# Fujitsu's Approach to Hybrid Cloud Systems

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**This paper introduces Fujitsu's approach to a hybrid cloud, which combines internal (on-premises) systems and services on public clouds. A hybrid cloud must be able to provide seamless links between a company's own business systems and services on on-premise systems or public clouds. This requires front-end integration, data integration, and process integration. Fujitsu has been providing middleware that has these three integration technologies (Interstage series of software) for some time. It has now developed middleware equipped with new functions for constructing and operating hybrid clouds. The merger of new technology for achieving hybrid clouds with previously refined integration technologies enables this middleware to promote the effective use of public clouds, which are becoming increasingly important in the corporate world, with the aim of optimizing business systems.**

## 1. Introduction

In corporate systems, hybrid cloud configurations are becoming noticeable, which means corporate systems can roughly be classified into 2 categories. In one, core business processes are kept in the on-premises side (either as silo type clouds or private clouds) of the hybrid configuration. In the other, non-core processes are migrated on to the public cloud side, as SaaS, eventually. In a hybrid cloud environment, various business systems constructed and operated so far as a conventional on-premises mode are distributed separately on on-premises systems and pubic clouds. Further, when using services newly offered by public clouds, it is necessary to combine (link) the operations on the public cloud and those of the existing business processes on the on-premises system.

In such circumstances, Fujitsu has developed middleware that can help achieve hybrid cloud systems.

In this paper, we will introduce our middleware technologies to achieve hybrid cloud systems, give a product description and describe our future approaches.

## 2. Technologies to support hybrid cloud systems

In a hybrid cloud system environment, it is essential to have seamless linkage among business systems and services scattered on the on-premises systems and public clouds. To do this, three integration technologies (front-end integration, data integration, and process integration) are necessary as indicated in **Figure 1**.

1) Front-end integration

When using business applications and services scattered on the on-premises and public clouds, this technology allows the operators in charge to efficiently carry out the processes by improving operability. This is achieved by allowing the system to be operated with an integrated single operation screen instead of

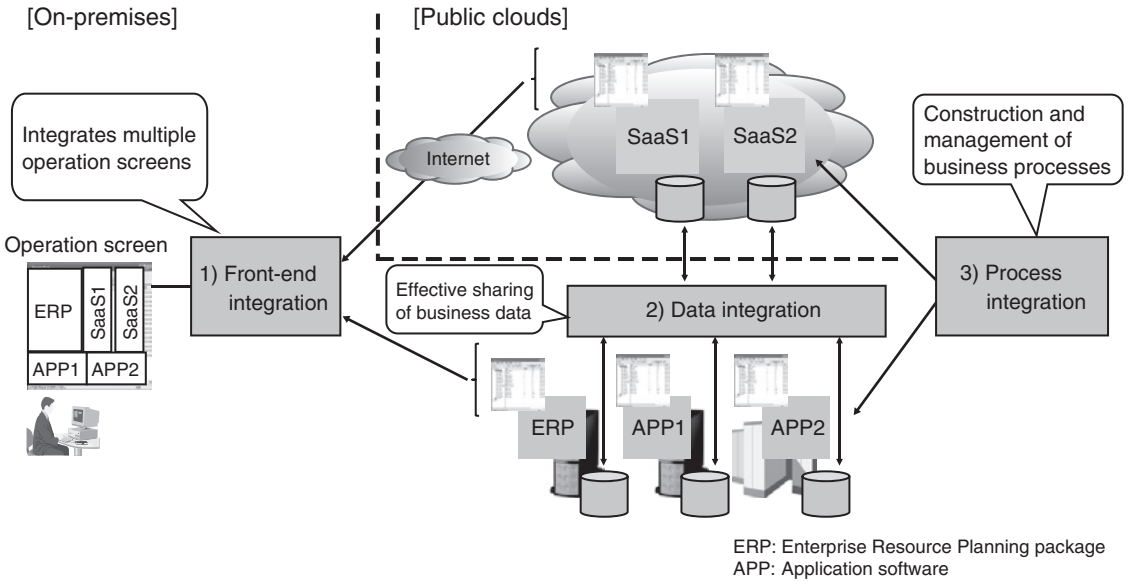


Figure 1
Hybrid cloud integration technology.

using multiple screens for each of the above-mentioned systems [1) of Figure 1].

2) Data integration

In a hybrid cloud system, business data (such as a Customer Master record and Product Master record) are managed on the on-premises systems, just as in conventional systems. This technology allows these pieces of business data to be sent to public cloud services for use, or enables data gathered on public clouds to be imported into on-premises business applications for further use [2) of Figure 1].

3) Process integration

This technology realizes comprehensive governance of the entire business. It constructs a business process that establishes a linkage between on-premises business applications and services on public clouds. Further, it constructs a business process linked with tasks requiring human decision making, such as applications and approvals [3) of Figure 1].

The middleware products developed implement these integration technologies.

In the following sections, we will give an overview of the middleware products that achieve the hybrid cloud system, the situations in which they can be used and an outline of their functions.

## 3. Front-end integration

Interstage Interaction Manager (hereafter "IIM") is offered as a product to support construction and operation of Web applications. By using IIM, it is possible (for developers) to use Ajax, a development approach of Web applications, to develop Web applications with excellent operability equivalent to those of conventional client/server style applications. It is also possible to construct an enterprise information portal by combining the existing Web applications and SaaS applications.

These technologies have drastically improved the working efficiency of personnel who use Web applications.

### 3.1 How front-end integration works in hybrid cloud with this product

In hybrid cloud systems, it may be necessary to combine multiple screens for business applications on the on-premises systems and

public clouds. However, it is troublesome for the operators in charge to simultaneously display many screens of business applications when carrying out their tasks. Besides, in most cases they have been created independently. This means such simultaneous display is very complicated because the configuration and operability of these screens are different.

If IIM is used, the operator can cut out only the necessary sections from each operation screen and integrate them in a single operation screen.

As an example usage of IIM, we will introduce an order-acceptance system for goods (**Figure 2**).

In this example, public clouds are used for the order acceptance system for goods. To carry out all of the processing for order acceptance in this company, it is necessary to combine a deal management service in public clouds, a merchandise management system in an on-premises system and a production control system. To do this, an integrated screen to process order acceptance for goods has been developed.

Client names displayed on the screen for processing order acceptance are cut out from the operation screen of the deal management system [1) in Figure 2], while specific information on goods is cut out from the product management system [2) in Figure 2]. Further, the inventory level of the goods to be ordered and the production plans are cut out from the operation screen of the production control system [3) in Figure 2]. A new operation screen is then developed by combining these cut out screens.

Operators in charge can carry out their tasks only by focusing on the new operation screens developed, without needing to worry about each business application or being aware of the location and presence of each service.

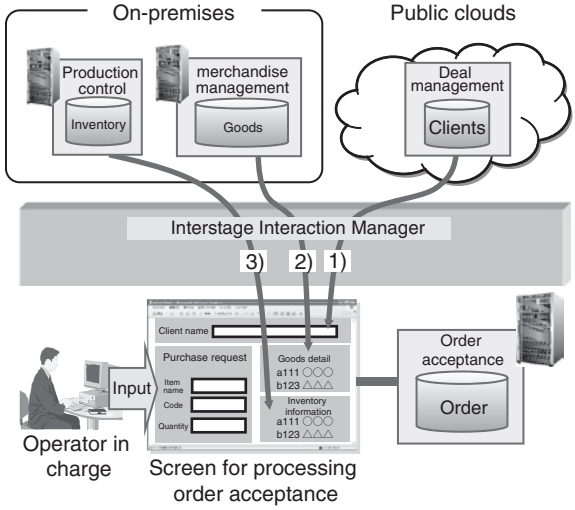


Figure 2
Order-acceptance system.

## 3.2 Functions to realize front-end integration

IIM offers Mashup Framework as a mechanism to use operation screens for on-premise business applications and public clouds services without changing the existing business systems (**Figure 3**). The main functions of these features are described below:

1) Scraping

The developer of the new operation screen can display existing screens for business applications and services on the editor screens offered by IIM. Screen information of the selected range can be saved in XLS stylesheet language transformation (XSLT) format. This is scraping. Besides, when developing an integrated operation screen, it is possible to combine and lay out the saved screen together on the new operation screen. Because a high level of freedom is allowed in the layout process, it is possible to have a screen design based on personal preference and convenience.

2) Access to distributed systems (Adaptor)

A lot of adaptors (for HTML, REST etc.) are included to obtain variable information from the operation screens of various business applications and services. The Mashup Framework issues the acquisition request to obtain screen information on behalf of Web front-end applications. With

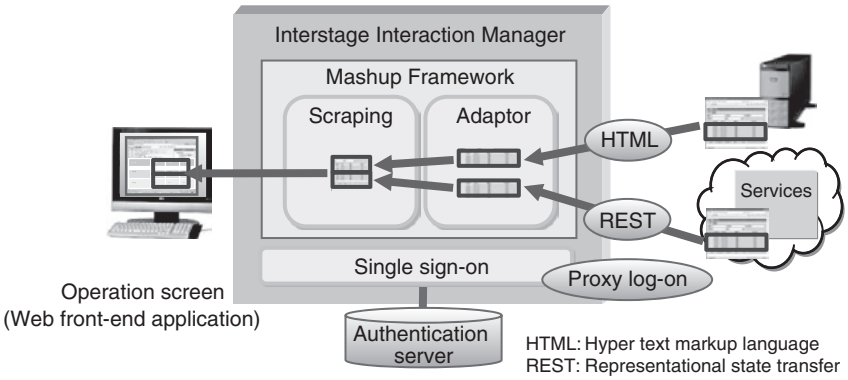


Figure 3
Mash-up framework functions of IIM.

this configuration, it is possible to eliminate cross domain restrictions which prohibit a single Web page from acquiring information from multiple servers on different domains.

3) Single sign-on

This function stands proxy for authentication servers such as lightweight directory access protocol (LDAP) and Active Directory in conducting log-on processing in linkage with these servers. Based on this function, it is possible to log in to multiple systems of on-premises or public cloud systems just by entering an ID and password once in the operation screen.

## 4. Data integration

Fujitsu offers Interstage Information Integrator (hereafter "III") as a product to support data integration. III collects and integrates data from various business systems and distributes them to the systems that utilize them.

When integrating data between on-premises and public clouds, III achieves highly reliable data linkage with high efficiency.

### 4.1 How data integration works in hybrid cloud by this product

In a hybrid cloud environment, it is essential to ensure effective sharing of business data between on-premises systems and public clouds.

In III, it is easy to construct a mechanism that allows public clouds to use the business data with high confidentiality managed by on-premises (Customer Master record, Product Master record etc.) upon transferring them to public clouds. It also allows on-premises systems to use the business data managed by public clouds by transferring them to the on-premises ones.

As examples of using III for data integration, a sales support system and a system to analyze variance between actual profit and loss and budgeted profit and loss are introduced below (**Figure 4**).

These systems use the Sales Force Automation (SFA) feature of public clouds. The sales representatives refer to the newest clients' information managed by on-premises [1) in Figure 4]. Further, the department managers analyze actual vs. budget variance by comparing everal sets of data, that is to say the deal information entered by the sales representatives, the actual and budget information managed by on-premises systems [2) in Figure 4], etc. By using III, mutual sharing of data between on-premises systems (customer information) and public clouds (deal information) can be achieved.

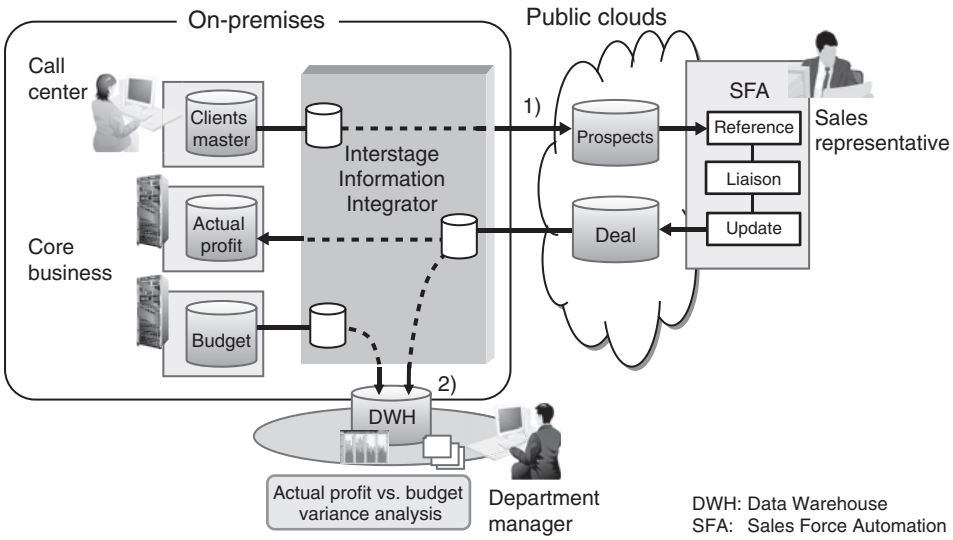


Figure 4
Sales force automation and analysis systems.

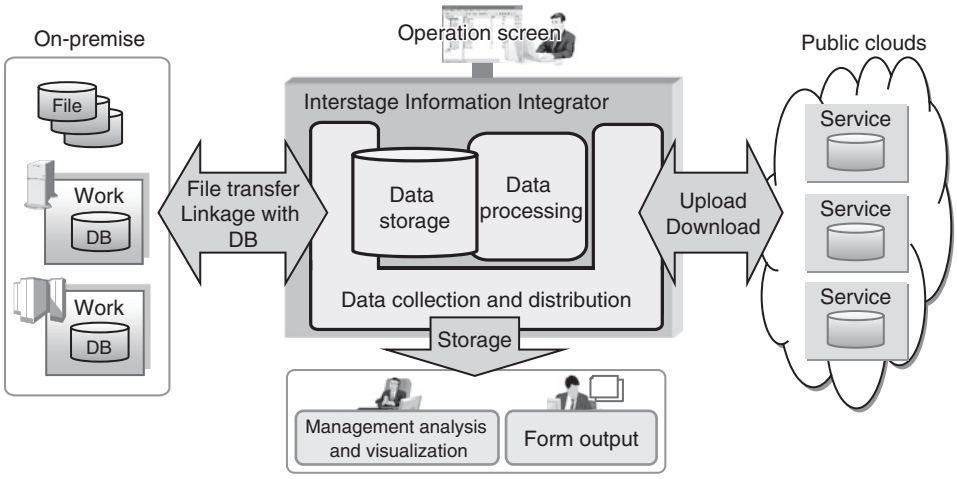


Figure 5
Data Integration functions of III.

## 4.2 Functions to realize data integration

Because on-premises systems and public clouds are connected via the Internet, the quality of transmission over the network may be unstable or the actual speed of communication may be restricted sometimes. III addresses these issues by offering highly reliable and efficient data integration functions (**Figure 5**). The functions to realize the data integration are described below:

1) Data collection and distribution

Various adaptors (various types of file transmission, database linkage, public clouds linkage etc.) are available so that they can cope with the data transmission modes of existing business systems. Further, to minimize the volume of data transmission, III can detect the changes in the data used in business processes in question and transfer only the portion with changes to the destination systems (incremental

transmission). Besides, to ensure synchronized data transmission between business systems, verification of transmission and resend processing can be done automatically.

2) Data storage

The method and unit of transmitting data and the time period available for data transmission depend on each business system. To cover all these diverse operations, the business process data can be once stored or saved on III. The business process data in storage can be taken out by users at the necessary timing by the necessary units.

3) Data processing

To change data into a data format suitable for each usage, various processing functions (code transformation, sorting, merging, four arithmetic operations, trimming etc.) are available in III. Besides, matching function between the data of transactions and master data records as well as in-advance data classification based on destinations of transfer are in place. These functions run very quickly based on technologies such as simultaneous matching among master data records, and ultra-high-speed batch decision on multiple rules.

## 5. Process integration

Fujitsu offers Interstage Business Process Manager (hereafter "IBPM") as a product to construct and manage business processes. IBPM allows tasks to be visualized and improves task efficiency by defining and conducting both the processing done on computers and manual work such as reception, review and approval (**Figure 6**).

### 5.1 How process integration works in hybrid cloud with this product

You can run front-end business processes on public clouds and back-end processing on on-premises systems.

The example in the following paragraph indicates a business process in which insurers pay an insurance (**Figure 7**).

The front-end business processes such as reception, review and approval are carried out by using public cloud services. By using IBPM, on-premises business processes are carried out automatically in linkage with the execution of front-end business processing. It realizes a unified management of the entire business process that encompasses both public clouds and on-premises ones [1) in Figure 7]. Further, because the execution logs (when, who, what)

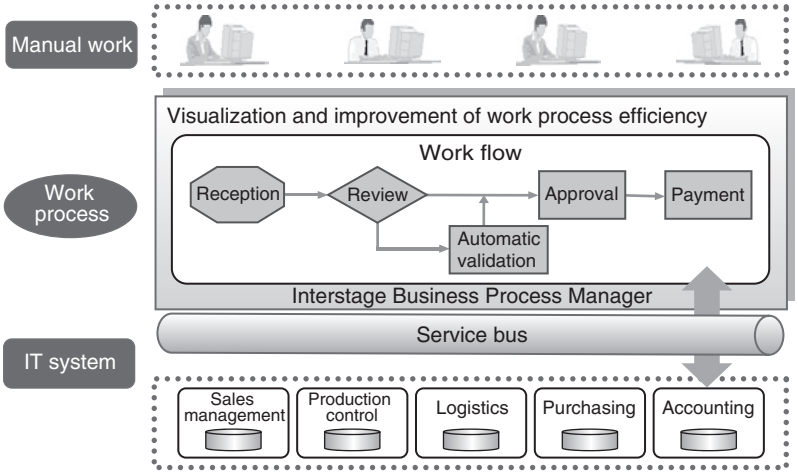


Figure 6
Process integration by IBPM.

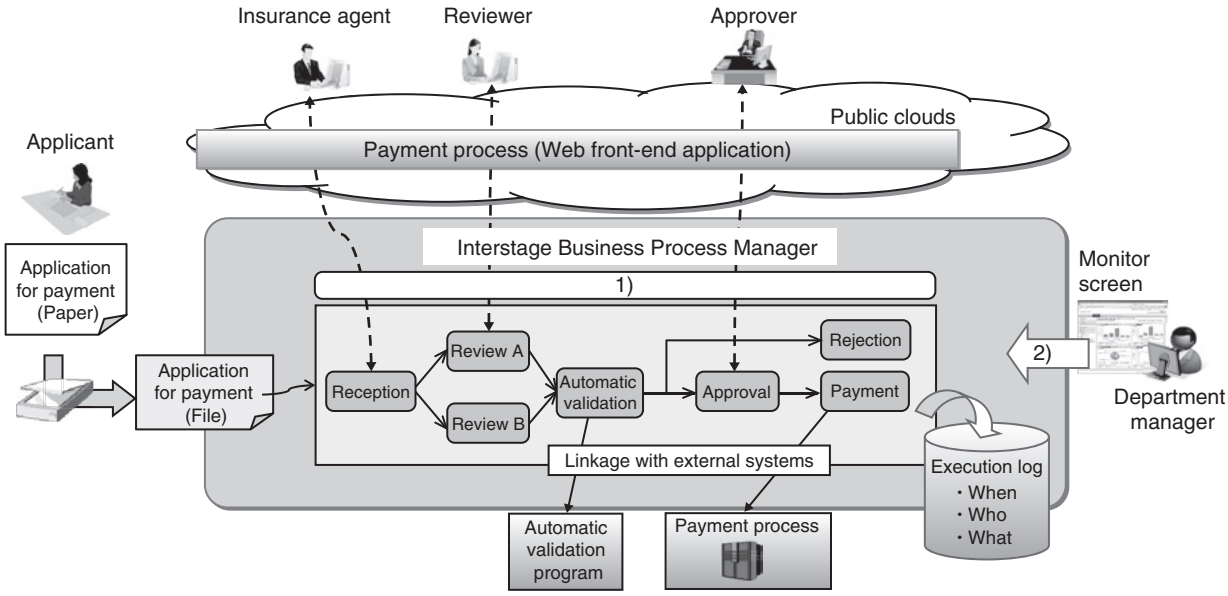


Figure 7
Insurance payment process.

are registered automatically, department managers can confirm the progress of work with their monitor screen, assign the most suitable personnel to each task and give directions to change business processes if required [2) in Figure 7].

## 5.2 Functions to realize process integration

Even if the front-end business processes managed by public clouds and the processing of business processes by on-premises ones are scattered, they can be conducted and visualized in a unified manner as an entire business process. Besides, it is possible to detect and mitigate bottlenecks of the business processes at an early stage. The functions to realize these features are described below:

1) Process management

By using IBPM, atypical tasks requiring human decision making can be integrated in the business processes in addition to the typical tasks.

For instance, making a decision for approval or rejection may be determined based on majority vote by multiple approvers. If approval processing does not progress for a specific duration, escalation of the approving occurs automatically. In this way, human decision making can be integrated in the business processes.

2) Monitoring

The estimated number of days necessary to execute a business process is set in advance, and the level of deviation from the set period can be monitored and measured. By using this logic, it is possible to issue alerts automatically upon detecting any deviation from the pre-set key performance indicator (KPI) such as amount of money and number of days.

3) Simulation

It is possible to simulate the suggested improvement for business processes. Values indicating the current situation such as number of completed cases, time spent on a case and number of steps required can be calculated from the execution logs of business processes. By using these parameters, effects of improvement can be estimated based on the business processes carried out with an improved design.

## 6. Approaches in future

In future, the application scope of public clouds will expand from non-core business processes to core business processes. Along with this, public clouds will need to be more reliable and safe, as on-premise systems are. Fujitsu has two approaches to ensure reliability and safety in our middleware that realizes hybrid cloud systems as shown below.

1) High-speed, high-reliability data communication

Because on-premises and public clouds are connected via the Internet, the quality of the network may be unstable. If the volume of data transmission increases in future, issues related to transmission time and assurance of reliability may occur. Therefore, a transmission technology with a data assurance mechanism is necessary to achieve higher efficiency than the conventional level.

2) Countermeasure to information leakage

With increasing opportunities to execute core business on public clouds, opportunities to use business data including private information and confidential information on public clouds will increase, too. In addition to the conventional approaches to exporting data to public clouds centered on ciphering and masking, an approach to minimize risks is necessary by allowing the public clouds to use business process data while retaining such data within the internal system.

To put these technologies to practical use, they are being designed and validated currently. We plan to offer these features from the next version on.

## 7. Conclusion

In this paper, we mainly introduced the integration technologies for middleware to achieve hybrid cloud systems.

Many enterprises have urgent needs to use public clouds to thoroughly reduce costs and speed up management. The application scope of public clouds will expand from non-core businesses to core businesses. To address these changes in ICT systems, we are committed to launching middleware that integrates advanced technologies in a timely manner, based on our technologies nurtured in the construction and operation of on-premise business systems.

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