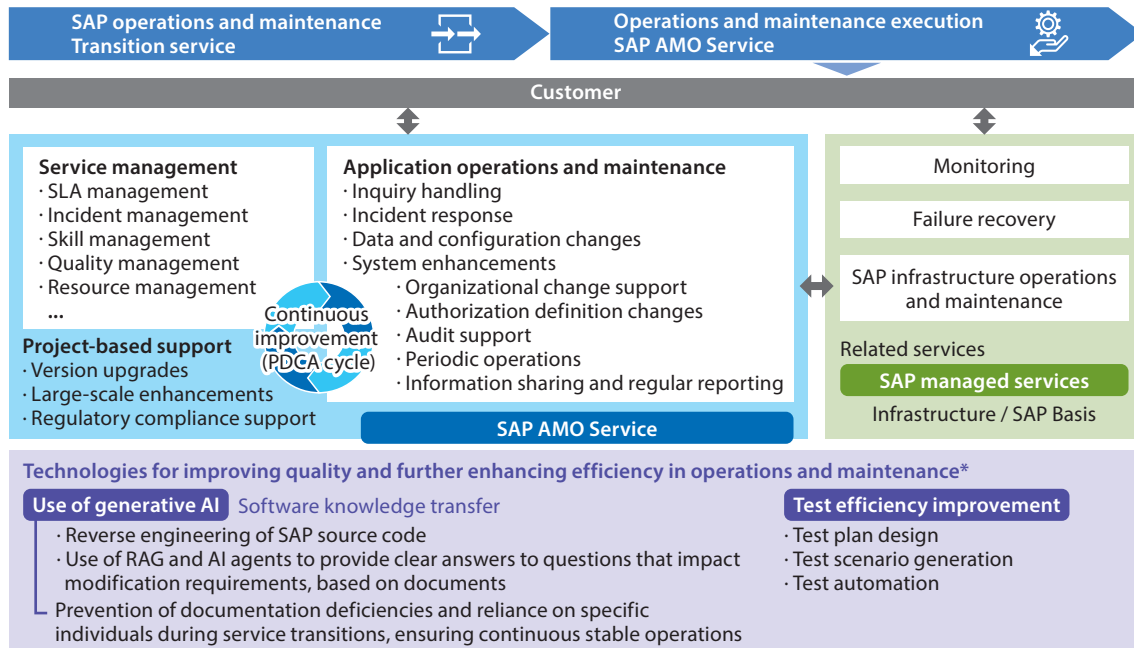
mates approximately 4 000 form-processing tasks per month. In addition, we have developed dashboards to monitor usage trends and measure the effectiveness of in-house generative AI applications and external generative AI services, enabling both quantitative and qualitative evaluation.

Furthermore, we have established guidelines for the use of generative AI to promote awareness and literacy through seminars and comic-based learning materials. In addition, we have developed a use-case catalog to help users envision practical applications of generative AI. For software development, we have also organized efficient use cases and defined reference architectures to facilitate the development of in-house generative AI applications and promote understanding of their effective use.

Since 2025, this project has been integrated with the technical assets of the Corporate Research & Development Center to align business challenges with applicable technologies and to accelerate the deployment of technological outcomes into business operations. To further enhance corporate competitiveness, we will leverage generative AI to promote business transformation by streamlining and automating software development and business processes, embedding the routine use of AI agents into operations and strengthening the implementation of generative AI in products and services.

5. Digital Solutions

5.12 Newly Released SAP Application Management Services



SLA: service-level agreement

* Planned for implementation in the SAP AMO Service

Overall SAP operations and maintenance service framework

Stable operation of SAP systems^(*), which support core business functions, is critical, as it directly affects business continuity and sustainable growth. However, many organizations face challenges such as shortages of SAP expertise and resources, reliance on specific individuals, and black-boxed system environments, all of which increase risks related to maintainability, stability, and future scalability.

To address these issues, Toshiba Corporation has launched two services—the SAP Operations and Maintenance Transition Service and the SAP Application Management Outsourcing (AMO) Service—designed to support the stable operation and continuous evolution of SAP environments. These services leverage our extensive experience in the implementation and operation of core business systems, as well as our advanced expertise in SAP Enterprise Asset Management (EAM) and SAP Enterprise Resource Planning (ERP) template deployments.

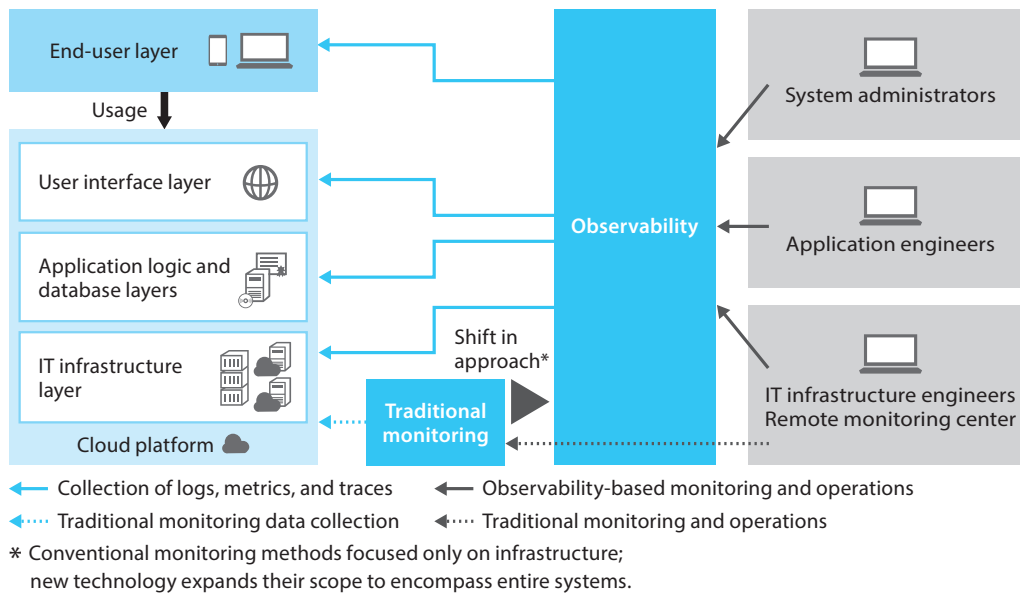
The SAP Operations and Maintenance Transition Service ensures a smooth and reliable transition by systematically evaluating the current operational status, visualizing and improving black-boxed environments, and performing operational validation, regardless of whether the original system was implemented in-house or by a third-party vendor. The SAP AMO Service delivers high-quality and efficient operations by comprehensively supporting inquiry handling, incident handling, system changes, and routine tasks, while enabling continuous improvement through a PDCA (Plan-Do-Check-Act) cycle to meet customer needs.

(*) SAP is an integrated enterprise resource planning system provided by SAP SE.

SAP is a registered trademark or trademark of SAP SE in Germany and other countries.

5. Digital Solutions

5.13 Observability Technology for Simplifying Operations of Increasingly Distributed Information Systems in AI and Cloud Environments



Differences between traditional information system monitoring and modern observability-based monitoring approaches

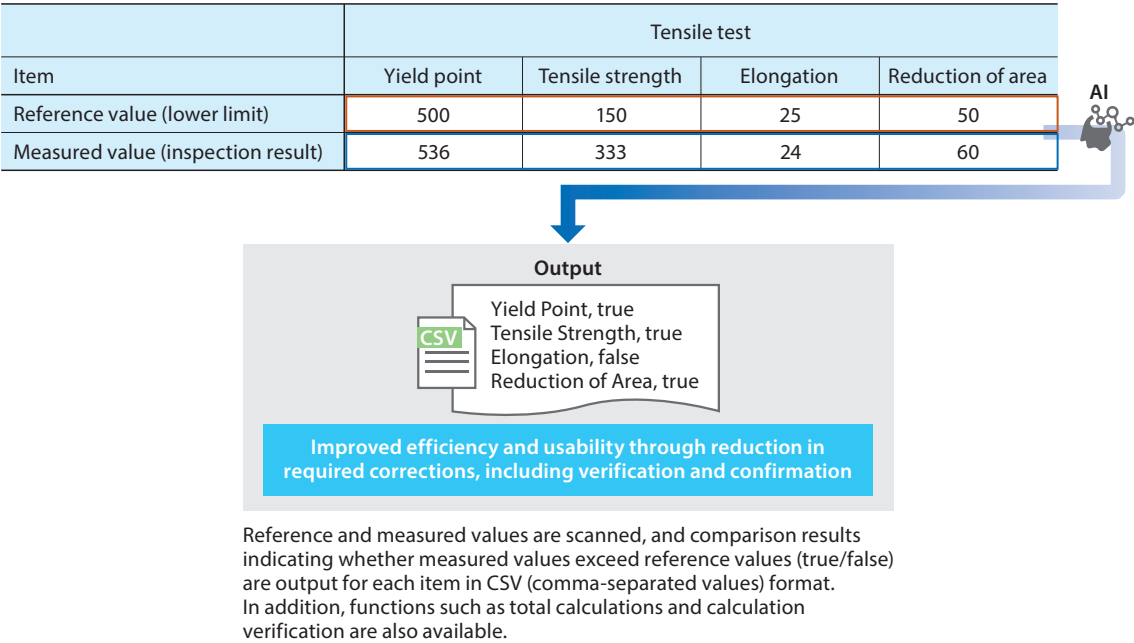
With the widespread adoption of generative AI and cloud environments, information systems are increasingly adopting microservices architectures and diverse technology stacks. As a result, applications and IT infrastructure have become highly distributed and complex, making it difficult to respond promptly to incidents and to identify their root causes using conventional monitoring methods. Consequently, addressing these operational challenges has become a critical issue.

In this context, Toshiba Corporation has incorporated observability technology into the monitoring functions of its managed services, which support the operation of information systems deployed in multi-cloud and hybrid-cloud environments. This technology enables the centralized collection and analysis of logs, metrics, and traces representing internal system states, thereby simplifying overall operations and enhancing system observability. It extends visibility beyond the IT infrastructure layer to include application performance and error conditions, as well as end-user behavior. These capabilities enable real-time incident response and root-cause analysis.

This technology was first adopted in general-purpose cloud platforms and has since been extended to the Toshiba Group's initiatives promoting the use of generative AI. In addition, its scope of application has been expanded beyond our cloud service offerings to include on-premises information systems operating within closed network environments.

5. Digital Solutions

5.14 AI OCR Synchro+: High-Accuracy AI-Based Document Scanning Service for Enhancing Operational Efficiency and Data Utilization



Application example for enhanced OCR result checking function

AI OCR Synchro+ is a deep learning-based optical character recognition (OCR) service designed to extract information from various documents, including invoices and slips, as well as technical documents used in design and development processes.

The service has previously provided features such as arithmetic processing of extracted data and validation of required fields. The latest release incorporates a new function for verifying relationships between two extracted data items—such as numerical values and character strings—including magnitude comparisons and consistency checks. This enhancement enables a more seamless workflow from data extraction to verification, thereby improving operational efficiency and facilitating data utilization.

In addition, the form identification function has been enhanced to enable the processing of documents with different formats without the need for prior format-based classification. Previously, forms were identified based on character strings located at specific positions; in contrast, the new approach identifies forms based on the presence or absence of pre-registered keywords across the entire document.

Going forward, we aim to expand the scope of applications by implementing features such as automatic identification of data fields and form definition support using generative AI, as well as compatibility with structured output formats such as Markdown. Through these enhancements, we seek to further improve operational efficiency and data utilization in the energy and infrastructure sectors.