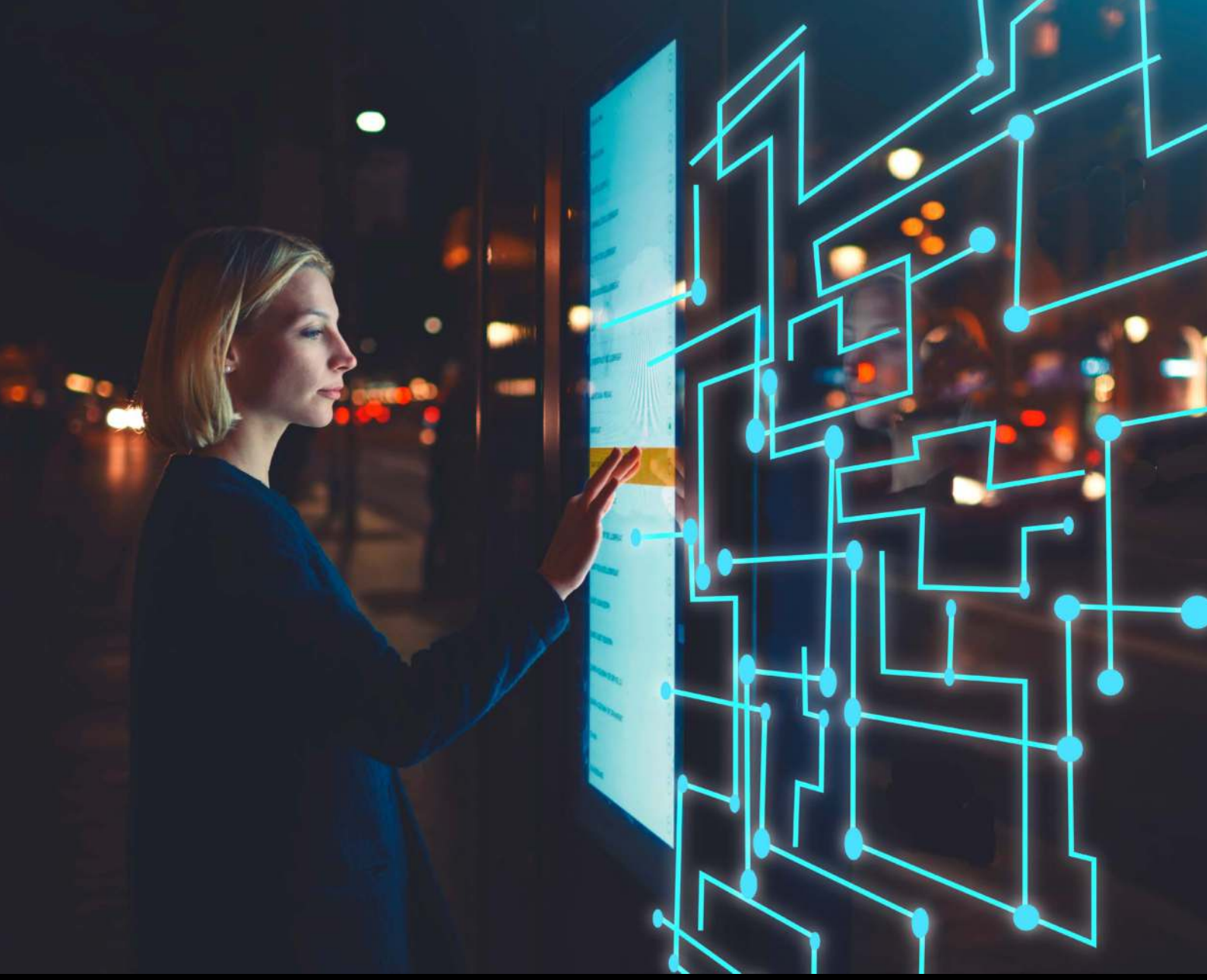

Hybrid Integration

CIO Guide: Process and Data Integration in Hybrid Landscapes

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Executive Summary

Integration becomes the key enabler for intelligent enterprises. SAP pursues the goal of **making integration in cloud and hybrid landscapes easy** and simple. If this sounds familiar, you may have read "CIO Guide: SAP Vision for Integrating SAP Applications in Cloud and Hybrid Environments." This document is a step on the way toward realizing that vision and serves as a snapshot of where process and data integration in hybrid environments are now.

Integration is the key enabler for the Intelligent Enterprise. SAP bases its integration strategy for the Intelligent Enterprise on four principles: out-of-the-box integration, open integration, holistic integration, and AI-driven integration. SAP provides prepackaged, out-of-the-box integration content for SAP® applications and is open to any third-party integration. With SAP Cloud Platform Integration Suite and SAP HANA® Data Management Suite, SAP provides the needed technologies for all types of integration use cases. This holistic coverage of integration is complemented by the integration solution advisory methodology that helps enterprise architects shape the integration strategy for their organizations. Besides embedding intelligence into business processes, SAP uses artificial intelligence and machine learning to simplify the development of integration scenarios.

This guide provides guidance on when to use which integration service or technology in a hybrid integration landscape. For process integration, it guides integration architects on when to use the SAP Cloud Platform Integration service, when to use SAP Process Orchestration software, and when to combine the two. They can be combined either with each other or with related integration technologies, such as the SAP Application Interface Framework tool. In addition, further services of SAP Cloud Platform Integration Suite, such as the SAP Cloud Platform API Management service, the SAP Cloud Platform Open Connectors service, and the SAP Cloud Platform Enterprise Messaging service, are discussed.

These considerations extend from application-to-application (A2A) integration to the equally important field of business-to-business (B2B) integration. This document delivers a concise introduction to the SAP Ariba® Cloud Integration Gateway solution that is based on SAP Cloud Platform Integration. This guide also contains a detailed introduction to the SAP Cloud Platform Integration Advisor service. The service uses machine learning techniques to improve the efficiency of building A2A and B2B integrations by making intelligent proposals for customized interfaces and mappings. In this way, the service demonstrates how integration becomes a key enabler for the Intelligent Enterprise – and vice versa.

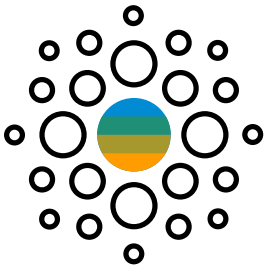
A summary of data integration approaches and technologies serves as an introduction to the SAP Data Hub solution, a major pillar of SAP HANA Data Management Suite. Existing customer investments in technologies are respected, including investments in SAP Data Services software, SAP Landscape Transformation Replication Server, SAP HANA smart data integration, and the SAP Cloud Platform Smart Data Integration service. SAP Data Hub builds on these investments. This guide gives integration architects explicit guidance on when to use SAP Cloud Platform Integration, when to use SAP Data Hub, and how to combine the technologies for scenarios that include process- and data-centric integration aspects.

Probably one of the most pressing topics for many customers is the integration and transition paths between SAP Business Suite applications, the on-premise version of SAP S/4HANA®, and SAP S/4HANA Cloud. This trio and its relationship to cloud-based solutions such as SAP Concur® solutions or SAP SuccessFactors® solutions are dealt with in a separate section. That section provides clear guidance on how to integrate the different possible combinations and which transition path to take for which purpose.

Finally, the guide provides insights into the new Cloud Integration Automation service that aims to automate the configuration of prepackaged integration scenarios in a hybrid customer landscape. The service turns manual configuration steps into structured processes guided by semiautomatic workflows. It leverages all relevant information from all concerned integration targets, the customer system landscape, and the user roles involved.

Since the first version of this document, some sections have undergone updates. Also, the following topics have been added: SAP Cloud Platform Open Connectors, SAP Cloud Platform Enterprise Messaging, UX Integration (focused on OData provisioning), and End-to-End Integration Monitoring.

As pointed out above, you should consider this document a snapshot of a step along the way toward realizing the vision for integration advanced by SAP. Updates and additional documents marking the next steps along the way may be provided.

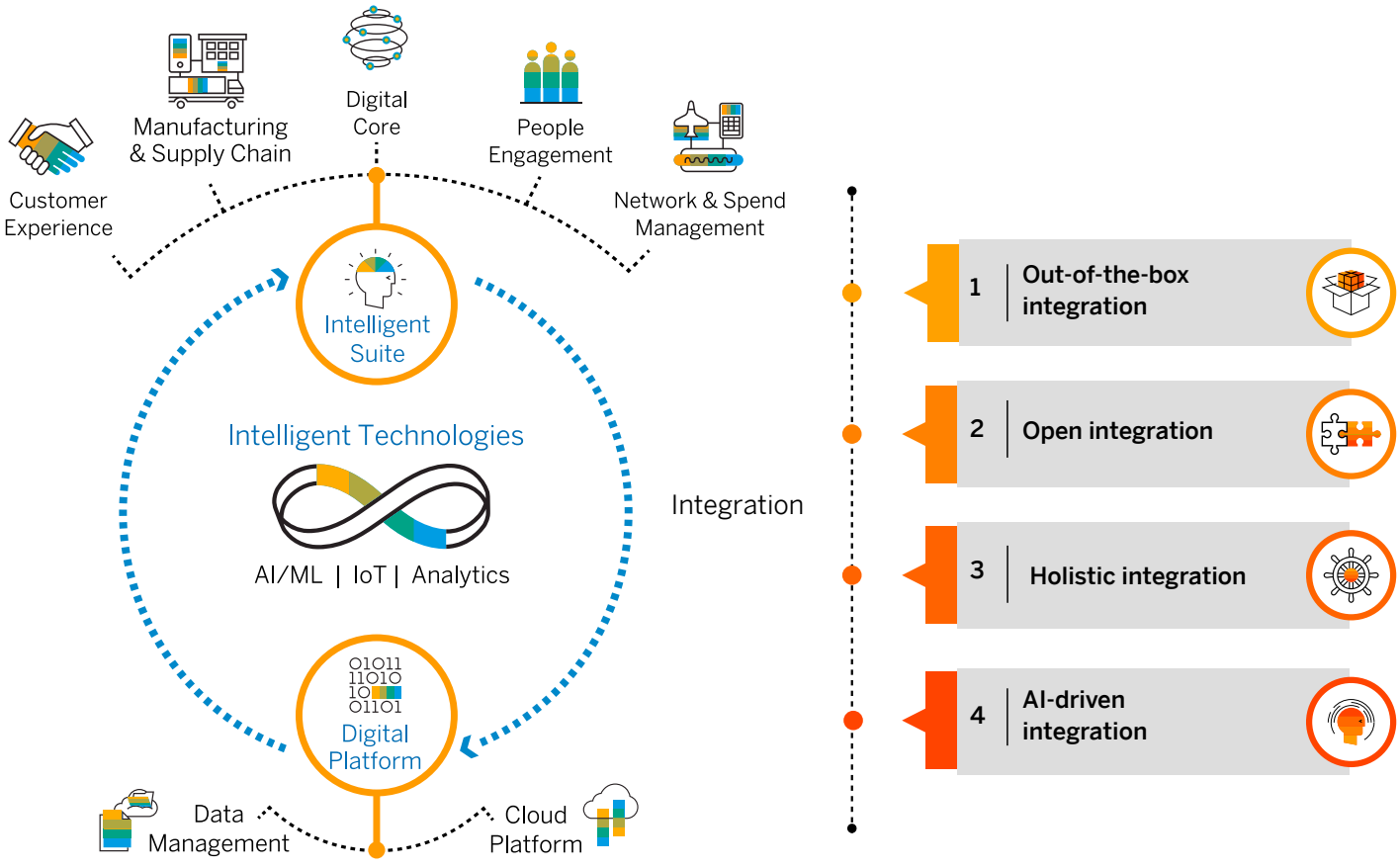


SAP bases its integration strategy for the Intelligent Enterprise on **four principles**: out-of-the-box integration, open integration, holistic integration, and AI-driven integration.

Introduction

Integration becomes the key enabler for intelligent enterprises. The holistic integration of processes, data, business partners, people, and physical assets such as sensors or machines builds the foundation for next-generation, intelligent enterprises.[1] As technologies, such as artificial intelligence, machine learning, and the Internet of Things (IoT), become mainstream, SAP will help turn its customers' businesses into intelligent enterprises with new capabilities that enable their workforces to focus on higher-value outcomes. To help businesses become intelligent enterprises, SAP provides three essential components (see Figure 1). With the intelligent suite, SAP provides modular and integrated applications that enable enterprises to automate their business processes and better interact with their customers, suppliers, and employees. These applications will be industry specific, global, and applicable to large, small, and midsize enterprises. SAP is embedding intelligent technologies into the core processes, enabling its customers to use their data to detect patterns, predict outcomes, and suggest actions. SAP Cloud Platform and SAP HANA Data Management Suite together build the digital platform that facilitates the integration and extension of processes as well as the collection, integration, and orchestration of data within the Intelligent Enterprise.

Figure 1: The Four Main Integration Principles to Enable the Intelligent Enterprise[1]



1. "The Intelligent Enterprise"

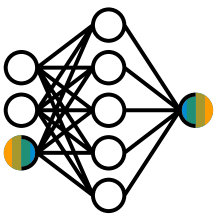
Full end-to-end integration is the key enabler for the Intelligent Enterprise and therefore a crucial pillar of SAP's overall strategy. The "CIO Guide: SAP Vision for Integrating SAP Applications in Cloud and Hybrid Environments" outlines the long-term vision of SAP, with a focus on SAP-to-SAP integration. This document complements that vision by providing enterprise and integration architects guidance on how to evolve their existing integration architectures based on the SAP offerings available today. As shown in Figure 1, the key principles of SAP's integration strategy for the intelligent enterprise include the following.

Out-of-the-box integration: SAP software supports end-to-end business processes, including out-of-the-box integrations, enabled by a standardized application and technology portfolio. Prepackaged integration content for SAP Cloud Platform Integration builds the foundation for integrating applications of the Intelligent Enterprise.

Open integration: Besides SAP-to-SAP integrations, SAP is open for any third-party integration as well as custom extensions. The foundation for open integration is based on public APIs. With the SAP Cloud Platform Open Connectors service, SAP provides feature-rich, prebuilt connectors for more than 150 non-SAP applications.

Holistic integration: SAP provides a holistic integration technology portfolio that covers all flavors of integration. Based on SAP Cloud Platform Integration Suite and SAP HANA Data Management Suite, SAP supports all types of integration use cases, ranging from process, data, user, and IoT to analytics-centric integration. A methodology helps enterprise architects shape their integration strategies, which can include integration technologies from SAP and third parties.

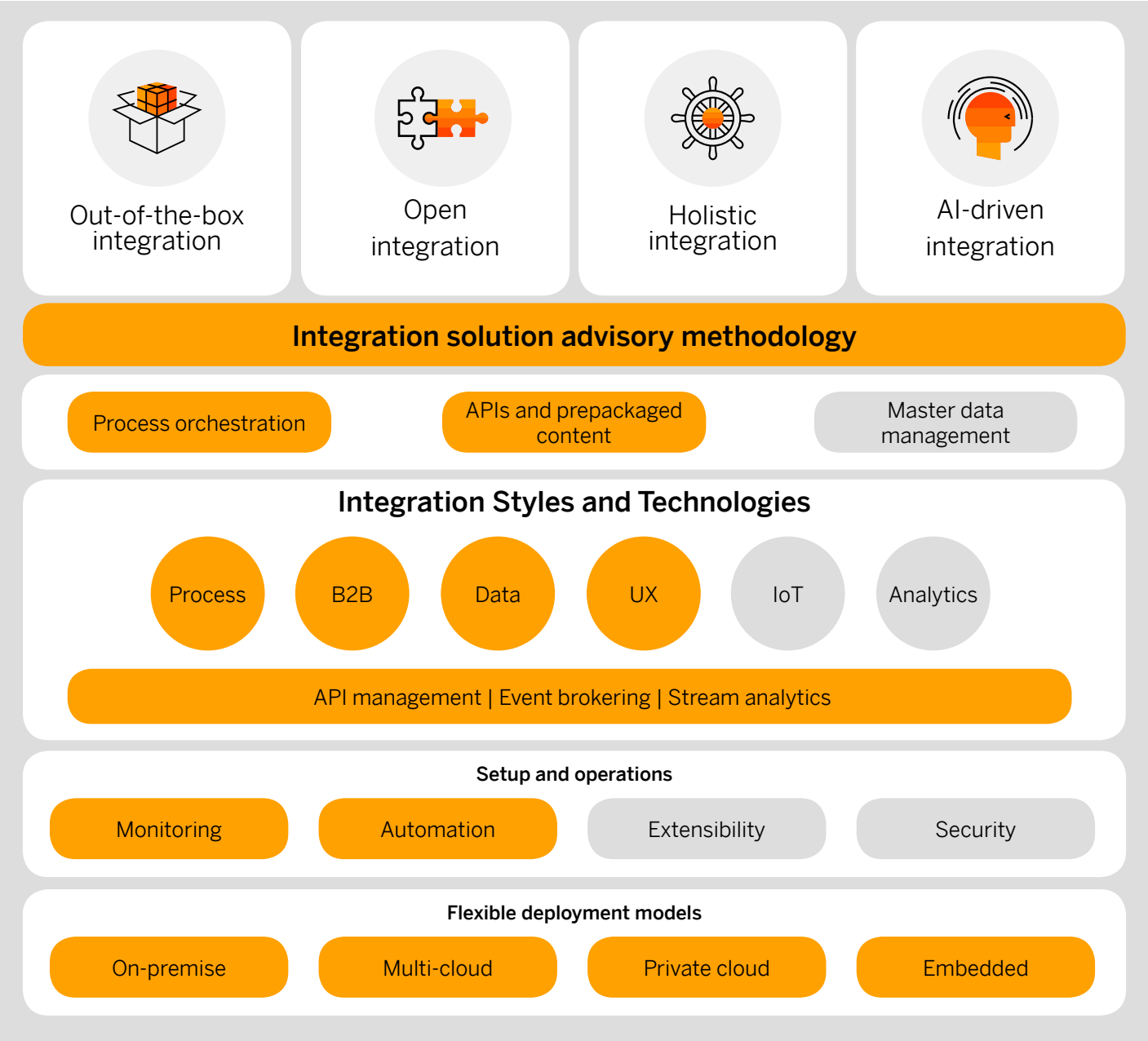
AI-driven integration: In addition to bringing intelligence into core business processes, SAP is using AI techniques to simplify the development of integration scenarios. One example is the SAP Cloud Platform Integration Advisor service for SAP Cloud Platform Integration. Its crowd-based machine learning approach enables users to define, maintain, share, and deploy B2B and A2A integration content much faster than building it from scratch. Further uses of artificial intelligence in other areas of integration, such as for integration monitoring, are planned.



Based on SAP Cloud Platform Integration Suite and SAP HANA Data Management Suite, **SAP supports all types of integration use cases**, ranging from process, data, user, and IoT to analytics-centric integration.

Based on these integration principles, the integration technology strategy of SAP consists of the following building blocks shown in Figure 2, where the orange-colored blocks indicate the areas covered by this document.

Figure 2: Integration Building Blocks



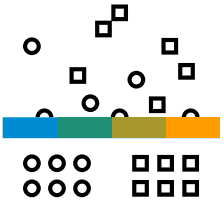
INTEGRATION STYLES AND TECHNOLOGIES

To support the needs of intelligent enterprises, the scope of the traditional integration discipline is constantly growing. Based on SAP Cloud Platform Integration Suite and SAP HANA Data Management Suite, SAP holistically covers this broader scope of integration by supporting all required integration styles. They include:

- **Process** – Covers the chaining of distributed business processes between two or more applications
- **Data** – Covers the movement and synchronization of data between applications, databases, and data lakes outside a transactional context
- **B2B** – Deals with integration between business partners
- **User experience (UX)** – Covers the rapid recombination of user interfaces (UIs), the consistent mash-up of task-specific UIs, and, ultimately, the total integration of multiple UIs into one central user interface, ensuring a seamless user experience
- **Business to government (B2G)** – Is related to B2B but focuses on integration between companies and government agencies
- **Analytics** – Includes the integration of data for analytical purposes (for example, embedded into business applications)
- **IoT** – Covers all scenarios where data from a device, asset, or machine must be integrated with business applications

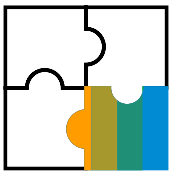
These integration styles are supported by events, messaging, and streaming capabilities.

This document focuses on the process, data, B2B, and UX integration styles. Detailed descriptions of services for the analytics and IoT integration styles are planned for later revisions of this paper or related documents.



To support the needs of intelligent enterprises, the scope of the traditional integration discipline is **constantly growing**.

SAP Cloud Platform Integration Suite is the integration platform as a service (IPaaS) from SAP, which covers a broad range of integration styles.[2] For process integration, SAP Cloud Platform Integration complements SAP Process Orchestration software, the on-premise integration technology from SAP. Both also cover the B2B integration style. SAP Cloud Platform Integration and SAP Process Orchestration are themselves supplemented by the SAP Application Interface Framework tool. This tool is an integral part of SAP S/4HANA and technically runs as an add-on for SAP Business Suite, supporting advanced interface monitoring, data validation, and error handling by business users. The SAP Cloud Platform Open Connectors service accelerates connectivity to third-party cloud applications by providing more than 150 connectors. The SAP Cloud Platform API Management service enables enterprise-grade security, traffic management, and performance monitoring capabilities.
The SAP Cloud Platform Enterprise Messaging service supports the decoupling of application logic and development of microservices based on message exchange and business events.
Within the data integration style, SAP HANA Data Management Suite, including the SAP Data Hub solution, serves as a data landscape management solution that enables agile data operations across the enterprise. It also provides capabilities to answer the challenges of Big Data. On the one hand, it uses existing data integration technologies such as SAP HANA smart data integration, SAP Landscape Transformation Replication Server, and SAP Data Services software. On the other hand, SAP HANA Data Management Suite comes with its own capabilities, for example, to include IoT-type data.



SAP Cloud Platform Integration Suite is the **integration platform as a service** from SAP, which covers a broad range of integration styles.

2. https://cloudplatform.sap.com/integration.html.

INTEGRATION SOLUTION ADVISORY METHODOLOGY

Besides the pure technology perspective, SAP provides a holistic methodology that supports enterprise architects in shaping their integration strategy and building a hybrid integration platform for their organizations. It includes an extensible set of integration styles and use-case patterns that are technology agnostic and can be mapped to integration technologies relevant for a specific customer context (for both integration technologies from SAP and third parties). You can use this methodology to assess and update your integration strategy or derive integration guidelines for your organization.

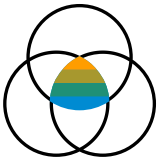
APIS AND PREPACKAGED INTEGRATION CONTENT

As outlined in the CIO vision guide mentioned above, our strategy is based on public APIs to ensure that our applications are open to custom integrations and extensions. Furthermore, prepackaged integration flows for hybrid and cloud-to-cloud scenarios are provided to accelerate the integration of business processes that are distributed across on-premise and cloud applications. These include SAP S/4HANA and SAP Business Suite as well as SAP Ariba, SAP SuccessFactors, SAP Fieldglass®, SAP Concur, and SAP Customer Experience solutions.

SAP API Business Hub is the central place to discover, explore, and test APIs from SAP and partners for building extensions and integrations. SAP API Business Hub is also the central place for prepackaged integration scenarios, consisting of graphical integration flows that can be configured and extended to enable the flow of messages between two or more participants using SAP Cloud Platform Integration.

SETUP AND OPERATIONS

The setup and operation of our integration scenarios are a key part of our strategy and include monitoring, automation, and security capabilities. SAP Solution Manager and the Focused Run solution for SAP Solution Manager provide integration administrators with centralized integration monitoring for both SAP Cloud Platform Integration and SAP Process Orchestration. The new Cloud Integration Automation service provides means to simplify and automate the configuration of prepackaged integration scenarios in hybrid landscapes. The SAP Identity Management component and the SAP Access Control application contribute to system integration in hybrid and cloud environments and make up the offering from SAP in the general space of identity and access management (IAM) software.[3]



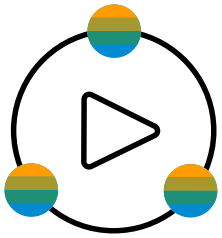
The **setup and operation** of our integration scenarios are a key part of our strategy and include monitoring, automation, and security capabilities.

3. Identity and access management (IAM) is the generic industry term for this field of services. This topic is discussed in detail in "SAP CIO Guide – Identity Lifecycle in Hybrid Landscapes."

FLEXIBLE DEPLOYMENT MODELS

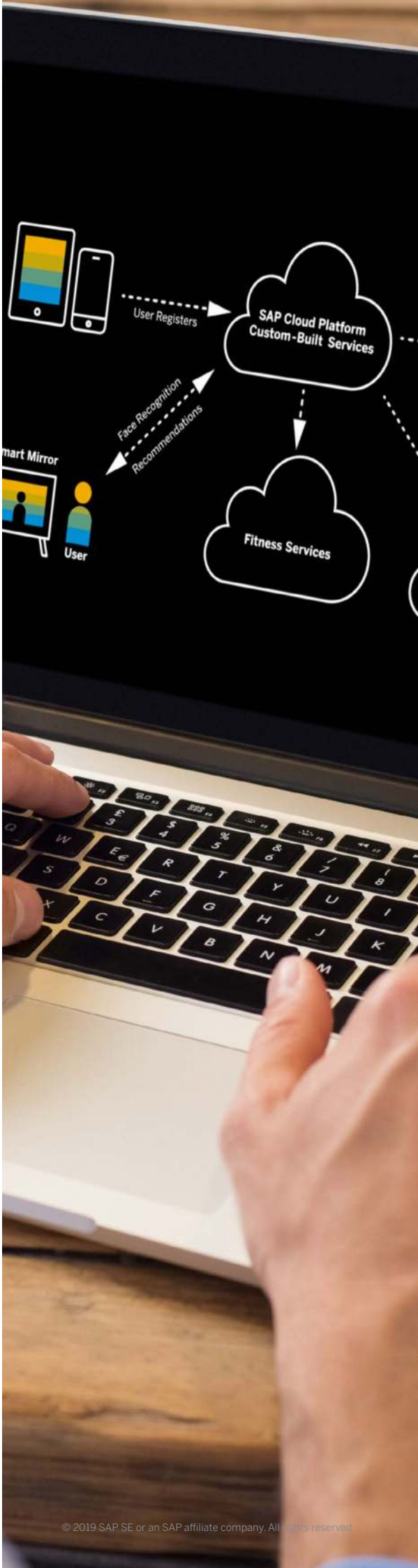
The integration technologies that make up the integration technology portfolio from SAP are available for a broad range of deployment models to meet your individual requirements.[4] This ranges from on-premise and private cloud deployment (for example, for SAP Process Orchestration) to public cloud service offerings (for example, SAP Cloud Platform Integration). It can also include models where the integration component is embedded in an application system (for example, the SAP Application Interface Framework tool embedded in SAP S/4HANA or SAP Business Suite).

These building blocks serve as a basis for process orchestration capabilities, such as workflow management, which is covered in this guide and represents just one example of these orchestration capabilities. They leverage integration technologies also discussed in this guide. Similarly, master data management services build on top of integration technologies.



This CIO guide covers a subset of the building blocks that make up the **overall integration strategy** of SAP.

4. The multi-cloud strategy of SAP – with Amazon, Google, and Microsoft as possible infrastructure providers – is explained in this **blog**.

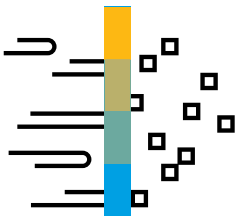


This document is structured into the following sections:

- "Integration Solution Advisory Methodology" provides an overview of relevant integration domains and use-case patterns in a hybrid system landscape. It also outlines how the integration solution advisory methodology can be used by enterprise architects to derive integration guidelines for their organizations.

- "APIs and Integration Content in SAP API Business Hub" outlines the key role of APIs in our integration strategy and gives an overview of the capabilities of SAP API Business Hub. This section provides an overview of prepackaged integration content for SAP Cloud Platform Integration as well as a pointer to the content road map.

- "Process Integration" provides guidance on using the process integration style. It describes typical ways you can evolve an on-premise integration architecture into a hybrid integration platform and contains information on the use of our core integration technologies. They include SAP Cloud Platform Integration and SAP Process Orchestration as well as a direct integration option. The section discusses the possibility of reusing integration content developed in SAP Cloud Platform Integration within the integration runtime of SAP Process Orchestration. It provides an outlook on how our prepackaged integration content will evolve over time through increasing alignment of APIs between SAP applications. Finally, the section discusses additional integration services of SAP Cloud Platform Integration Suite that complement the core integration technologies. They include SAP Application Interface Framework, SAP API Management, SAP Cloud Platform Open Connectors, SAP Cloud Platform Enterprise Messaging, SAP Cloud Platform Workflow, and the cloud connector of SAP Cloud Platform Connectivity.



The section on process integration style describes **typical ways you can evolve an on-premise integration architecture** into a hybrid integration platform. It contains information on the use of core integration technologies from SAP.

- "B2B Integration" gives guidance for using the B2B integration style, which includes the B2B functionality for SAP Process Orchestration and the B2B capabilities of SAP Cloud Platform Integration. A description of the SAP Ariba Cloud Integration Gateway solution outlines how SAP Cloud Platform Integration is used in the context of buyer and supplier integration. An overview of the SAP Cloud Platform Integration Advisor service demonstrates how SAP uses machine learning and crowdsourcing techniques to improve the efficiency of B2B and A2A integration development. It serves as one example of AI-driven integration.

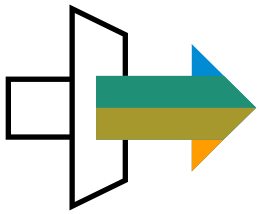
- "Data Integration" provides guidance on using the data integration style, with specific focus on SAP Data Hub, SAP HANA Data Management Suite, and their relationship to SAP solutions for enterprise information management (EIM). In addition, the section provides guidance on when to use SAP Cloud Platform Integration and when to use SAP Data Hub and how the two can be combined.

- "UX Integration" provides guidance on OData provisioning options for the SAP Fiori® user experience, with focus on user-centric integration.

- "End-to-End Integration Monitoring" provides an overview of monitoring options for hybrid landscapes, including SAP Solution Manager and Focused Run for SAP Solution Manager.

- "Transition Path to SAP S/4HANA and Cloud Integration" gives guidance on how to transition from SAP Business Suite to SAP S/4HANA and SAP S/4HANA Cloud and what this means from an integration perspective. The section includes guidance on using integration protocols and APIs.

- "Integration Automation" provides insights into how our new Cloud Integration Automation service helps simplify and automate the configuration of prepackaged integration scenarios from SAP within a customer landscape.



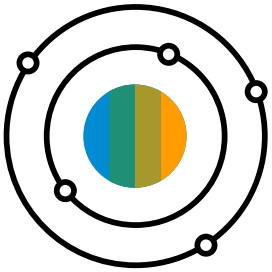
The section "Transition Path to SAP S/4HANA and Cloud Integration" **gives guidance on how to transition** from SAP Business Suite to SAP S/4HANA and SAP S/4HANA Cloud and what this means from an integration perspective.

Integration Solution Advisory Methodology

To support the digitalization of business processes, the scope of integration practices within customer organizations is constantly increasing. To tackle the broad scope of integration, customers need to evolve their integration architecture while leveraging existing investments and skill sets. Large organizations typically build on the principle of a hybrid integration platform,[5] combining integration technologies and services that may come from different vendors. With the integration solution advisory methodology, we support enterprise architects on this journey. In this section, we give an overview of typical roles involved in integration, followed by use cases illustrating how customers can apply the integration solution advisory methodology. We then describe the general concepts of the methodology in more detail.

INTEGRATION ROLES

Integration typically involves different roles in an organization. The table "Sample Integration Roles and Responsibilities" summarizes frequently occurring integration roles in organizations, including their typical responsibilities. Examples for related activities within the context of SAP software are also provided. The concrete definition of integration roles depends on the customer context, for example, the general scope of integration, the integration maturity level of an organization, or the structure of the IT organization. These roles can help establish an integration competency center or a center of excellence for integration. Either one can play an important role in establishing integration as a recognized discipline within an organization, which will enable it to operate on a well-defined basis of best practices for integration. For further details on the different usage scenarios within an organization for the integration solution advisory methodology, please refer to the section "Use Cases."



The **concrete definition of integration roles** depends on the customer context, for example, the general scope of integration, the integration maturity level of an organization, or the structure of the IT organization.

5. "Innovation Insight for Hybrid Integration Platforms," Gartner Inc., February 2017.

Sample Integration Roles and Responsibilities

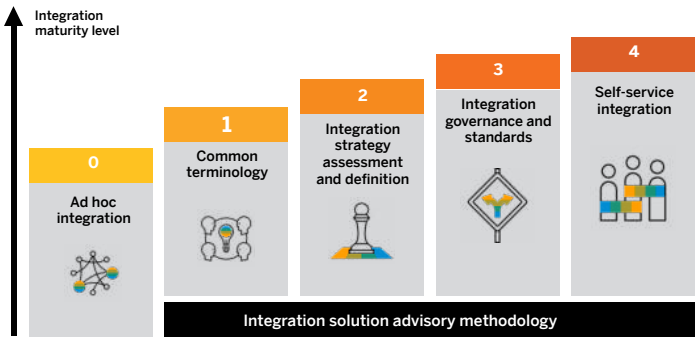
Role	Responsibility	Sample Tasks in SAP® Software Context
Enterprise architect	• Definition, communication, and continuous improvement of an integration reference architecture based on an overall IT strategy • Definition of integration standards and technology selection guidelines (cross-vendor) • Evaluation of new integration technologies	Definition and rollout of company-wide technology selection guidelines using the integration solution advisory methodology
Integration architect	• Definition of technical integration architectures with a focus on specific integration technologies • Definition of technical specifications for integration scenarios based on business requirements • Definition and communication of patterns, templates, and best practices	• Definition of development guidelines for the SAP® Cloud Platform Integration service or SAP Process Orchestration software • Definition of best practices for integration flows for SAP Cloud Platform Integration, for example, based on enterprise integration patterns[6]
Integration developer	• Implementation and test of integration scenarios based on technical specifications • Implementation and extension of prepackaged integration scenarios	• Implementation of integration flows in SAP Cloud Platform Integration or SAP Process Orchestration • Implementation of data flows in the SAP Data Hub solution
Integration administrator	• Technical setup and operations of integration scenarios (for example, archiving or certificate management) • Technical monitoring of interfaces, including root-cause analysis and technical error handling	• Technical monitoring of messages from SAP Cloud Platform Integration in SAP Solution Manager • Deployment of certificates in SAP Cloud Platform Integration
Business domain expert	• Specification of business requirements for a specific business process domain or line of business • Semantic definition of interface customizations and messages mapping (with an integration architect)	Definition of customized business-to-business interfaces and mappings in the SAP Cloud Platform Integration Advisor service
Business user	• Monitoring and error correction of messages in a specific business process domain or line of business • Processing of workflow tasks • Elimination of need for integration knowledge	• Error correction, canceling, or restart of messages in the SAP Application Interface Framework tool as part of SAP S/4HANA® or SAP Business Suite applications • Processing of workflow tasks in the SAP Cloud Platform Workflow service
Citizen integrator	• Business user with the ability to perform some integration tasks independently (self-service) • Elimination of need for deep integration knowledge	• Implementation of simple integration scenarios by HR business users in the integration center for SAP SuccessFactors® solutions • Integration of buyers and suppliers in the SAP Ariba® Cloud Integration Gateway solution based on a self-service wizard approach
Application or API developer	• Customization of enterprise applications • Provisioning of customer-specific APIs • Development of extension applications or mobile applications	• Customization of applications with SAP S/4HANA • Development of extension applications on SAP Cloud Platform

6. Gregor Hohpe and Bobby Woolf, "Enterprise Integration Patterns," Addison-Wesley, October 2003.

USE CASES

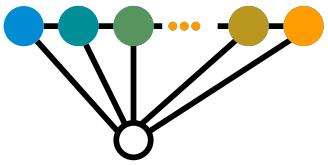
The goal of the integration solution advisory methodology is to help raise the integration maturity level of an organization by moving from ad hoc integration to a systematic approach based on well-defined integration standards. This shift supports the creation of self-services for integration specialists working independently (for example, in different lines of business) and citizen integrators.

Figure 3: Integration Solution Advisory Methodology – Use Cases and Maturity Levels



The integration solution advisory methodology can be applied stepwise for the following use cases (see Figure 3):

- **Common terminology**: As a starting point, enterprise architects can build on a systematic classification scheme of integration domains, integration styles, and use cases that improves the communication between project teams, functional teams, and involved system integrators.
- **Integration strategy assessment and definition**: Enterprise architects can use the methodology to assess their current integration architecture and identify areas for future improvement. The integration solution advisory methodology can also be used to blueprint an integration reference architecture for an organization based on integration technologies from SAP as well as third parties.
- **Integration governance and standards**: Enterprise architects can derive integration standards and policies, giving project teams guidance on when to use which integration technology. This makes it possible to channel the integration demand through well-defined processes and systematically implement integration solutions based on company best practices.
- **Self-service integration**: Based on established integration standards, integration architects can identify areas where independent integration developers or even citizen integrators can implement simple integration scenarios on their own. Their work could be based on the boundary conditions and support of the central integration team. An example would be the implementation of simple integration scenarios by HR business users in an integration center for SAP SuccessFactors solutions.

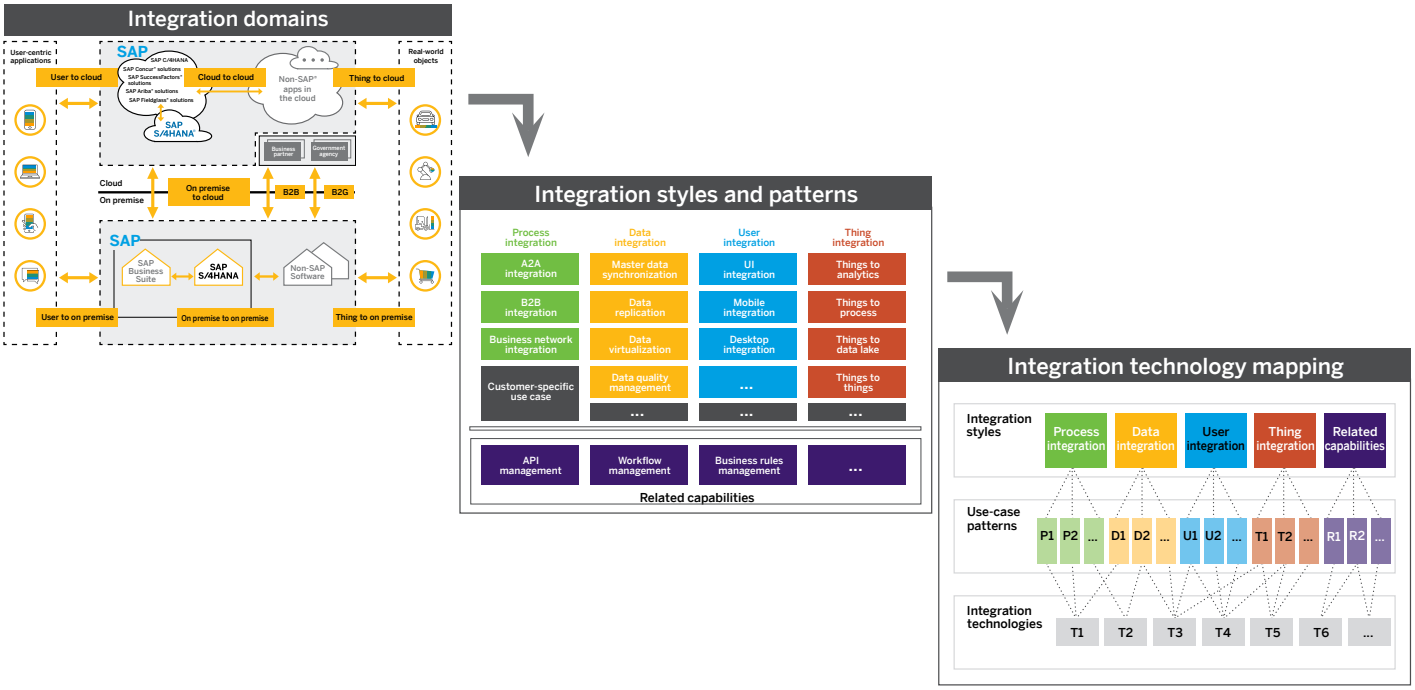


The goal of the integration solution advisory methodology is to **help raise the integration maturity level** of an organization by moving from ad hoc integration to a systematic approach based on well-defined integration standards.

METHODOLOGY IN A NUTSHELL

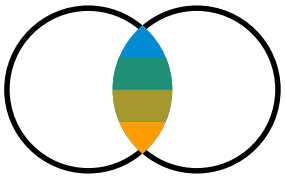
The integration solution advisory methodology consists of a set of technology-agnostic integration patterns that can be mapped to integration technologies from both SAP and third parties. The methodology consists of three major steps, depicted in Figure 4.

Figure 4: The Integration Solution Advisory Methodology



Integration domains: Entry points of the methodology are integration domains that describe typical integration areas within a hybrid system landscape, such as on-premise-to-cloud or cloud-to-cloud integration.

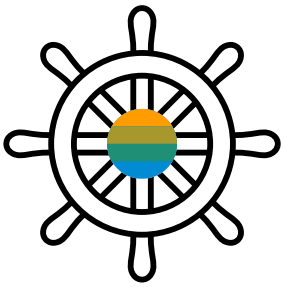
The methodology includes domains for the integration of user-centric applications (for example, user to cloud) and IoT devices (for example, thing to cloud). Integration domains are technology agnostic.



Entry points of the methodology are **integration domains** that describe typical integration areas within a hybrid system landscape, such as on-premise-to-cloud or cloud-to-cloud integration.

- **Integration styles:** Integration styles describe the different categories of integration: process, data, user, and IoT centric.[7] Each integration style has specific characteristics and can be refined by use-case patterns. For example, the data integration style includes use-case patterns such as data replication and data virtualization. The integration solution advisory methodology includes an initial set of use-case patterns that can be extended by customers with additional use cases. Like integration domains, integration styles and use-case patterns are technology agnostic.
- **Integration technology mapping:** Finally, integration styles and use-case patterns can be mapped to integration technologies and services, including integration technologies from SAP and third parties. This allows enterprise architects to derive integration guidelines for their organizations. A sample integration guideline could state that the SAP Cloud Platform Integration service is the preferred integration technology for the process integration style within the on-premise-to-cloud integration domain. This mapping depends on the customer context, which takes into consideration aspects such as existing investments and available skill sets.

The integration solution advisory methodology has been successfully adopted in large organizations, and it is planned that it will be further enhanced based on community feedback. The blog "Integration Solution Advisory Methodology (ISA-M): Define Integration Guidelines for Your Organization" provides more detail. It includes information on how to access the template that SAP offers customers and partners for the integration solution advisory methodology.



The integration solution advisory methodology has been **successfully adopted** in large organizations.

7. For better readability of this paper, we have used B2B integration as a separate integration style. In the integration solution advisory methodology, it is part of the process integration style.

APIs and Integration Content in SAP API Business Hub

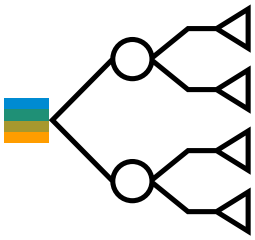
This section outlines the key role of APIs in the integration strategy of SAP. It gives an overview of the capabilities of SAP API Business Hub and the prepackaged integration content for SAP Cloud Platform Integration and provides a pointer to the content road map.

THE API STRATEGY OF SAP

The cornerstone of the integration strategy of SAP is an API-first approach. SAP offers access to most of the functionality in its services and solutions through APIs. Customers and partners use these APIs from SAP to adapt the provided functionality for their specific use, such as extensions. For example, you can create a new application on SAP Cloud Platform that caters to a use case not addressed by the standard functionality and integrate the new solution or service with other solutions or services. The challenge ahead is to provide this kind of API-based access to all – not just most – relevant solutions, services, and data.

To further the API-first approach, SAP is working on three aspects:

- SAP envisions an integration architecture based on aligned public APIs to ensure that all systems are open for integration and extension. It is planned that new applications will feature fully documented and aligned public APIs, with REST, OData, and SOAP[8] being the preferred integration protocols. The purpose, structure, and primary use case of aligned APIs are agreed on beforehand by its consumers and the team building the API. This ensures that aligned APIs are built with an outside-in approach, involving the consumers in the definition process early, as opposed to an inside-out approach, where existing functionality is exposed as is.



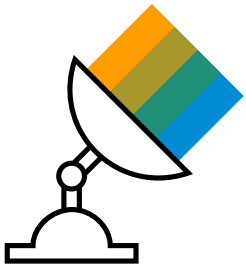
The cornerstone of the integration strategy of SAP is an **API-first approach**. SAP offers access to most of the functionality in its services and solutions through APIs.

8. "List of Abbreviations" can be found at the end of the document.

- SAP API Business Hub enables integration and application developers in the SAP ecosystem to discover, test, and use public APIs from SAP and integration content for SAP Cloud Platform Integration (see "Use Cases and Capabilities"). The APIs are documented in the open API format, a vendor-neutral open-source format for REST API documentation (SAP joined the open API consortium in 2017).
- While these public APIs facilitate broad and intense reuse, integration and application developers need assurance that these APIs are versioned to deliver the stability they require. SAP has extended the existing API lifecycle and version management with an API deprecation policy that defines API versioning, compatibility of changes, and their applicability for all APIs from SAP.

To facilitate advanced integration use cases and enable sophisticated extensions, SAP plans to provide advanced API qualities on selected REST and OData APIs. It is intended that business and data change events will, for example, be exposed to subscribers to enable real-time integration capabilities. SAP continues to extend the OData APIs to support consistent initial loading of large data sets and delta-load capabilities to support offline scenarios and data replication.

SAP's strategy for new applications is to align coherent domain models, not just single APIs. A domain model defines an object model (data model, types, or values) and the set of possible actions and events not just for one application or use case but across an entire domain and its subdomains. Please see "CIO Guide: SAP Vision for Integrating SAP Applications in Cloud and Hybrid Environments" for more details about domain model alignment.

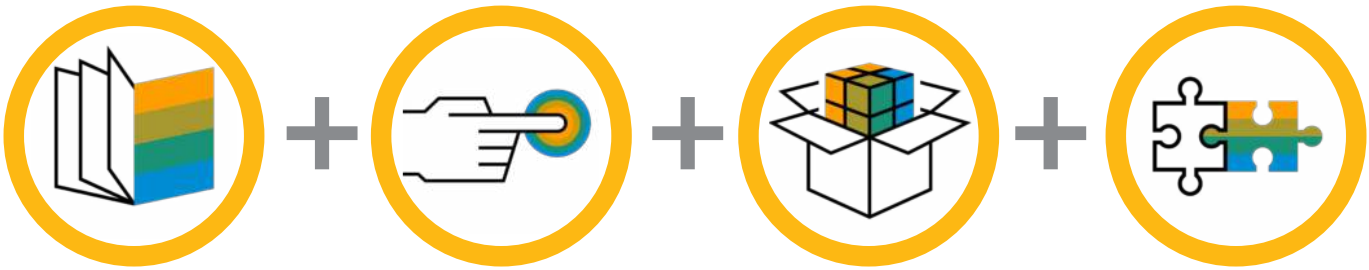


SAP's strategy for new applications is to **align coherent domain models**, not just single APIs.

USE CASES AND CAPABILITIES

SAP API Business Hub (see Figure 5) is a public catalog of all SAP APIs and partner APIs. It helps integration and application developers – including our customers, partners, and ecosystem – to search, discover, experience, and consume the right APIs to build apps and integrations easily.

Figure 5: SAP API Business Hub – Easy Integration with the Right APIs and Accelerators



Catalog
Central place for APIs from SAP and its partners

API sandbox
One-click-test experience for developers with an API sandbox

Prepackaged accelerators
Integration packages to integrate APIs

Tool integration and easy consumption
Integration with developer environment and code generations

SAP API Business Hub has four main ingredients:

- A public **catalog** of APIs from SAP is provided in SAP Business Suite applications, line-of-business applications, SAP S/4HANA, and SAP Cloud Platform. Also included are business services, such as data quality, globalization services, and machine learning. These are provided with standardized documentation in the OpenAPI Specification (originally known as the Swagger Specification) for integration and application developers. The catalog also contains APIs from our partners and the ecosystem.

SAP API Business Hub is a public catalog of all APIs from SAP and partner APIs. It helps integration and application developers **search, discover, experience, and consume** the right APIs to build apps and integrations easily.

- An **API sandbox** lets integration and application developers try out the APIs and learn how to use them without having to sign up for each individual application and solution. Developers can use the APIs to connect to their own environments from the sandbox and test against these environments.
- **Prepackaged accelerators,** such as packaged integration scenarios from SAP and partners, help accelerate integration projects. SAP API Business Hub provides policy templates and best-practice information for API projects. SAP API Business Hub includes adapters for SAP Cloud Platform Integration provided by SAP partners that support integration with third-party applications such as those from Salesforce.com Inc., several services within Amazon Web Services, and Microsoft Dynamics CRM.
- **Tool integration and easy consumption** are important design principles of SAP API Business Hub. Integration developers can consume pre-packaged accelerators in environments such as SAP Cloud Platform Integration or SAP API Management in a discover-deploy-consume experience. Application developers can consume APIs in SAP Web IDE to accelerate application development. They can consume APIs in SAP Cloud Platform Mobile Services to create mobile apps and in the SAP Build service to help integration developers and citizen integrators build apps and prototypes quickly.

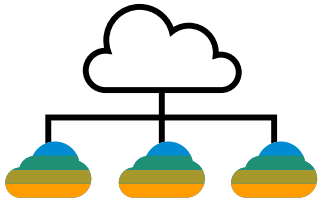
Tool integration and easy consumption are important design principles of SAP API Business Hub.

The road map for SAP API Business Hub focuses on the following areas:

- **APIs from SAP and partners:** Currently, over 1,800 content items are available, including APIs, policy templates, and integration flows. SAP plans to deliver more APIs covering areas such as the SAP Business ByDesign® solution and the SAP Business One® solution. Also planned are new platform services, such as machine learning and blockchain, and industry-specific services, such as consent management. Partners also offer content, such as APIs for location-based services, supply chain management, and prepackaged integration content for payroll services.
- **API discovery:** SAP API Business Hub has a comprehensive search-and-discover capability to find the right API. Based on consumer feedback, we constantly improve the API discovery function. Results of this feedback include a scenario-based API discovery feature and a hub assistant powered by machine learning to help integration and application developers find the right content for their scenarios.
- **A business hub for customers (hub as a service):** SAP is planning to offer customers the digital content delivery infrastructure that powers SAP API Business Hub. Customers will be able to manage the lifecycle of their own content, such as APIs, apps, and integration packages, and engage their developer ecosystems.

ROAD MAP FOR INTEGRATION CONTENT

To help customers integrate our cloud and on-premise applications, SAP offers predefined integration packages that can be configured, run, and monitored with SAP Cloud Platform Integration. Included is integration content for SAP S/4HANA and SAP SuccessFactors, SAP Ariba, SAP Customer Experience, SAP Fieldglass, and SAP Concur solutions. Predefined integration content is also available for third-party cloud applications and B2B and B2G integration scenarios on SAP API Business Hub. A detailed road map for planned cloud integration features can be found at www.sap.com/roadmaps. There, enter *SAP Road Map for Cloud Integration* in the search field and include the quotation marks.



To integrate our cloud and on-premise applications, SAP offers **predefined integration packages** that can be configured, run, and monitored with SAP Cloud Platform Integration.

Process Integration

This section provides technology guidance for the process integration style. The first part discusses how to use the core integration technologies from SAP – SAP Cloud Platform Integration and SAP Process Orchestration – within the context of a typical hybrid system landscape. It outlines how the SAP Application Interface Framework tool, along with SAP S/4HANA and SAP Business Suite software, complements the two core technologies with additional capabilities, such as error handling for business users. This combination makes it possible for integration architects to implement end-to-end integration scenarios across integration and application layers.

This section then provides an overview of related integration technologies, such as SAP API Management technology and the SAP Cloud Platform Workflow service, that complement the core technologies for additional use cases.

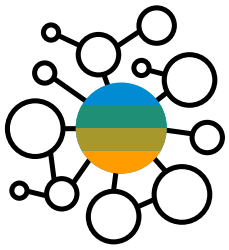
SAP Application Interface Framework complements **core integration technologies** from SAP with additional capabilities, such as error handling for business users.

SAP CLOUD PLATFORM INTEGRATION SUITE

SAP Cloud Platform Integration Suite is the enterprise-grade integration platform as a service from SAP. SAP Cloud Platform Integration Suite is an open IPaaS and consists of a modular set of integration services that work together to support a comprehensive variety of end-to-end integration scenarios. In particular, SAP Cloud Platform Integration Suite supports the integration of SAP and non-SAP applications in the cloud and on premise (A2A) and integration with business partners (B2B) and government agencies (B2G). It supports the design and runtime governance of APIs, including API-based integration; extensions of business processes with workflows, including human interaction steps and business rules; as well as the integration of IoT devices and equipment. The following services belong to SAP Cloud Platform Integration Suite:

- SAP Cloud Platform Integration for tight integration of cloud and on-premise applications
- SAP Cloud Platform Integration Advisor for accelerated governance of message implementation and mapping guidelines, leveraging machine learning and crowd-sourcing mechanisms
- SAP Cloud Platform API Management to govern and manage APIs and their lifecycle end to end
- SAP Cloud Platform Open Connectors for accelerated connectivity to non-SAP applications
- SAP Cloud Platform Workflow to automate and extend business processes using workflow technology
- SAP Cloud Platform Business Rules to extend business processes with decision modeling
- SAP Cloud Platform Enterprise Messaging to support event-driven integrations with messaging and functions
- SAP Cloud Platform Internet of Things to manage the lifecycle of IoT devices end to end and securely connect to remote devices over a broad array of IoT protocols
- SAP API Business Hub to search, discover, experience, and consume APIs, prepackaged integration content, and adapters from SAP and select partners

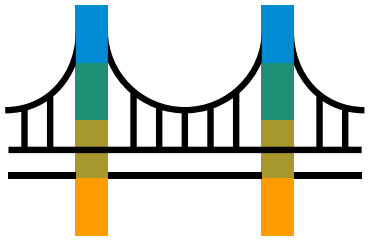
See "SAP Cloud Platform Integration Suite" for more details.



SAP Cloud Platform Integration Suite is an open IPaaS and consists of a **modular set of integration services** that work together to support a comprehensive variety of end-to-end integration scenarios.

CORE INTEGRATION TECHNOLOGIES

SAP Cloud Platform Integration and SAP Process Orchestration build the foundation of SAP's integration strategy for supporting A2A, B2B, and B2G integration as well as for use cases for master data synchronization.[9] The technologies are complementary. SAP Cloud Platform Integration is SAP's strategic integration technology for hybrid and cloud integration for both SAP-to-SAP software integration as well as third-party integration. SAP Process Orchestration is on-premise integration software that bundles process integration, business process management, and business rules management capabilities. One subsection describes the evolution of prepackaged integration content for SAP Cloud Platform Integration, which follows SAP's strategy for building new SAP-to-SAP software integration scenarios based on public and aligned APIs (see "The API Strategy of SAP"). Described next is how SAP Cloud Platform Integration and SAP Process Orchestration can be used to complement each other in a typical hybrid system landscape. Focus is then given to how integration content developed for SAP Cloud Platform Integration can be deployed on SAP Process Orchestration (starting with release 7.5). The section concludes with a discussion on how, based on typical integration patterns, SAP Application Interface Framework can be combined with SAP Cloud Platform Integration and SAP Process Orchestration.



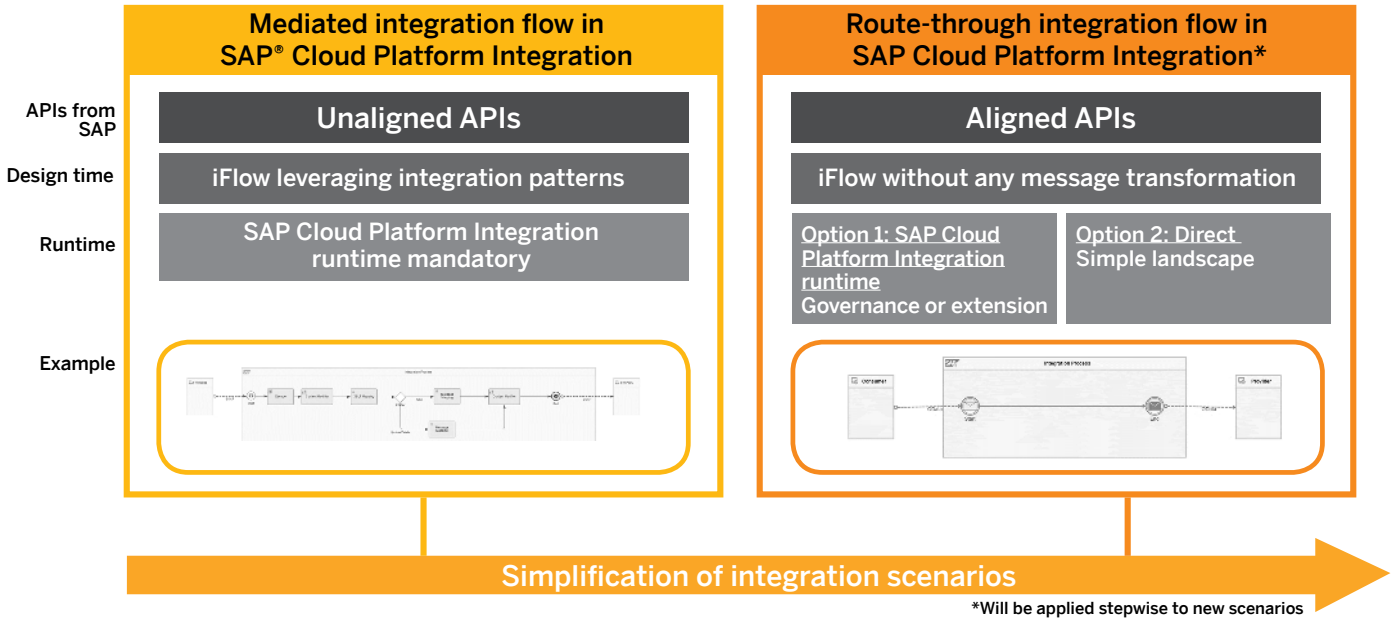
SAP Cloud Platform Integration and SAP Process Orchestration **build the foundation of SAP's integration strategy** for supporting A2A, B2B, and B2G integration.

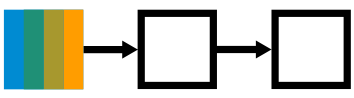
9. A detailed definition of the use cases is given in "CIO Guide: SAP Vision for Integrating SAP Applications in Cloud and Hybrid Environments."

EVOLUTION OF INTEGRATION CONTENT

SAP and its partner ecosystem provide a wide variety of prepackaged integration content to support the integration of SAP software as well as third-party applications based on SAP Cloud Platform Integration. SAP aims to simplify the integration with and between SAP solutions with the ultimate goal of zero integration effort for SAP-to-SAP software integration in the cloud. SAP plans to develop new integration scenarios between applications where SAP controls all ends of the integration based on aligned APIs (see "The API Strategy of SAP"). This will minimize the integration efforts for new integration scenarios for SAP software, as no structure mapping between the standard API of a consumer and a provider will be required. SAP Cloud Platform Integration supports both types of integration scenarios – those for unaligned as well as aligned APIs (see Figure 6).

Figure 6: Evolution of Integration Content from SAP





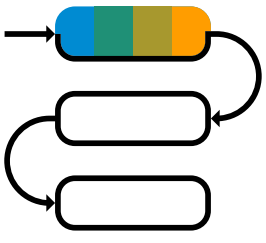
SAP aims to simplify the integration with and between SAP solutions, with the ultimate **goal of zero integration effort** for SAP-to-SAP software integration in the cloud.

- **Mediated integration flows** in SAP Cloud Platform Integration address SAP-to-SAP integration scenarios that are not based on aligned APIs (for example, integration flows of existing prepackaged integration scenarios). Integration mediated by SAP Cloud Platform Integration covers all integration scenarios that include third-party applications, business partners (B2B), or public authorities (B2G). Mediated integration flows typically make use of integration patterns, such as structure mappings, splitters, aggregators, and protocol adaptation (for example, from REST/OData to SOAP). They are executed on the runtime of SAP Cloud Platform Integration.
- **Route-through integration flows** in SAP Cloud Platform Integration are based on aligned APIs, have exactly one consumer and one provider, and do not change the message payload or the header. The customer has the choice to deploy a route-through integration flow on the runtime of SAP Cloud Platform Integration. Reasons could include complying with company standards, establishing central monitoring capabilities, or enabling extensions such as routing to multiple back-end applications. Optionally, the consumer and provider of an integration flow could be directly integrated during runtime for simple landscapes that do not require runtime governance. A route-through integration flow with SAP Cloud Platform Integration also provides the foundation to plug in customer extensions.

Examples could be for the enrichment of the standard flow with information from third-party applications, or the integration of an archiving system. A customer extension changes the route-through integration flow into one that is mediated by SAP Cloud Platform Integration. SAP has started to provide tool support to generate route-through integration flows for SAP Cloud Platform Integration based on aligned APIs from SAP or third parties in SAP API Business Hub. Currently, simple REST-OData operations (GET, POST, DELETE) are supported and will be extended based on customer feedback.

Besides simplifying prepackaged integration scenarios from SAP using aligned APIs, SAP is currently investing in various areas to further simplify integration:

- The SAP Cloud Platform Integration Advisor service leverages machine learning and crowdsourcing techniques so B2B integration flows can be created more efficiently. The integration advisor helps reduce the expert domain knowledge required to mediate between interfaces (see“B2B Integration”).
- To streamline the technical configuration of integration content from SAP, the Cloud Integration Automation service simplifies and automates the configuration process for integration scenarios within a hybrid landscape based on the SAP Cloud Platform Workflow service (see “Integration Automation”).

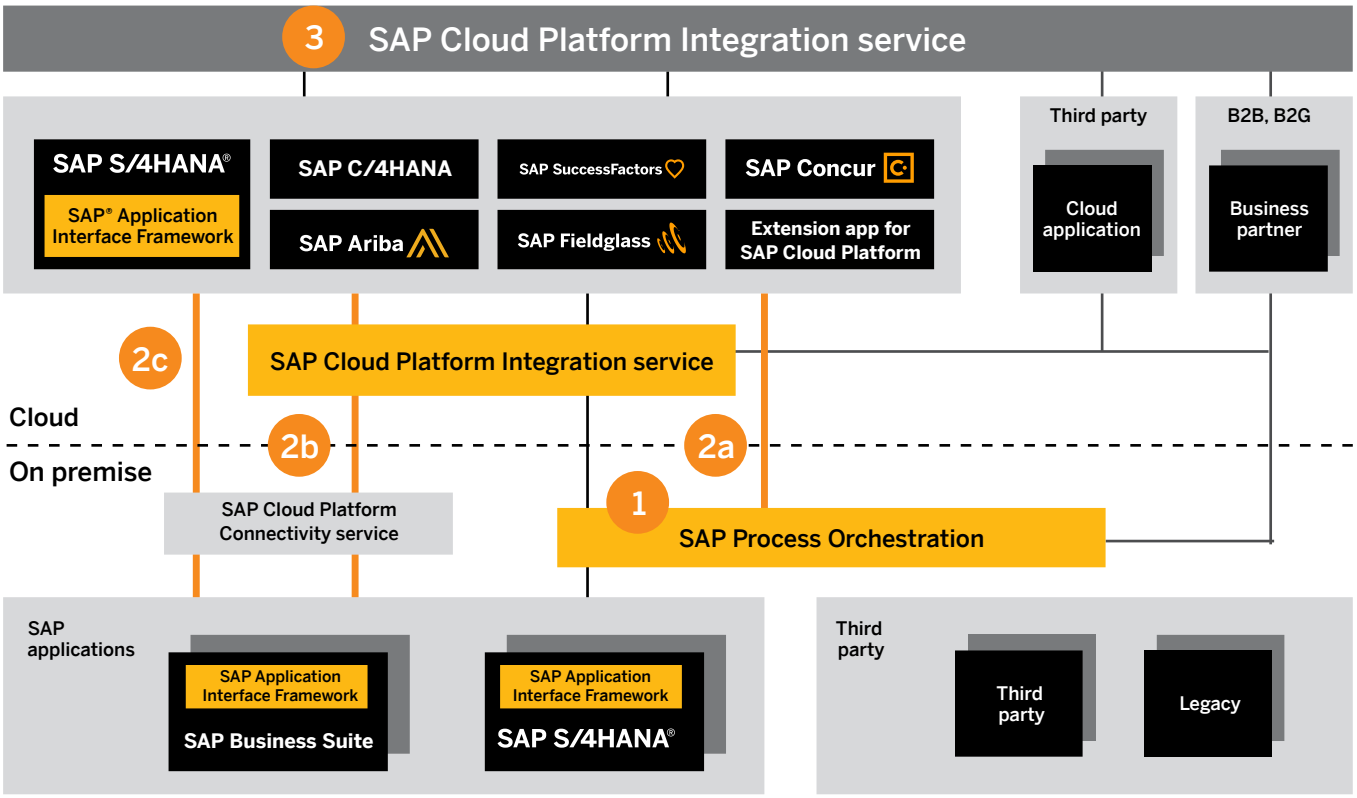


Route-through integration flows in SAP Cloud Platform Integration are based on aligned APIs, have exactly one consumer and one provider, and do not change the message payload or the header.

SAP Cloud Platform Integration and SAP Process Orchestration

Figure 7 shows a typical hybrid system landscape from an integration point of view. It includes on-premise SAP applications, cloud solutions from SAP, and applications from third parties, business partners, and public authorities.

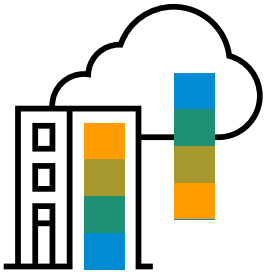
Figure 7: Hybrid Integration Landscape – Integration Domains



SAP Process Orchestration offers B2B functionality with **exhaustive capabilities** to integrate business partners, leveraging industry standards such as EDIFACT and ANSI X.12.

On-premise-to-on-premise integration: When starting with a typical as-is customer landscape, SAP Process Orchestration is the recommended approach for integrating on-premise software such as SAP S/4HANA, SAP Business Suite software, third-party applications, and legacy applications (see Figure 7, path 1). In addition, SAP Process Orchestration offers B2B functionality with exhaustive capabilities to integrate business partners, leveraging industry standards such as EDIFACT and ANSI X.12 (see "B2B Integration"). SAP Process Orchestration is also available in SAP HANA Enterprise Cloud and can be used to connect on-premise applications in the customer landscape with applications hosted in a private cloud environment.

Hybrid integration: If a customer with a major on-premise footprint and existing investments in SAP Process Orchestration wants to integrate a single cloud solution from SAP (for example, an SAP SuccessFactors solution), SAP Process Orchestration can be used (see Figure 7, path 2a). For customers with an increasing need to integrate cloud applications, for example, due to a dedicated cloud strategy, SAP Cloud Platform Integration is the recommended integration platform. It provides a rich set of prepackaged integration scenarios that is being continually increased. Following SAP's integration strategy as introduced above, SAP Cloud Platform Integration supports mediated integration for SAP application scenarios that are not based on aligned APIs (see Figure 7, path 2b). Aligned APIs between two SAP applications may provide route-through content for SAP Cloud Platform Integration. In that case, the customer can choose to deploy the route-through integration flow on the runtime of SAP Cloud Platform Integration, for example, to comply with company standards or if point-to-point integration should be used. The point-to-point (direct) option may be considered for simple landscapes (see Figure 7, path 2c). Customers with a policy to route all communication to and from the cloud through their local SAP Process Orchestration can integrate SAP Process Orchestration with SAP Cloud Platform Integration. However, this leads to the necessity of maintaining routing rules in both technologies. In addition to SAP-to-SAP integration scenarios, SAP Cloud Platform Integration can be used to integrate cloud-based software from third parties, business partners, business networks, and public authorities. Examples are the integration of SAP applications with SAP Information Collaboration Hub for Life Sciences to track pharmaceutical products at every stage in the supply chain. Another example is the integration of SAP applications with the systems of tax authorities (e-documents).



In addition to SAP-to-SAP integration scenarios, SAP Cloud Platform Integration can be used to **integrate cloud-based software** from third parties, business partners, business networks, and public authorities.

Cloud-to-cloud integration: SAP Cloud Platform Integration is the recommended approach for integrating between cloud applications (see Figure 7, path 3). SAP-to-SAP software scenarios can be managed by SAP or by the customer. For scenarios managed by SAP, configuration and operation are performed by SAP, which gives the customer maximum speed to value and lowest project risk. In the customer-managed case, prepackaged integration content is provided by SAP and configured by the customer while SAP still operates the SAP Cloud Platform Integration service. This provides the customer with the highest flexibility and the ability to implement custom extensions. SAP Cloud Platform Integration can also be used to integrate cloud applications from third parties, business partners (B2B), and public authorities (B2G).

SAP Cloud Platform Integration and SAP Process Orchestration are complementary. The following table summarizes key criteria for integration architects to consider when deciding which integration technology to use. For additional technology guidance for the B2B integration style, see "B2B Integration."

SAP® Cloud Platform Integration and SAP Process Orchestration

	SAP® Cloud Platform Integration	SAP Process Orchestration
Deployment	• Data centers owned and run by SAP • Multi-cloud[10]	• Customer landscape • Private cloud (for example, SAP HANA® Enterprise Cloud)
Operations	SAP	Customer
License model	Monthly subscription fee, pay per use	Product license
Architecture	•Multitenancy with data isolation •Virtualization with automated failover •Rolling software updates	• Single-tenant solution • Failover to be configured by customer • Near-zero downtime maintenance for updates through support packages or enhancement packages
Prepackaged integration content	Availability for a wide variety of cloud solutions from SAP, third-party applications, and business-to-business and business-to-government scenarios	• Availability for a wide variety of on-premise SAP® software and third-party software • Runtime of the SAP Cloud Platform Integration service (starting from SAP Process Orchestration software, release 7.5) for reuse of cloud integration content
Preferred integration domains	• Cloud to cloud • On premise to cloud (for customers with a cloud focus)	• On premise to on premise • On premise to cloud (for customers with an on-premise focus)
Decision criteria	• Center of gravity – deployment of most or leading applications – in the cloud • No need to invest in on-premise middleware (installation, operation, upgrades) • Fast innovation cycle • Flexible license model • Scenarios with a need for compliance, such as e-invoicing or payroll, to integrate with legal authorities	• Center of gravity – deployment of most or leading applications – on premise • Interest in leveraging an existing investment in SAP Process Orchestration • Customer interest in having full control over integration (installation, operation, upgrades)

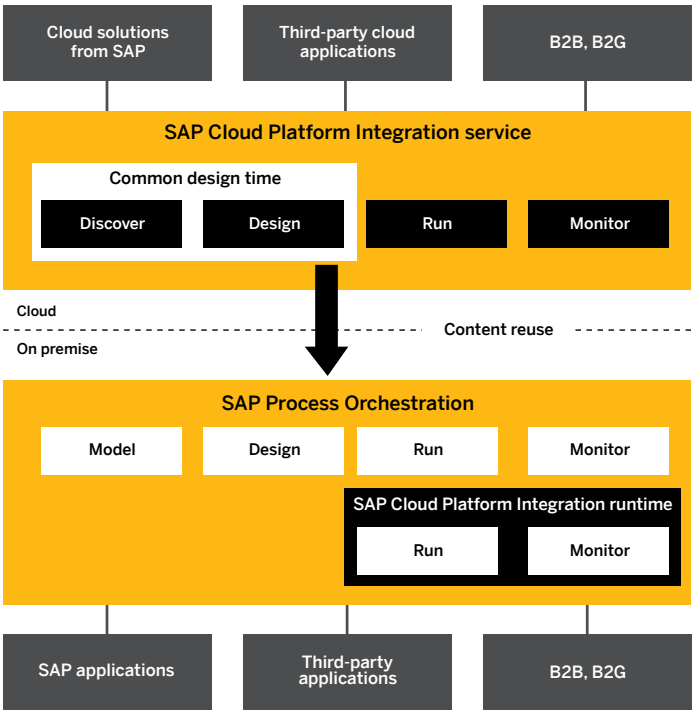
10. See the road map for SAP Cloud Platform Integration.

Reuse of Integration Content

Prepackaged integration content is built and released by SAP following a cloud-first strategy: new content is built on SAP Cloud Platform Integration, leveraging fast innovation cycles in the cloud, and shipped through SAP API Business Hub. With release 7.5, SAP Process Orchestration has been extended to support a variant of the runtime of SAP Cloud Platform Integration. As per the release schedule of SAP Process Orchestration, dedicated versions of the runtime of SAP Cloud Platform Integration are planned to be released for SAP Process Orchestration. This is intended to enable compatibility of the corresponding content versions of SAP Cloud Platform Integration and SAP Process Orchestration. This content compatibility allows customers to continue to leverage their investments in SAP Process Orchestration while benefiting from the capability to run prepackaged cloud integration content on SAP Process Orchestration (see Figure 8).

Customers and partners can use the Web tooling of SAP Cloud Platform Integration to create and configure cloud integration content. In the discover area of their SAP Cloud Platform Integration service tenant, they can browse integration content packages provided by SAP and partners and copy them to their workspace. In the design area of SAP Cloud Platform Integration, they can modify and configure the content. Within the cloud integration content management cockpit of SAP Process Orchestration, customers can connect to their tenant of SAP Cloud Platform Integration, select the relevant integration flow, and deploy, run, and monitor it on the local runtime of SAP Cloud Platform Integration.

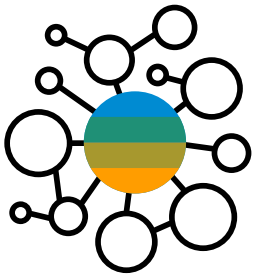
Figure 8: Content Reuse in SAP Cloud Platform Integration on SAP Process Orchestration



SAP introduced product profiles to make sure that cloud integration content modeled in the workspace of SAP Cloud Platform Integration is compatible with a specific release of SAP Process Orchestration. A specific product profile restricts the configuration of an integration flow to the set of adapter types and integration flow steps supported by a particular release and support package stack of SAP Process Orchestration. Based on the common cloud-based design time, including the integration flow concept, SAP follows a common modeling paradigm. This gives customers the flexibility to decide where to deploy their integration flows – in the cloud or on premise. This can, for example, be useful in cases when the customer wants to run some integration flows on premise during migration phases and later deploy them in the cloud.

SAP Application Interface Framework

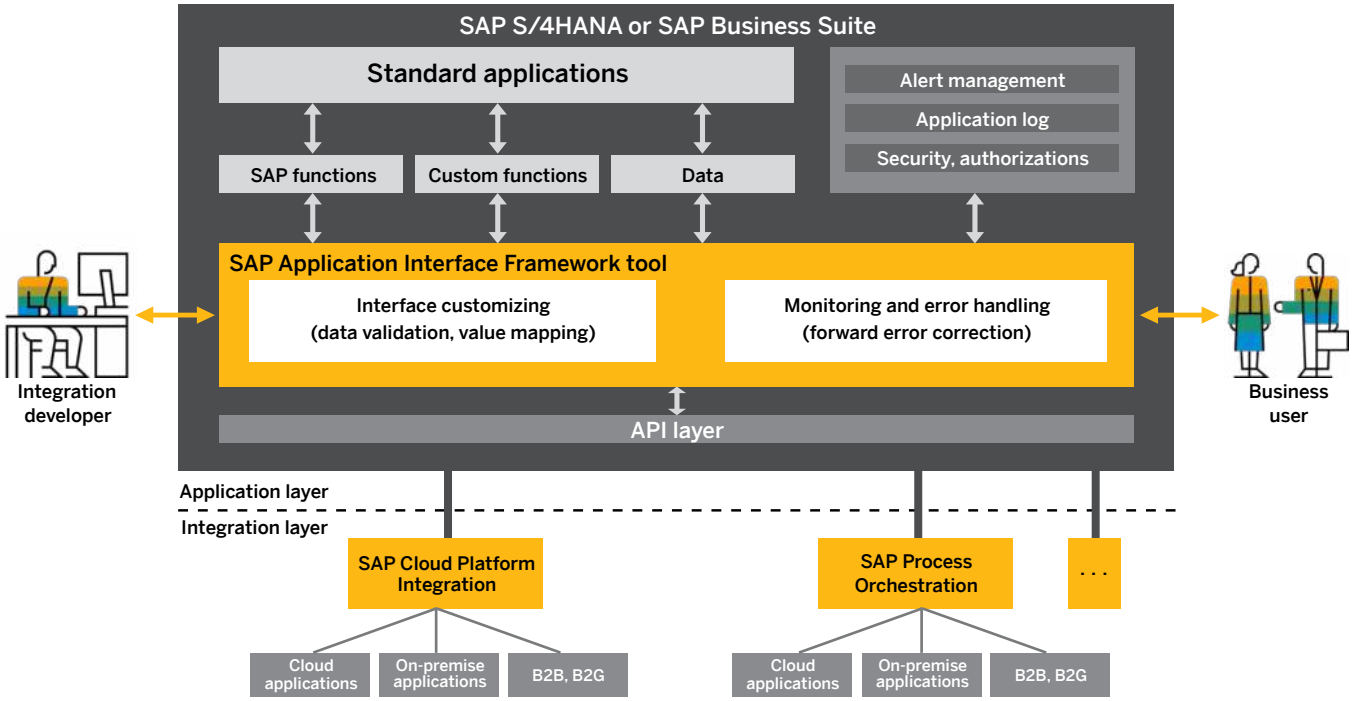
SAP Application Interface Framework is an interface management tool that is embedded in SAP S/4HANA and serves as an add-on to SAP Business Suite. It complements SAP Cloud Platform Integration and SAP Process Orchestration with a deep integration capability in the application layer (see **Figure 9**). SAP Application Interface Framework provides an efficient way to implement, monitor, and analyze inbound and outbound application interfaces from a central location within the application. It provides full access to the relevant data and functions of the underlying SAP applications. This, for example, makes it possible to implement data validation checks as well as value mappings that rely on application data and business logic.

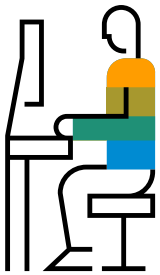


SAP Application Interface Framework provides an **efficient way to implement, monitor, and analyze** inbound and outbound application interfaces from a central location within the application.

In addition, SAP Application Interface Framework enables business users to monitor interfaces, trigger alerts, and manage errors without IT support, which drastically reduces the time needed for error handling. Integration messages that run into application-level errors can be efficiently corrected by business users in a way that complies with the General Data Protection Regulation (GDPR). It eliminates the need to return the message to the sending application and ask for a resend. SAP Application Interface Framework improves governance through role-based access to interface data and through its capability to hide sensitive fields from monitoring and error handling.

Figure 9: The SAP Application Interface Framework





SAP Application Interface Framework complements SAP Cloud Platform Integration and SAP Process Orchestration with a **deep integration capability** in the application layer.

The combination of SAP Application Interface Framework with either SAP Cloud Platform Integration or SAP Process Orchestration (with both being part of the integration layer) has great potential. Available with either SAP S/4HANA or SAP Business Suite, it provides integration architects with a powerful combination for integrating external applications, business partners, and public authorities. The management of process integration becomes simpler, because integration patterns can be distributed ideally in the integration layer or close to the application.

Figure 10 gives an overview of typical integration patterns best implemented in the integration layer or the application layer and provides guidance for integration architects on best practices for each integration pattern.

Figure 10: Sample Integration Patterns – Integration and Application Layer

Integration Pattern	Integration Layer	Application Layer
Integration technology	**SAP® Cloud Platform Integration or SAP Process Orchestration**	**SAP Application Interface Framework tool**
Structure mapping	●	●
Routing	●	●
Splitter	●	●
Aggregator	●	●
Protocol adaptation	●	●
Value mapping – static code list	●	●
Value mapping – dynamic code list	●	●
Data validation	●	●
Forward error correction (business user)	●	●

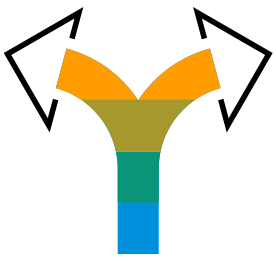
● **Recommended** ● **Partially possible** ● **Not recommended**

The combination of SAP Application Interface Framework with either SAP Cloud Platform Integration or SAP Process Orchestration (with both being part of the integration layer) has **great potential.**

It is recommended that the following integration patterns be implemented in the integration layer either in SAP Cloud Platform Integration or SAP Process Orchestration, as reflected in Figure 10:

- The **structure mapping pattern** maps message fields between two interfaces. Structure mappings can mediate between different structures of the same format (for example, two different XML structures) or even change the format (for example, from JSON to XML).
- The **routing pattern** is used to determine, for a given message, a set of receivers based on static settings (technical routing) or message payload data (content-based routing). Logical receiver destinations define a message receiver within the sending application. The determination of logical receiver destinations within an application is usually tightly coupled with the application data and process model and, hence, is part of the application layer. An example is the configuration of the distribution model in the ABAP® programming language.
- The **splitter pattern** creates multiple messages out of a received message by fragmenting the payload by a splitter rule. By then applying the routing pattern, split message parts might be routed to different receivers.
- The **aggregator pattern** collects multiple inbound messages until a modeled threshold is reached. A single payload is then constructed out of all aggregated payloads by applying a certain aggregation rule. Finally, this single message is forwarded to the receivers.
- The **protocol adaptation pattern** handles the mediation between two different protocols used by the sending and receiving applications (for example, Java Message Service, REST, or SOAP).

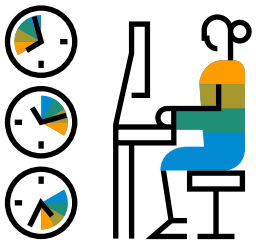
For further integration patterns related to the integration layer, refer to the book Enterprise Integration Patterns by Gregg Hohpe and Bobby Woolf published in 2003 by Addison-Wesley.



The splitter pattern **creates multiple messages** out of a received message by fragmenting the payload by a splitter rule. By then applying the routing pattern, split message parts might be routed to different receivers.

The following patterns can be implemented either in the integration layer or the application layer:

- The **value mapping pattern** transforms field values that are exchanged between two applications. Since this pattern is tightly coupled with business application data, business users must be able to maintain value mappings in a dynamic way. This is a typical value mapping pattern covered by SAP Application Interface Framework, as business users may detect application errors, such as incomplete value mappings, due to unforeseen values coming up. They then must extend these mappings in an agile way close to the application. Static code list value mappings (for example, country code mappings) can be best implemented in the integration layer, as they can be reused across multiple integration scenarios between various applications.
- The **data validation pattern** checks a received message with respect to schema correctness or data correctness. This pattern can be applied in the integration layer as well as in the application layer. SAP Application Interface Framework particularly supports this pattern, as it provides full access to application data and functions.
- The **forward error correction pattern** handles an application error during message processing by forwarding it to the receiver. One key capability of SAP Application Interface Framework is error correction and resolution by business users.



One key capability of SAP Application Interface Framework is **error correction and resolution** by business users.

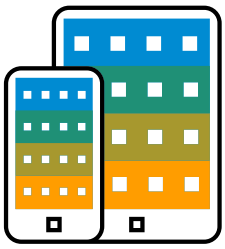
RELATED INTEGRATION TECHNOLOGIES

This section gives an overview of related technologies for specific use cases that complement the core technologies: SAP API Management technology and the SAP Cloud Platform Workflow service as well as the SAP Cloud Platform Connectivity service.

SAP API Management

SAP API Management provides a solution for the full lifecycle management of APIs. This technology complements SAP Cloud Platform Integration. APIs provide a hinge between "mode 1" IT – on-premise ERP software, databases, and legacy systems – and "mode 2" IT, which are the agile and innovative solutions offered mostly in the cloud. Our enterprise customers from different lines of business (HR, procurement, finance) and different industries (retail, telecommunications, media, public sector, banking, and utilities) leverage managed APIs with SAP API Management in the following archetypical scenarios:

- **Omnichannel and mobile access** – In retail and media, omnichannel access has become the new reality, as most consumers today use mobile devices rather than PCs or laptops to access Web-based services. Retail mobile apps use product catalogs, order management, and transportation information and processes. APIs provide omnichannel access across mobile apps, kiosks, and retail outlets. The use of APIs is further intensified by the fact that many mobile initiatives are driven by external agencies and application developers who have limited knowledge of enterprise systems and their platforms. Therefore, they often rely on APIs that serve their specific purpose.



SAP API Management provides a solution for the **full lifecycle management** of APIs.

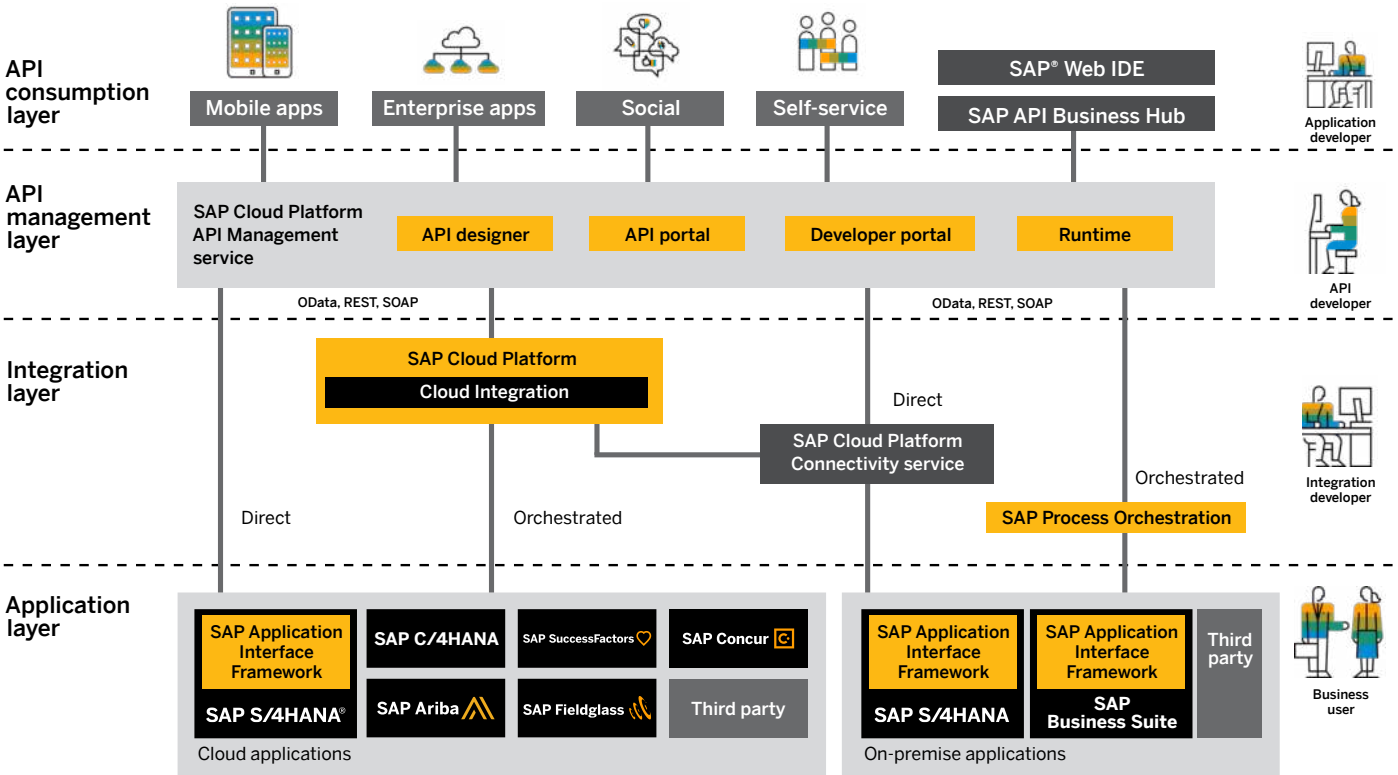
- **Open real-time integration** – In B2B, business collaborations are often driven through APIs. In the banking industry, the rise of numerous FinTech startups and some legal regulations – such as the Revised Directive on Payment Services (PSD2) in Europe – require banks to expose basic account and transaction details through APIs. SAP Concur solutions provide a travel business network by exposing APIs. This enables partners such as Uber Technologies Inc., Airbnb Inc., Marriott International Inc., and The Hertz Corporation to integrate with the network. This trend is technically supported by the microservices architectural style, which leads to well-defined business capabilities that are exposed through APIs for open A2A integrations.
- **Data access governance and monetization** – Organizations in the fields of telecommunications and utilities curate Big Data in their data lakes and expose it in a governed fashion to their ecosystems, sometimes even monetizing this data. In some cases, regulatory compliance requires exposing enterprise data to regulators and governmental agencies or to citizens in the public sector. In these cases, APIs help to expose data with the necessary governance. Another use case is to expose APIs for internal usage within organizations.

Regulatory compliance may require exposing enterprise data to regulators and governmental agencies or to citizens in the public sector. In these cases, **APIs help to expose data** with the necessary governance.

SAP API Management complements SAP Cloud Platform Integration and SAP Process Orchestration by allowing you to manage the full lifecycle of APIs – from design, development, management, and usage analytics to engaging with the developer community. Figure 11 shows a typical hybrid system landscape consisting of four logical layers: the API consumption layer, the API management layer, the integration layer, and the application layer, including the relevant roles.

Integration of SAP API Management with cloud and on-premise applications can be established through SAP Cloud Platform Integration or SAP Process Orchestration. Or it can be established through a direct integration link if no mediation or runtime governance through a central hub is required. Integration with back-end applications can also be achieved by using, for example, the SAP Cloud Platform OData Provisioning service or SAP Gateway technology.[11]

Figure 11: SAP API Management Technology



11. For deployment options of SAP Gateway technology, see the blog "SAP Gateway Deployment Options in a Nutshell."

Figure 12 gives an overview of some typical API policies and integration patterns that are best implemented in the API management layer or the integration layer. It provides guidance for integration architects on how to combine the capabilities of both offerings optimally.

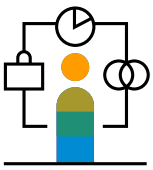
Figure 12: Sample API Policies and Integration Patterns

API Policies and Integration Patterns	API Management Layer	Integration Layer
Integration technology	SAP® API Management	SAP Cloud Platform Integration or SAP Process Orchestration
API traffic management policies	●	●
API security policies	●	●
API analytics and monetization	●	●
Structure mapping	●	●
Protocol adaptation	●	●
Routing	●	●
Splitter	●	●
Aggregator	●	●
Value mapping	●	●

● Recommended ● Partially possible ● Not recommended

Policies define a set of rules that are applied to an API to customize its behavior. It is recommended that the following policies and patterns be implemented in the API management layer, represented by SAP API Management:

- **API traffic management policies** – This group of policies helps control traffic quotas and spikes and can set concurrent rate limits for an API. For example, the quota policy helps API providers restrict the number of calls made to an API, for example, in a specific time frame. It also supports the definition of cache policies for an API.

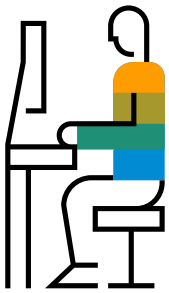


Policies define a set of rules that are applied to an API to **customize its behavior**.

- **API security policies** – This group of policies lets you control security-related aspects of an API. For example, the access control policy makes it possible to limit access to APIs to a specific IP or group of IPs (whitelisting, black-listing). Another example is the verify API key policy, which enforces verification of the application key to access certain APIs. SAP API Management automatically generates API keys on behalf of applications. It enables API providers to view, approve, and revoke API keys.
- **API analytics and monetization** – SAP API Management provides analytics to understand API usage as well as errors. Custom reports can be created in the platform. Metering APIs help to obtain metering information for integrations with billing software systems, such as the SAP Billing and Revenue Innovation Management solution. SAP API Management provides a built-in rating and monetization capability for simple API monetization use cases.

SAP API Management supports basic structure mappings. Forty built-in policies help manage and secure API end points. SAP ships support for best-practice policies in SAP API Business Hub to be copied to and reused in the customers' tenants of SAP API Management. Engaging with developer ecosystems is an important part of SAP API Management. The technology allows API developers and product managers to create API products by packaging several APIs, define rate plans, and publish these API products to the developer portal included in SAP API Management. Customers can create their own branded developer portals using the SAP Cloud Platform Portal service.

As mentioned in "SAP Application Interface Framework," it is recommended that the following patterns be implemented in the integration layer – either in SAP Cloud Platform Integration or SAP Process Orchestration: structure mapping, routing, splitter, aggregator, protocol adaptation, and value mapping. For additional integration patterns related to the integration layer, refer to the book Enterprise Integration Patterns. The API policies and integration patterns listed are only a sample of policies and patterns typically used.

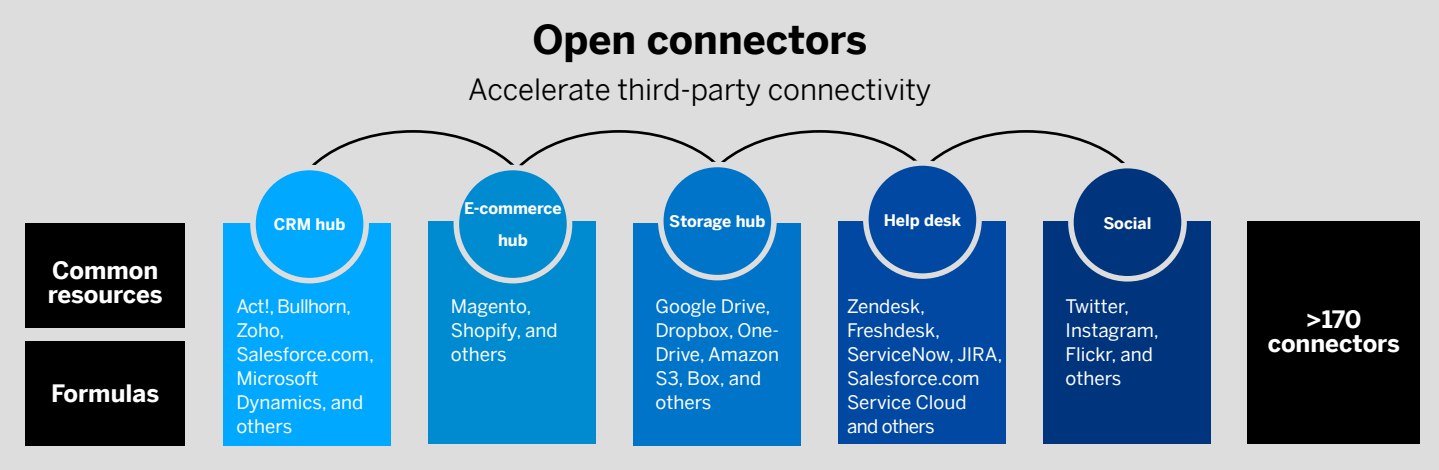


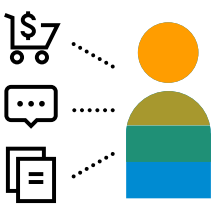
Engaging with developer ecosystems is an important part of SAP API Management. It lets API developers and product managers create API products by packaging several APIs, define rate plans, and publish these API products to a developer portal.

SAP Cloud Platform Open Connectors
Customer system landscapes are becoming more heterogeneous and have data maintained in various distributed systems. The SAP Cloud Platform Open Connectors service aims to simplify connectivity to third-party applications and accelerate integration by providing prebuilt, feature-rich connectors to more than 170 non-SAP applications. Customers benefit from simplified connectivity to third-party applications through REST APIs with normalized authentication, error handling, search, pagination, and bulk support – regardless of the underlying architecture of the third-party applications. Standardized events support polling and Web hooks irrespective of the eventing support of the connected third-party application. This simplifies handling of change notifications through the prebuilt connectors. The ready-to-use connectors come with interactive API documentation based on the OpenAPI Specification 2.0, an open standard for RESTful APIs. It provides integrated test and try-out functionality for third-party applications in one place. The connectors are kept up-to-date by changes at the end point, so the integrations built on them are not affected.

The connectors are grouped or categorized as hubs to provide a unified set of Uniform Resource Identifiers (URIs) across various connectors that are part of the same hub (see Figure 13). Hubs provide consistent resource URIs regardless of the technology used by the target third-party application. Hub topics include marketing, social, finance, field service, help desk, cloud storage, CRM, human capital, payments, ERP, accounting, database, messaging, collaboration, e-commerce, and more.

Figure 13: Connectors Grouped as Hubs





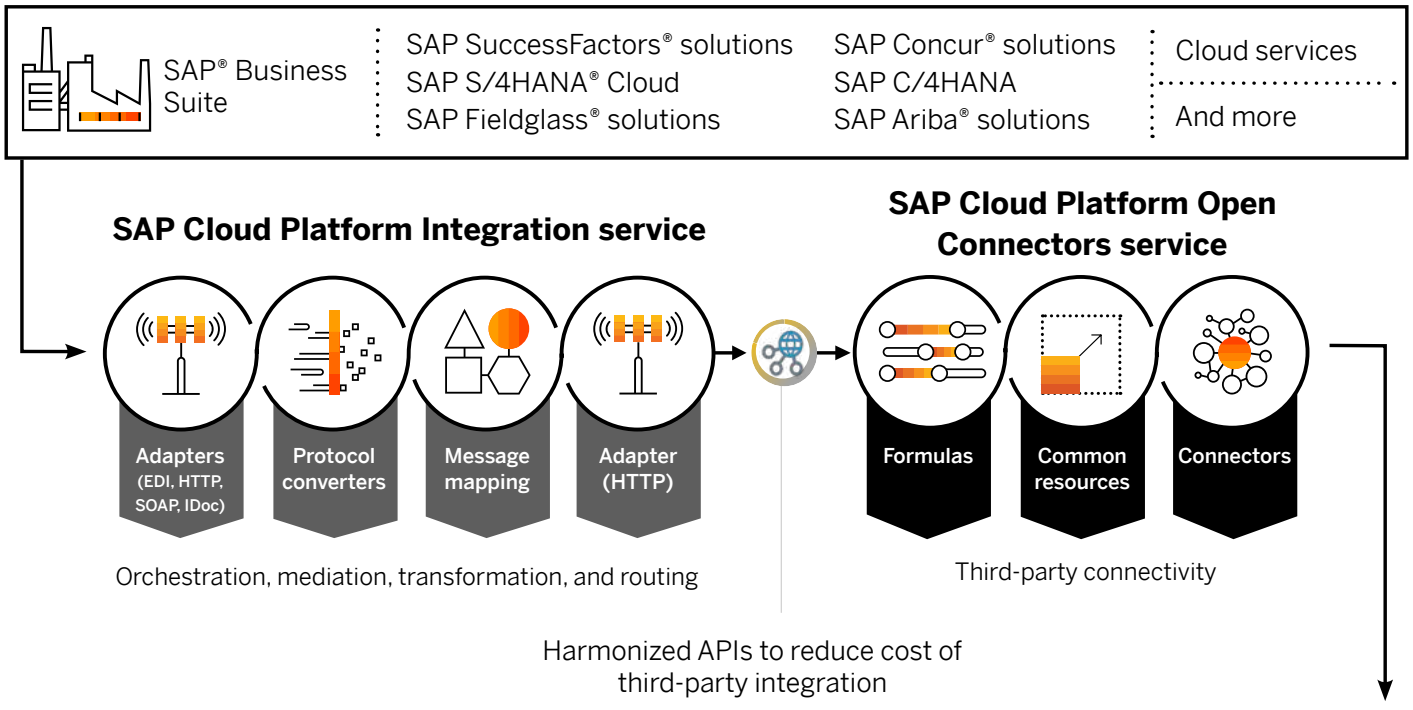
Connectors provide **simplified connectivity** to more than 170 third-party applications. Common resources functionality enables mapping of third-party application objects into customer processes.

The "common resources" functionality enables customers of the SAP Cloud Platform Open Connectors service to define their own custom data model and map it to the connectors. This enables them to extend features of the prebuilt connectors and turn their custom data model into a callable REST resource within the prebuilt connector. The custom data model of the common resources functionality can be mapped to more than one prebuilt connector to provide a simplified one-to-many integration across multiple third-party applications.

The "formulas" functionality enables customers to build simple API compositions across multiple connectors by efficiently chaining requests from multiple connectors together. This enables customers to easily address common use cases, such as synchronizing contacts across multiple third-party applications.

Customers can use the SAP Cloud Platform Open Connectors service with SAP Cloud Platform Integration to simplify integration with several third-party apps and drive innovation with open and easy integration between SAP and non-SAP ecosystems, as captured in Figure 14. SAP Cloud Platform Integration routes requests to the open connectors service, which then establishes the actual connections to third-party systems.

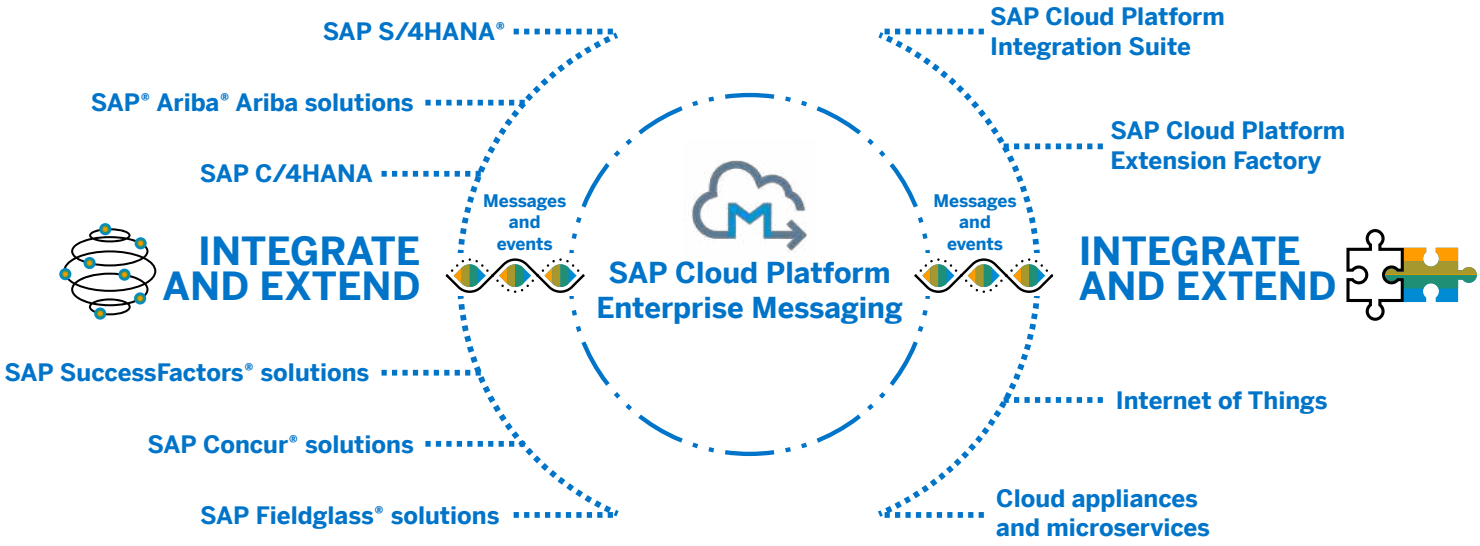
Figure 14: Simplified Integration to Numerous Third-Party Apps



Connectors provide simplified connectivity to more than 170 third-party applications. Common resources functionality enables mapping of third-party application objects into customer processes.

The formulas functionality lets customers define actions on mapped resources. This enables customers to define harmonized APIs to third-party applications.

Figure 15: Event-Driven Integration with SAP Cloud Platform Enterprise Messaging



SAP Cloud Platform Enterprise Messaging

The SAP Cloud Platform Enterprise Messaging service is a fully-managed cloud service that allows applications, services, and systems to communicate through asynchronous messages and events, so you can extend the digital core without disrupting central business processes. Use this service to create responsive applications that work independently and participate in event-driven processes inside your company and across your business ecosystem for greater agility and scalability. (See Figure 15.)

SAP Cloud Platform Enterprise Messaging is a key component for enabling the intelligent enterprise and is an integral part of SAP Cloud Platform Extension Factory. To facilitate your company's transition to becoming an intelligent enterprise, SAP Cloud Platform Enterprise Messaging supports you in connecting systems, building cloud-native apps, and extending on-premise apps with equal ease.

Messaging as a Service

SAP Cloud Platform Enterprise Messaging is a fully-managed messaging-as-a-service offering. SAP as cloud provider is responsible for managing, running, and operating this service as part of the serverless computing offering on SAP Cloud Platform. This serverless ecosystem in which all servers are implemented and managed by SAP allows you to spend less time on operations, scaling, and solving infrastructure dependencies.

Messaging and Event Capabilities

SAP Cloud Platform Enterprise Messaging decouples applications and services in your system landscapes by introducing a dedicated messaging service to take full responsibility for sending and receiving messages and events. By decoupling communication, messages and events can be sent asynchronously. This results in higher throughput since the sender does not need to know of the receiving applications or services, so its resources are not blocked while waiting for a response. Asynchronous communication ensures greater scalability (high throughput, low latency) because sending applications can simply "fire and forget."

You can use a number of open standards and protocols, such as REST, AMQP,[12] and MQTT[13] with SAP Cloud Platform Enterprise Messaging. It supports point-to-point messaging, publish-subscribe messaging patterns, and publish-and-consume messages from queues and topics through REST APIs. Libraries for Java and Node.js are also available.

SAP manages all your data messages across secure data centers around the globe. Messages and events can be placed in queues from which they can be sent securely and reliably to the relevant receivers. In case of network issues, messages and events are stored in the queue until they can be delivered.

Event-Enablement Capabilities

SAP Cloud Platform Enterprise Messaging is fully event-enabled and provides the messaging capabilities through which events (for example, notifications with business object identifiers) can be transported between applications and services in hybrid landscapes. (See **Figure 16**.)

SAP Cloud Platform Enterprise Messaging supports the CloudEvents specification[14] to ensure that all event data is shared in a standard way that is easily consumable. You can send events from SAP sources, such as SAP S/4HANA "out of the box", and non-SAP sources and consume these events in side-by-side extension apps built on SAP Cloud Platform. Extension apps implement additional logic or logic different to the underlying business process and use event subscriptions to be informed of changes in the original. For security, extension app consumers use a read service to obtain additional information and data about the event. In this way, you can share and replicate data across hybrid landscapes and enable event-driven applications in which events can trigger the execution of atomic pieces of business logic (functions).

12. Advanced Message Queuing Protocol
13. Message Queuing Telemetry Transport
14. **https://cloudevents.io**

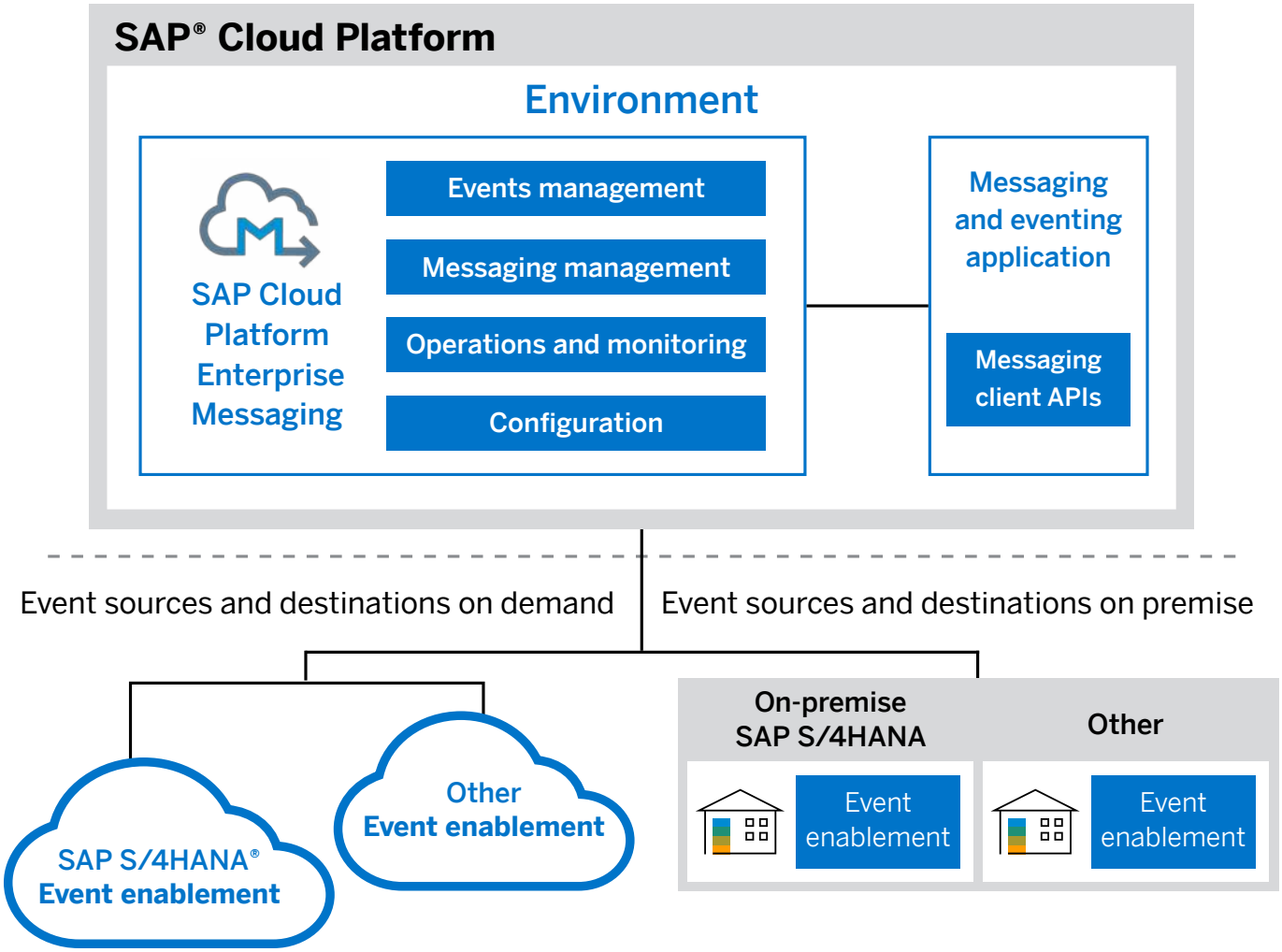
Implement Event-Driven, Serverless Architectures

To implement a fully event-driven, serverless architecture for the intelligent enterprise, use SAP Cloud Platform Enterprise Messaging with other SAP Cloud Platform services. SAP Cloud Platform Enterprise Messaging is part of the SAP Cloud Platform Integration Suite of services designed to help you implement end-to-end integration and extension scenarios.

For more information, see:

- SAP Cloud Platform Integration Suite
- Serverless computing
- SAP Cloud Platform Enterprise Messaging

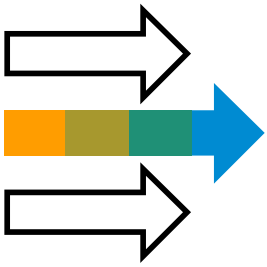
Figure 16: Events and Messages in Hybrid Landscapes



SAP Cloud Platform Workflow
For customers with an on-premise focus, SAP Process Orchestration provides the capabilities for business rules management, business process management, and process integration. The software supports processes running across different third-party and SAP solutions as well as the involvement of disparate business users in a single solution. The possibility of creating net-new processes as well as extensions of existing processes provides more flexibility. In these use cases, SAP Business Process Management software focuses on human-centric processes and orchestrates system-centric ones running on the SAP Process Integration offering – both essential parts of SAP Process Orchestration.

In the cloud, the SAP Cloud Platform Workflow service covers human-centric processes, while system-centric processes are covered by SAP Cloud Platform Integration. In supporting new workflow-based applications and extensions of standard cloud application workflows, SAP Cloud Platform Workflow uses SAP Cloud Platform Integration to connect to other applications, services, and systems. In other words, the "power couple" of integration and business process management now provides its strengths in the cloud.

The workflows in SAP Cloud Platform Workflow are modeled within SAP Web IDE using the industry-standard Business Process Model and Notation (BPMN) 2.0.



The "power couple" of integration and business process management now **provides its strengths in the cloud**.

Different task types are available for modeling workflows. For example, user tasks can be linked to a user interface designed with the SAP Fiori® user experience to involve business users and trigger their required action. Service tasks are meant to read and write data to and from other services provided by external or internal applications. This could occur directly through REST APIs or mediated through the integration capabilities of SAP Cloud Platform Integration. You can select available services directly from SAP API Business Hub or integrate business rules built with the SAP Cloud Platform Business Rules service for flexible and agile decision management. With the available gateways (for example, split or XOR), it is possible to control the flow of the designed process and let the system decide which course to take in a process based on defined conditions. With the REST APIs provided, integrating these workflows into custom-built applications is straightforward.

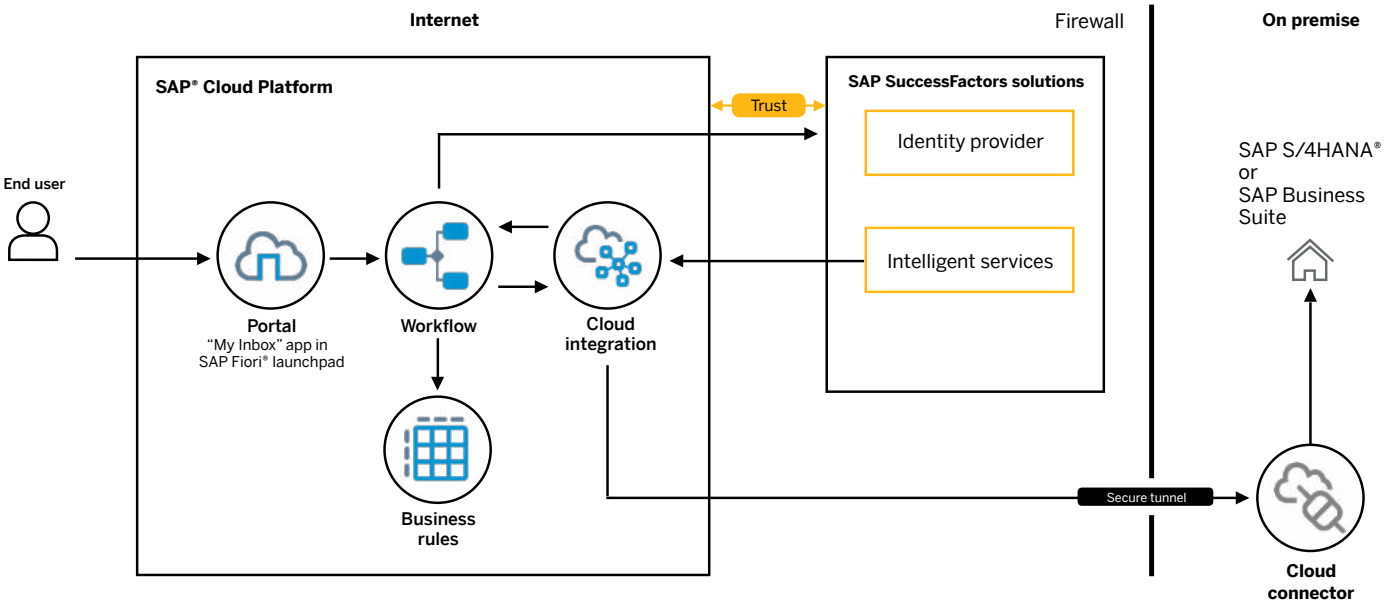
The user tasks mentioned can be managed with the "My Inbox" app, an SAP Fiori app. It serves as the central in-box for the SAP Business Workflow® tool, SAP Process Orchestration, and SAP S/4HANA.

Besides design and execution, an integration administrator, business user, or a user in a similar role must ensure that the workflows are running smoothly and respond in case of any issues. For this purpose, the SAP Cloud Platform Workflow service comes with the "monitor workflow" app, also an SAP Fiori app. With it, the integration administrator can access, monitor, and – in case of any errors – work on all deployed and running workflows.

SAP Cloud Platform Workflow comes with the "monitor workflow" app, an SAP Fiori app. With it, the integration administrator can access, monitor, and – in case of any errors – **work on all deployed and running workflows**.

The use cases supported by SAP Cloud Platform Workflow are quite diverse. Examples include process extensions for SAP S/4HANA, adaptation of procurement processes, development of custom marketing campaign approval processes, and tailoring manufacturing change-management processes to support business requirements. Other common use cases include the extension of line-of-business solutions from SAP – such as the SAP Sales Cloud solution, SAP Ariba solutions, SAP Concur solutions, and SAP SuccessFactors solutions (see Figure 17) – to handle more complex workflow requirements.

Figure 17: Employee Onboarding Scenario as Extension of SAP SuccessFactors Solutions



In the future, it is planned to enhance the SAP Cloud Platform Workflow service to strengthen core workflow and task management capabilities. Other planned goals are to simplify the development of user interfaces and integrations with other services and applications.

The Cloud Connector for SAP Cloud Platform Connectivity

The cloud connector comes as a standard part of the SAP Cloud Platform Connectivity service. It establishes secure technical connectivity between cloud solutions from SAP and protected on-premise networks that cannot be accessed directly from the Internet. The cloud connector is used in hybrid scenarios in which cloud applications must access or extend on-premise software. It can be combined with SAP Cloud Platform Integration when process integration is needed (see "SAP Cloud Platform Integration and SAP Process Orchestration").

The cloud connector acts as a reverse invoke proxy component that is installed and runs on an on-premise network. It establishes a tunnel using the Transport Layer Security protocol – which replaces Secure Sockets Layer – from the on-premise network to its counterpart in the cloud, the SAP Cloud Platform Connectivity service. SAP Cloud Platform Connectivity is integrated in SAP Cloud Platform and SAP S/4HANA Cloud. Once a tunnel from the cloud connector to SAP Cloud Platform Connectivity has been established, cloud applications authorized to use SAP Cloud Platform Connectivity can access whitelisted, on-premise systems through the tunnel. From an application perspective, the connectivity service and its tunnel act like an HTTP-SOCKS5 proxy, that is, they can be used in a programming-language-agnostic way. The cloud connector administrator has full control over which on-premise systems are exposed to the cloud. The administrator can restrict access to on-premise systems to explicitly configured resources when using HTTP or remote function call (RFC). The administrator can also switch the tunnel on or off at any given time. A single cloud connector instance can be connected to multiple subaccounts of SAP Cloud Platform and vice versa. For scenarios in which principal propagation is needed – for example, when forwarding the identity of the cloud user to an on-premise system – trust must be configured between the cloud connector and the targeted on-premise system. Apart from this, on-premise systems do not need to be touched or modified to expose them to cloud applications over the cloud connector.

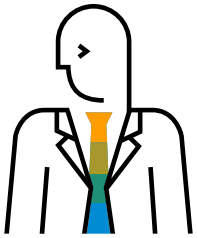
B2B Integration

The SAP offering for B2B integration is based on the B2B functionality for SAP Process Orchestration and the B2B capabilities of SAP Cloud Platform Integration. This section starts with technology guidance on when to use which technology. An overview of the SAP Ariba Cloud Integration Gateway solution follows, which discusses how to use SAP Cloud Platform Integration in an environment managed by SAP for supplier and buyer integration. The section's third part introduces the SAP Cloud Platform Integration Advisor service. The advisor uses machine learning algorithms to improve the efficiency of B2B interface development and mappings.

OVERVIEW AND TECHNOLOGY GUIDANCE

B2B and B2G integrations refer to processes interlinking business partners in the private and public sector. In addition to the requirements of A2A integration within an organization, this use case must support a variety of industry standards in electronic business document exchange. These include UN/EDIFACT, ASC X12, and, at a communication level, AS2. With B2B functionality for SAP Process Orchestration and SAP Cloud Platform Integration, SAP offers two options to build and run B2B integration scenarios.

The B2B functionality for SAP Process Orchestration lets customers create, manage, enhance, and secure their B2B connections between internal enterprise systems and trading partners through multiple channels. The customer is responsible for the system, all operation activities, and the B2B content. SAP Process Orchestration with its support for B2B scenarios should be the preferred solution for an enterprise with an on-premise B2B strategy. The technology can help the enterprise retain full control of its system and all traffic passing through it, for example, to conform to security or data privacy policies. Another tactical reason to choose SAP Process Orchestration may be that specific features, such as trading partner management, are not yet available with the SAP Cloud Platform Integration service.



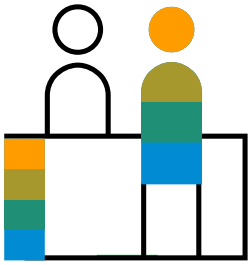
The B2B functionality lets customers **create, manage, enhance, and secure** their B2B connections between internal enterprise systems and trading partners through multiple channels.

SAP Cloud Platform Integration orchestrates and integrates B2B data by connecting cloud and on-premise applications smoothly and securely. SAP Cloud Platform Integration provides major capabilities for B2B integration and preconfigured content packages for B2B and B2G scenarios. It supports the e-document framework for electronic document exchange based on public standards used in diverse countries, and it lets customers define individual B2B interfaces and mappings through the integration advisor service.

The key decision criteria for using the B2B functionality of SAP Cloud Platform Integration are:

- Minimize effort and cost for operation and maintenance
- Benefit from the innovation speed of the cloud
- Connect easily to several cloud-based business applications
- Position the B2B business network in a neutral environment "in the middle" between the business partners, potentially allowing their easier integration

SAP plans to provide all required B2B capabilities with both deployment variants – SAP Cloud Platform Integration and SAP Process Orchestration. This will allow customers to choose between the cloud and on-premise solutions with no limitations imposed, while offering support for a wide variety of B2B and B2G scenarios. Furthermore, SAP plans to enable SAP Cloud Platform Integration and SAP Process Orchestration to use the same B2B integration content by employing content reuse between them. This will reduce errors, costs, and maintenance efforts and will enable easy migration from cloud to on premise and vice versa.



SAP Cloud Platform Integration **provides major capabilities** for B2B integration and preconfigured content packages for B2B and B2G scenarios.

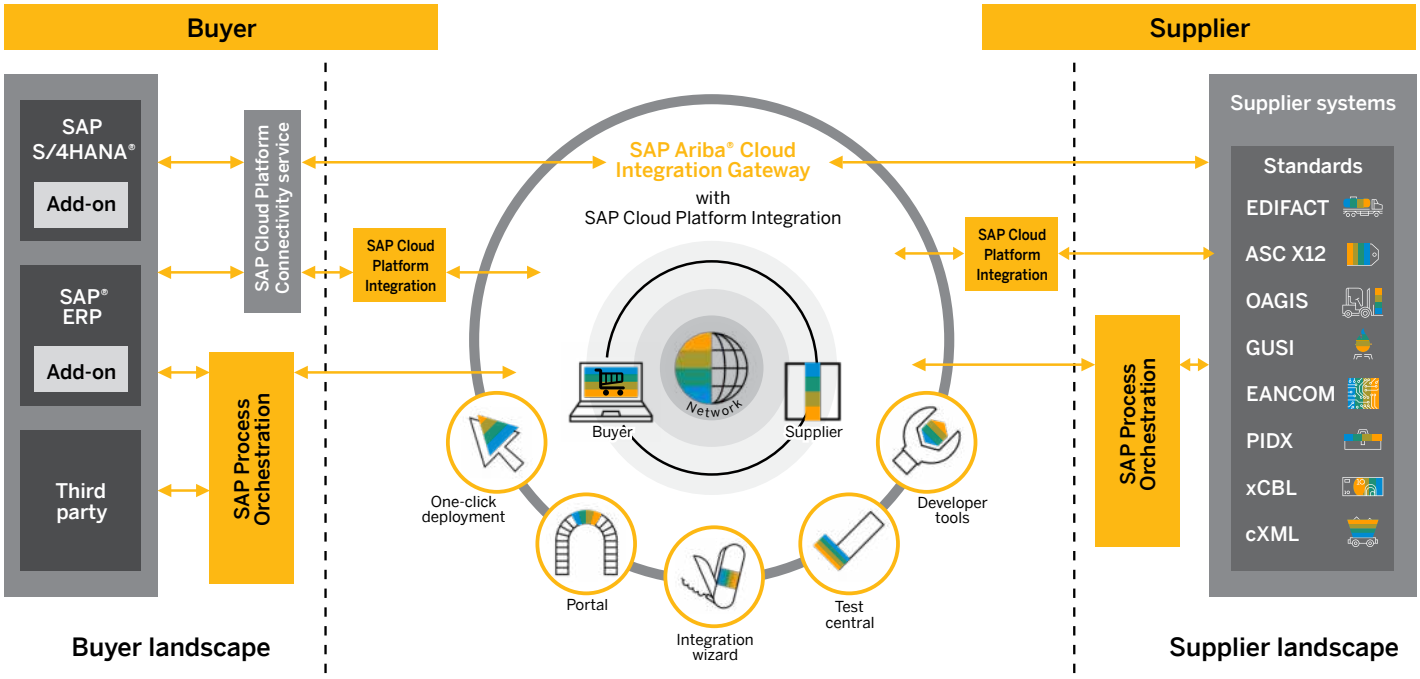
SAP ARIBA CLOUD INTEGRATION GATEWAY

The SAP Ariba Cloud Integration Gateway solution enabled by SAP Cloud Platform Integration is an offering that integrates SAP Ariba solutions into an existing customer infrastructure. While SAP Cloud Platform Integration is a generic integration platform for all kinds of A2A, B2B, and B2G scenarios, SAP Ariba Cloud Integration Gateway specializes in supply chain and procurement processes with a defined set of message types and mappings. SAP Ariba Cloud Integration Gateway accelerates the integration process by making it simple to connect trading partners, SAP Ariba solutions, Ariba Network, and customer back-end systems, such as SAP S/4HANA or SAP Business Suite. More specifically, SAP Ariba Cloud Integration Gateway is an integration offering managed by SAP and based on SAP Cloud Platform Integration. It provides an efficient way to integrate buyer and supplier systems through one gateway to Ariba Network and SAP Ariba solutions in the cloud. SAP Ariba Cloud Integration Gateway offers self-service tools built on SAP Cloud Platform Integration that include integration wizards, a self-testing framework, and reporting and monitoring capabilities, all tailored for the integration use case by SAP Ariba solutions.

Figure 18 gives an overview of the integration options for buyers and suppliers with SAP Ariba Cloud Integration Gateway.

SAP Ariba Cloud Integration Gateway is based on SAP Cloud Platform Integration and provides an **efficient way to integrate** buyer and supplier systems through one gateway to Ariba Network and SAP Ariba solutions in the cloud.

Figure 18: SAP Ariba Cloud Integration Gateway with SAP Cloud Platform Integration

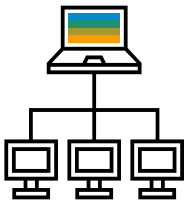


Buyers can integrate SAP S/4HANA or SAP Business Suite by using their existing integration technologies. They might use SAP Process Orchestration or SAP Cloud Platform Integration (managed by the customer) or integrate directly through the cloud connector. As a foundation, SAP provides an add-on for SAP S/4HANA and SAP Business Suite that covers all application-related artifacts, such as application configuration and interface data. This allows suppliers to connect once to Ariba Network to integrate with many customers without having to deal with buyer-specific mappings or customized configurations. As shown in Figure 18, SAP Ariba Cloud Integration Gateway supports multiple B2B standards and can integrate with the existing supplier infrastructure through, for example, SAP Process Orchestration or SAP Cloud Platform Integration.

The process to connect to SAP Ariba Cloud Integration Gateway and use it in an SAP software environment is simple:

1. **Configure** – The account setup wizard lets you identify, download, and install the add-on for the SAP ERP application or the add-on for SAP S/4HANA for the SAP Ariba Cloud Integration Gateway solution. The add-on automatically synchronizes its configuration data with SAP Ariba Cloud Integration Gateway. The gateway then matches this configuration information with built-in integration content for SAP ERP and SAP S/4HANA. The built-in content supports more than 20 business scenarios and more than 100 standard integration interfaces, mostly in the fields of procurement and supply chain.
2. **Extend** – SAP Ariba Cloud Integration Gateway centrally manages customizations of SAP solutions to meet industry, location, and business needs. For example, it supports adding customer-specific fields to the standard integration scenario by SAP Ariba solutions.
3. **Use integration developer tools** – Work-saving integration developer tools expedite formerly resource-intensive processes, accelerating time to value. An integration wizard automates complex integration tasks by guiding business domain experts through a series of simple steps to complete the configuration.
4. **Test** – Test and validate the connectivity, transformation, and content of documents you configured in SAP Ariba Cloud Integration Gateway. This lowers overall testing and setup time, allowing you to go live with the integration quickly. You can select and run a variety of mandatory, optional, and custom test cases to test and perfect these scenarios. This includes simulation of test data for buyers and suppliers.
5. **Validate** – Business rule validation checks your test scenario transactions against the buyer's business rules and alerts you to any issues so you can resolve them up front to ensure your documents are posted.
6. **Operate** – Integration with SAP Solution Manager, the support infrastructure of SAP, and basic platform services inherited from SAP Cloud Platform ensures that the integrations run smoothly and are highly secure. (Basic platform services include single sign-on, real-time monitoring, persistence, centralized upgrades, and enterprise-grade security.)

Further information about SAP Ariba Cloud Integration Gateway can be found at SAP Ariba Cloud Integration Gateway.



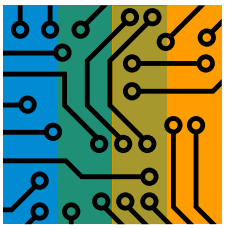
Test and validate the connectivity, transformation, and content of documents you configured in SAP Ariba Cloud Integration Gateway to lower testing and setup time and **go live with the integration quickly**.

SAP CLOUD PLATFORM INTEGRATION ADVISOR

Defining and implementing standards for business document exchange involves complex processes. For each specific business need, a B2B standard must be chosen out of the many that exist and its interface must be customized, and both require agreement between partners. A detailed analysis must be made, and the required customization of the B2B standard interfaces involved must be specified. Most of these interfaces allow millions of different expressions of information on the semantic level, whereas just a few are usually required. Those few must be mapped to the other individually customized B2B interfaces at the business partner sites. The comparison and negotiation involved require deep business domain knowledge.

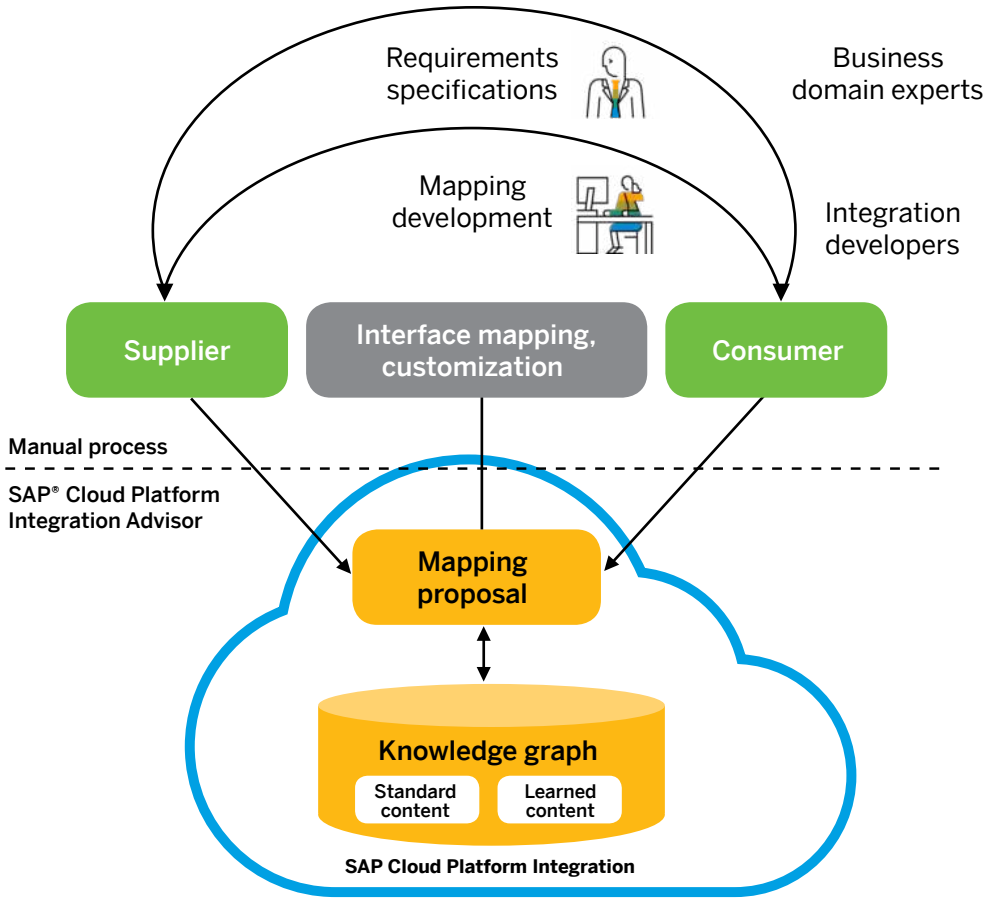
This complexity cannot be reduced by pre-packaged content, which cannot anticipate all possibilities, or by experts, whose expertise is usually in only one of the involved domains.

The SAP Cloud Platform Integration Advisor service is a cloud-based service that addresses these challenges. As shown in Figure 19, the integration advisor service unifies the required tasks for creating B2B integration content based on intelligent proposals derived from a comprehensive knowledge base through a machine learning approach. With this technology, it is possible to accelerate the process of building integration content by more than 60%.



Implementing standards for business document exchange involves **complex processes**. For each specific business need, a B2B standard must be chosen, an interface must be customized, and both require agreement between partners.

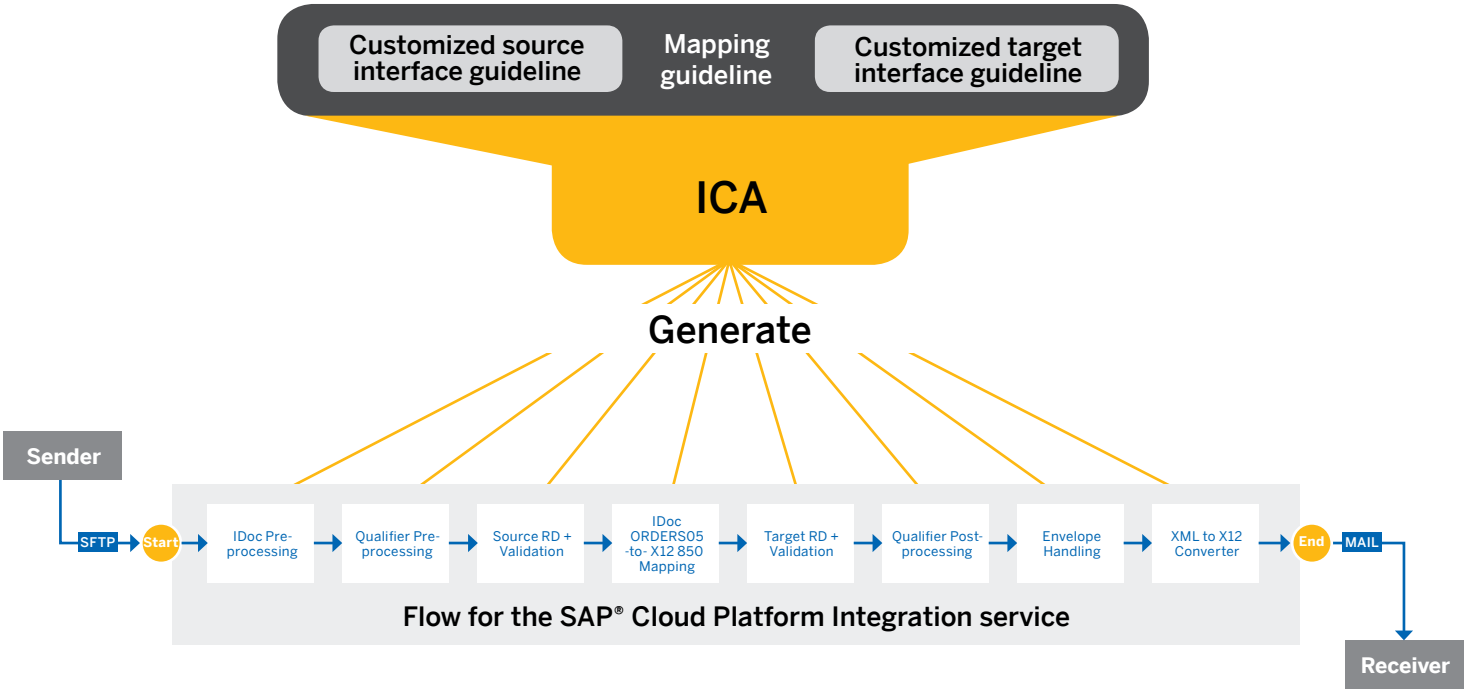
Figure 19: The Basis for Semiautomatic B2B Integration



For creating customized B2B interfaces, SAP Cloud Platform Integration Advisor provides a comprehensive library of the documentation and code lists of all frequently used B2B standards and de facto standards (for example, ASC X12 and UN/EDIFACT). The integration advisor service has a unified design-time view. The machine learning algorithms provide high-quality proposals on how interfaces should be customized and mappings based on practices learned from "the crowd." The crowd refers to the central knowledge graph, where all interface customizations, mappings, and changes made by experts are anonymously registered. These are used to calculate proposals.

The integration advisor service supports business domain experts who need to specify and document the interfaces and mappings. These customized interfaces and mappings are used to automatically generate the required runtime artifacts for validation, conversion, transformation, preprocessing, and postprocessing. Technically, these artifacts can be used immediately in the integration flows of SAP Cloud Platform Integration[15] (see Figure 20).

Figure 20: Integration Flows of SAP Cloud Platform Integration

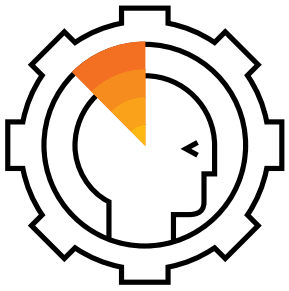


As in the A2A use case, business users should always be able to handle failed messages in their application context. The content generated by the integration advisor service guarantees precise validation of incoming messages as well as the generation of error messages. These can be used for internal error handling or for submission to business partners through functional acknowledgments,[16] which is supported by SAP Cloud Platform Integration.

15. In the future, ICA-generated artifacts may also be available for SAP Process Orchestration.
16. UN/EDIFACT: CONTRL and ASC X12: 997

SAP Cloud Platform Integration thus makes it possible to create individually customized integration flows in a semiautomatic manner, which serve as the technical adapters for external communication.[17] The service also supports tracking and handling failed messages and should be used for all B2B communication scenarios to take full advantage of this combination. Using application-specific implementations or third-party solutions would significantly diminish this benefit.

With the integration advisor service, SAP Cloud Platform Integration lets customers expose their digital assets, either within or outside their organizations. For example, they would be able to submit their B2B interface requirements to business partners.



SAP Cloud Platform Integration thus makes it possible to **create individually customized integration flows** in a semiautomatic manner.

17. For example, through AS2, SFTP, HTTP/S, or SOAP

Data Integration

This section discusses the most important tools and solutions for data management in SAP software environments – for data-centric scenarios such as intelligent business warehouses and for process-centric use cases, which require data as well. SAP HANA Data Management Suite orchestrates all these tools and solutions, reduces data sprawl, helps to analyze data in an instant, and solves previously unsolvable business problems, simplifying overall the transition to the Intelligent Enterprise.

SAP DATA HUB AND SAP SOLUTIONS FOR EIM

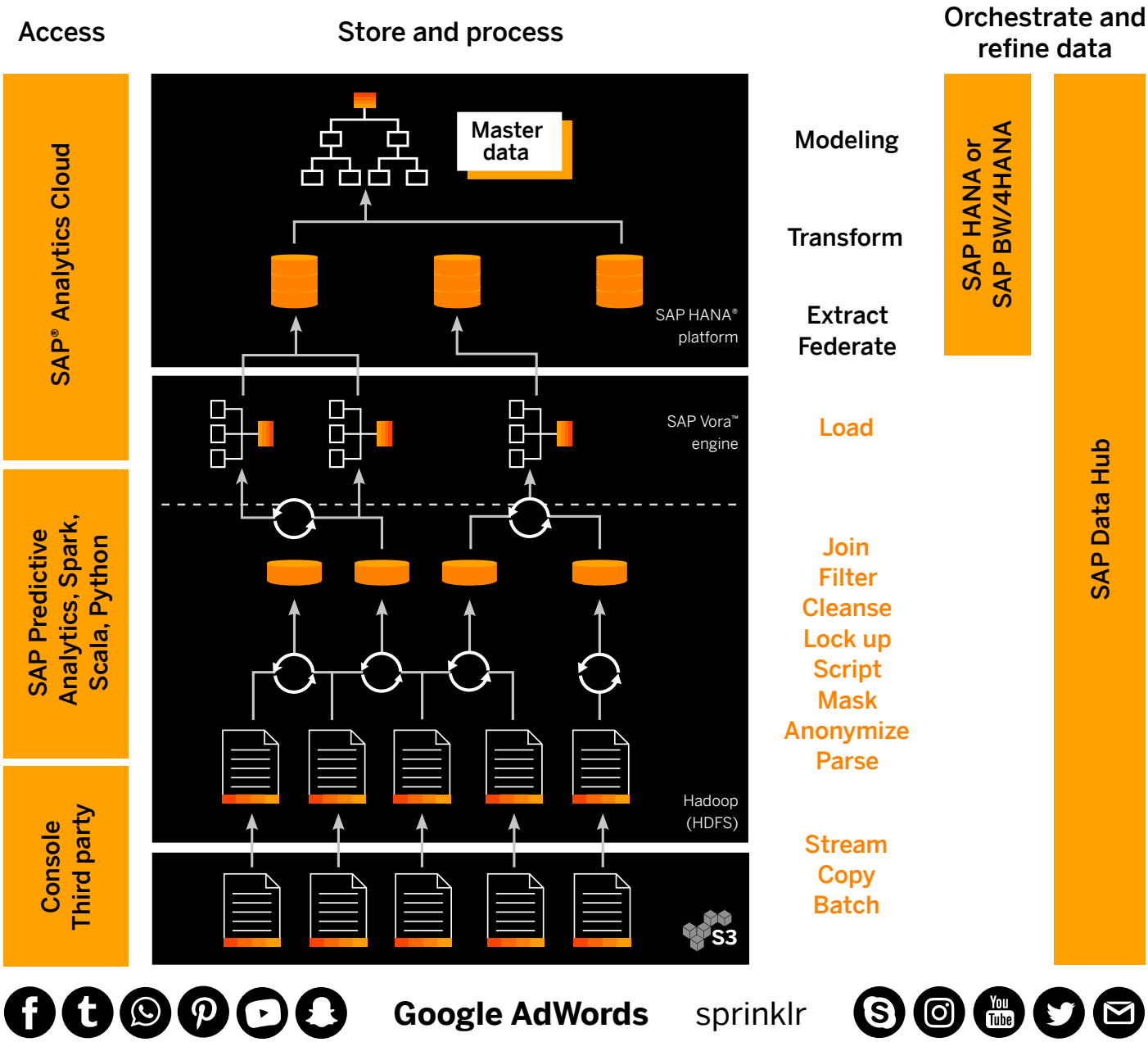
The SAP Data Hub solution is a data operations management solution that enables the agile management of data in a diverse landscape across the organization. It is an enterprise-ready solution that provides governance and orchestration as well as data refinement and enrichment using pipelines with many complex data processing operations, such as image processing and machine learning. In other words, SAP Data Hub is on the one hand able to orchestrate, integrate, and streamline data operations owned by preexisting technologies, such as SAP Landscape Transformation Replication Server or SAP Data Services software. On the other hand, it comes with a set of its own capabilities to enable modern data-integration use cases and processes. SAP Data Hub can be deployed on premise or in the cloud on Amazon Web Services, Google Cloud Platform, or Microsoft Azure.

SAP Data Hub supports the following use cases.

The intelligent data warehouse:

- Close integration with SAP S/4HANA and cloud solutions from SAP (see Figure 21)
- Schema-less data warehouse with high automation and minimal modeling
- A data lake as the primary persistency for high-volume computation
- Scalable storage and data processing capabilities available in the cloud or on premise
- Data processing beyond OLAP with machine learning and predictive analytics

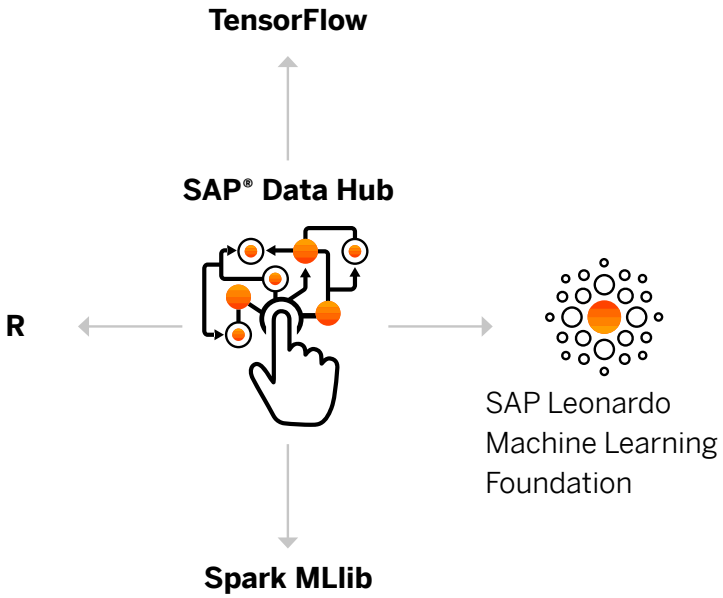
Figure 21: Layers of the Intelligent Data Warehouse



Data science and machine learning:

- Apply machine learning and predictive algorithms to any data set (see Figure 22)
- Operationalize machine learning processes rather than serializing individual algorithms manually
- Add machine learning and predictive processing to any scenarios within use cases such as Big Data warehousing, the IoT, and enterprise information management
- **Examples include:**
  - Insurance industry risk profiling
  - Credit analysis and automated scoring models
  - Machine failure prediction, leading to automated preventive maintenance

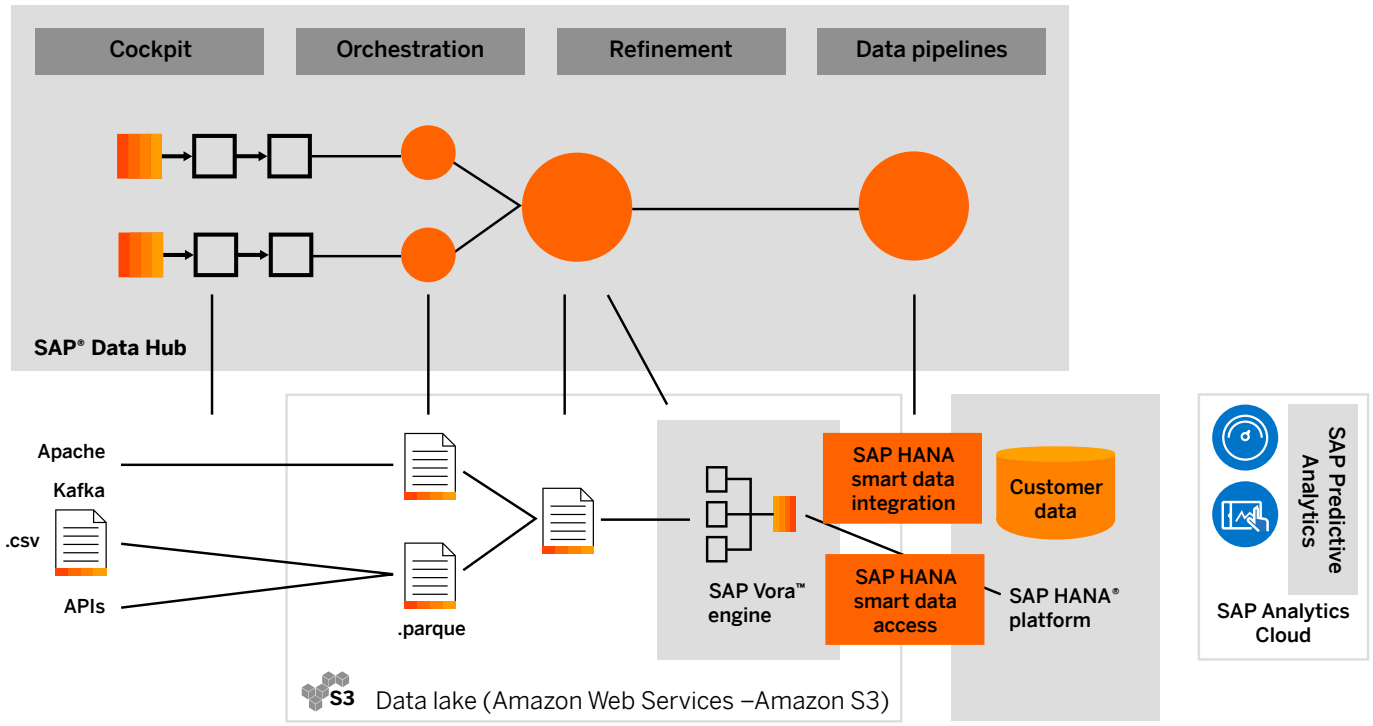
Figure 22: Integrating Machine Learning and Predictive Algorithms



Internet of Things:

- Combine real-world information from IoT-enabled devices such as fitness trackers or home appliances with, for example, customer demographics or supply chain information
- Unite data from messaging systems, cloud storage, data management software from SAP, and enterprise software from SAP (see Figure 23)
- Use event-based pipelines that scale to execute many pipelines in parallel at any time
- **Examples include:**
  - Real-world performance information from Internet-enabled devices, such as appliances
  - Customer demographics
  - Supply chain information
  - Improved product development and marketing based on granular product usage information
  - Application of the concept of digital twins to data streams, enabling customers to test the outcomes and impacts of potential actions

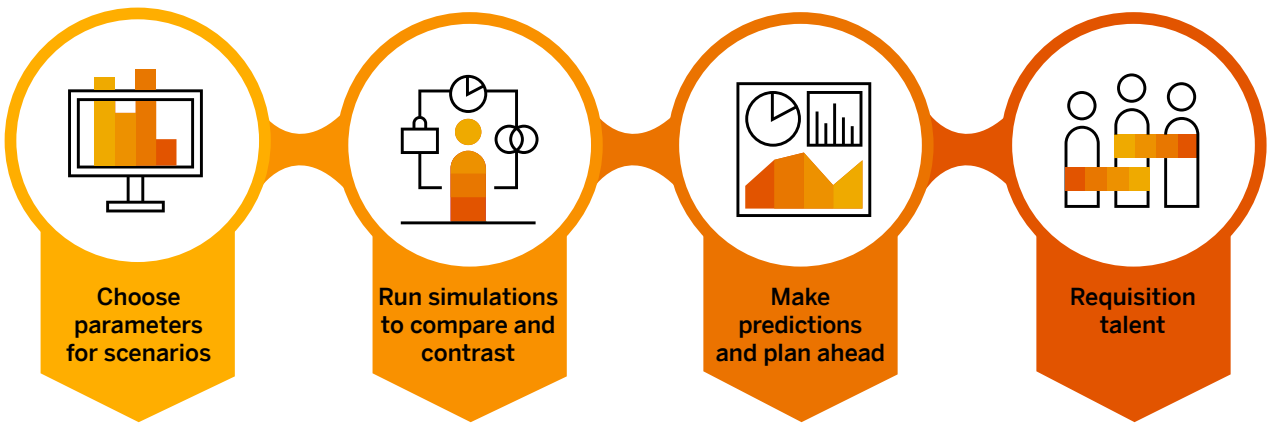
Figure 23: Ingestion and Processing of IoT Data



SAP Leonardo Data Intelligence capabilities:

- Integrate multiple data sources with help from the SAP Fieldglass Live Insights service (see Figure 24)
- Harness data science and machine learning to enrich the recruiting process
- Leverage capabilities of SAP Data Hub, such as data ingestion, processing, and enrichment (see Figure 23)

Figure 24: Improvements with the SAP® Fieldglass® Live Insights Service



Data tiering: Tiering is the assignment of data to storage classes or media based on data type, operational usefulness, performance requirements, frequency of access, and security requirements of the data.

Cold data tiering is used to store less frequently accessed data in inexpensive storage layers:

- Distributed file systems such as Apache Hadoop
- Cloud storage such as Amazon Simple Storage Services from Amazon Web Services or storage services from Google Cloud Platform or Microsoft Azure

When you manage cold data tiering with SAP Data Hub, the data in these storage layers can exclusively be accessed through artifacts provided by SAP HANA for data lifecycle management, such as data lifecycle management profiles and pruning and union views.

Figure 25: Hadoop Example with Different Data Tiers for Different Data Temperatures

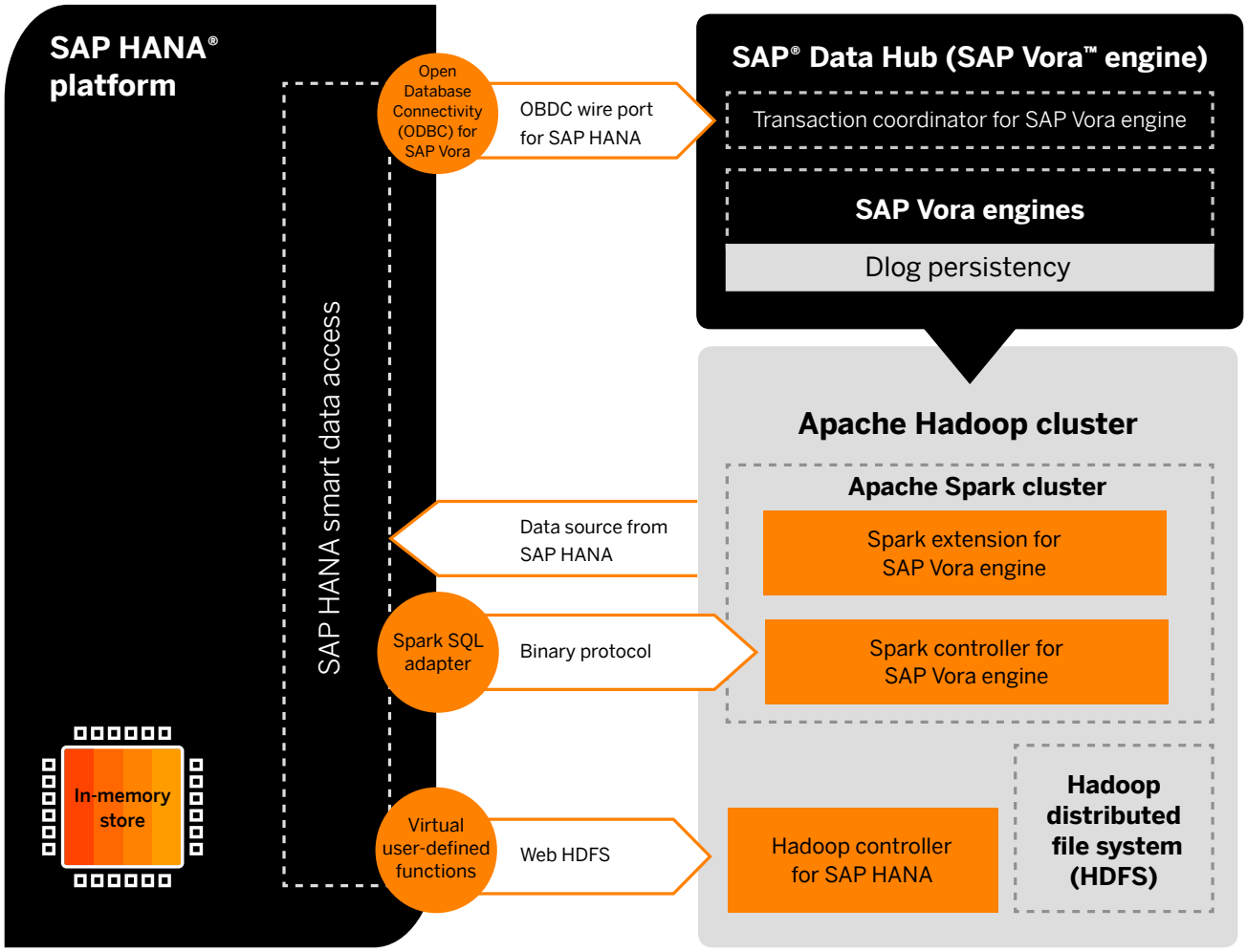
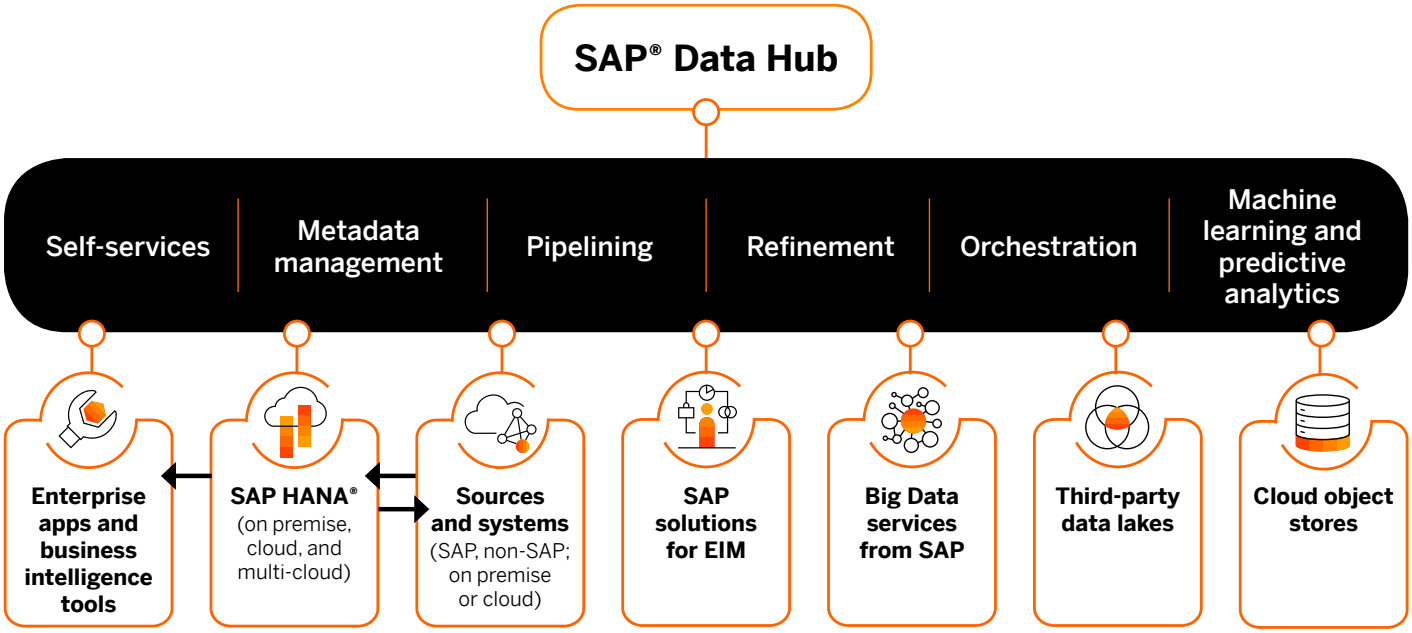


Figure 26: Data-Driven Apps Across Complex Enterprise Landscapes



SAP Data Hub provides capabilities for data preparation, governance, integration, and processing (see Figure 26). They include:

- **Self-services**
  - Data preparation to browse, preview, sample, profile, transform, shape, and enrich data sets
- **Metadata management**
  - Discovery and profiling of data sets
  - Crawling data sources, extraction of metadata, and creation of a searchable information catalog
  - Data lineage and impact analysis
- **Pipelining**
  - Batch or streaming data
  - Structured, semistructured, or unstructured data
  - Graphical pipeline modeling environment with reusable components for connectivity, structured processing, and custom code
- **Refinement**
  - Transformations of type extract, transform, and load (ETL)
    - Projection, joining, and aggregation
  - Validation rules
  - Integration with SAP Data Quality Management, microservices for location data
    - Address cleansing
    - Geocoding
  - Custom code
    - JavaScript, Python, Spark, and others
- **Orchestration**
  - Workflow
    - Creation of complex data processes that combine multiple pipelines or pipelines and data processes in other data management solutions from SAP
  - Scheduling
  - Monitoring
- **Machine learning and predictive analytics**
  - SAP Leonardo Machine Learning Foundation
  - Python programming language
  - R programming language
  - Scala ML – a programming language for machine learning

For more details about the capabilities of SAP Data Hub and how to employ it in conjunction with other data management technologies, see the following:

- What Is SAP Data Hub? and Answers to Other Frequently Asked Questions
- CIO Guide: SAP Vision for Integrating SAP Applications in Cloud and Hybrid Environments
- CIO Guide to Using SAP Technology for Big Data

Not only can SAP Data Hub process data itself, it can also orchestrate the following data integration and data management solutions from SAP:

- SAP BW4/HANA and the SAP Business Warehouse application
- SAP Landscape Transformation Replication Server
- SAP Data Services
- SAP HANA smart data integration

The question may be asked why SAP Data Hub is needed to orchestrate other solutions. Here are a few reasons you might want to consider:

- To protect prior investments by leveraging existing data processes implemented in other solutions, such as jobs in SAP Data Services or process chains in SAP Business Warehouse
- To simplify your data operations by centralizing the scheduling, execution, and monitoring of data processes that span multiple tools in a single solution, with that solution being SAP Data Hub
- To get access to data for which SAP Data Hub does not provide a connector

Usage Guidance

In some situations, it is possible to use SAP Data Hub or one of the traditional SAP solutions for EIM. The question is when to use which solution. While it is difficult to provide an answer for every possible situation, here are some guidelines.

For **batch ETL of structured data** with SQL-type transformations – including data quality – in simple system landscapes for data migration, data warehousing, and data mart scenarios, choose SAP Data Services.

For **real-time change data capture** from databases supported by the SAP NetWeaver® technology platform to other databases supported by SAP NetWeaver, including the SAP HANA database, choose SAP Landscape Transformation Replication Server.

SAP Data Hub is a data operations management solution that enables **agile management of data** in a diverse landscape across the organization.

For **batch ETL to SAP HANA** or for real-time change data capture from databases and other real-time data sources to SAP HANA, choose:

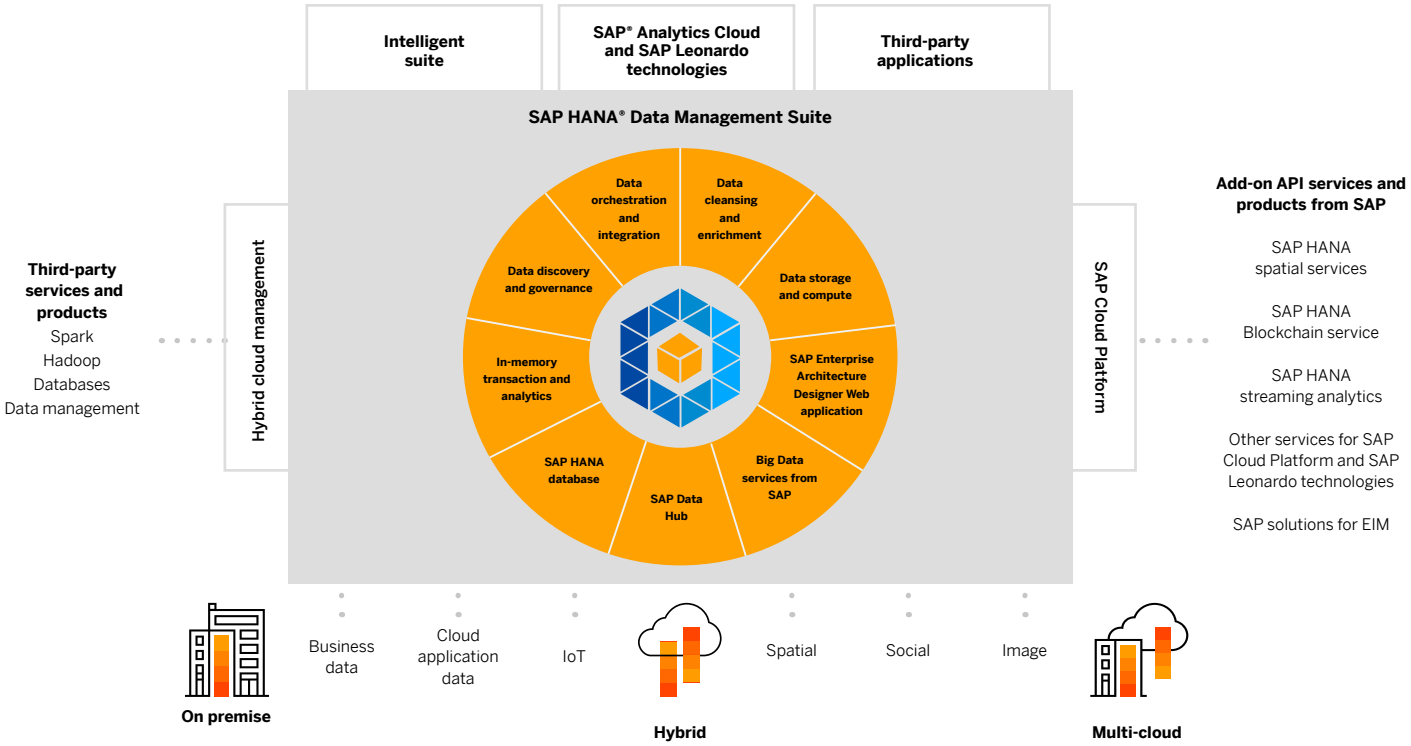
- SAP HANA smart data integration for on-premise SAP HANA
- SAP Cloud Platform Smart Data Integration for SAP HANA running with SAP Cloud Platform

For complex data processes that go beyond moving data from point A to point B, SAP Data Hub is the solution of choice. The hub should also be used in complex system landscapes where you need to combine enterprise data and Big Data, whether for on-premise or cloud-based object storages. SAP Data Hub is also the solution of choice for high-frequency streaming scenarios such as the IoT, and for scenarios that require complex data processing using machine learning or other custom algorithms.

SAP HANA DATA MANAGEMENT SUITE

As you can see in Figure 27, SAP Data Hub is one of the four major components of SAP HANA Data Management Suite. The suite enables secure, governed, enterprise-class applications and analytics by providing an open, hybrid, multi-cloud–enabled solution suite that orchestrates all the data you need within a trusted, unified landscape. SAP HANA Data Management Suite thus reduces complexity.

Figure 27: SAP HANA Data Management Suite



EXISTING CUSTOMER INVESTMENTS

SAP understands that customers have made significant investments in SAP solutions for EIM and strives to help them protect those investments. To leverage existing data integration defined in their tools, SAP Data Hub integrates with SAP Data Services, SAP Landscape Transformation Replication Server, SAP HANA smart data integration, and the SAP Cloud Platform Smart Data Integration service.

SAP advocates an open solution that recognizes and reduces the complexity and diversity of today's enterprise data landscapes. It uses open-source Big Data technologies, such as Python, Scala, Kafka, Apache Hadoop, and Apache Spark, and combines them into productive, end-to-end scenarios. SAP Data Hub is also open on the enterprise side, allowing data to be shared no matter the source, through a tight integration with SAP Data Services.

Outlook

Future plans at SAP include the release of SAP Data Hub as a service, a fully managed service available on SAP Cloud Platform. It is also planned to provide templates for easy integration with on-premise and cloud solutions from SAP (for example, SAP S/4HANA or the SAP C/4HANA suite) as well as industry-specific models and scenarios. And finally, SAP intends to enhance existing capabilities such as metadata management, pipelining, and orchestration.

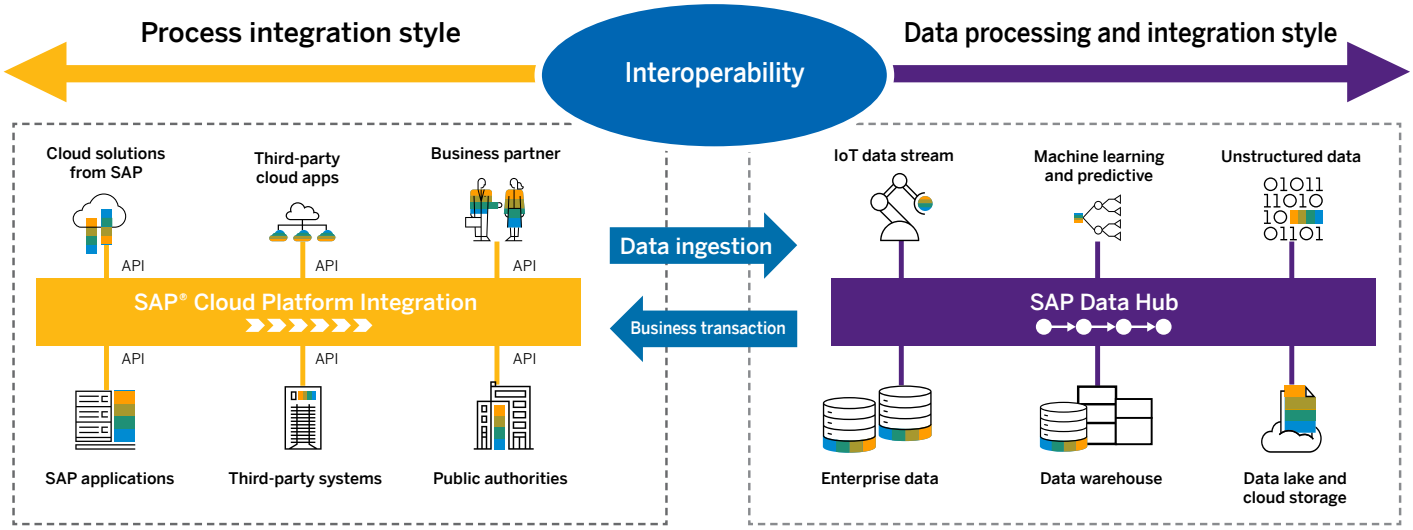
For details, check out the road map for SAP Data Hub.

SAP CLOUD PLATFORM INTEGRATION AND SAP DATA HUB

SAP Cloud Platform Integration and SAP Data Hub are complementary offerings that address two different integration styles, as depicted in Figure 28. Based on typical usage scenarios and characteristics of both integration technologies, this section gives enterprise and integration architects guidance on when to use which integration technology. It also discusses how to combine the technologies in an end-to-end integration scenario.

SAP advocates an **open solution** that recognizes and reduces the complexity and diversity of today's enterprise data landscapes.

Figure 28: SAP Cloud Platform Integration and SAP Data Hub – Complementary Offerings



SAP Cloud Platform Integration addresses process integration and facilitates linking business processes that are distributed across multiple applications within a hybrid system landscape. As outlined in "Process Integration," SAP Cloud Platform Integration supports A2A, B2B, and B2G integration use cases. Typically, the focus of SAP Cloud Platform Integration is on the secure and reliable API-based integration of applications.[18] SAP Cloud Platform Integration uses a message-based processing paradigm that allows the queuing, transforming, routing, and monitoring (including error handling) of exchanged business data on a message level. A key requirement of this process integration style is to guarantee the transactional integrity of an integration scenario that, for example, is ensured by reliable messaging capabilities. Furthermore, SAP offers a broad range of prepackaged integration scenarios for SAP Cloud Platform Integration.

18. Table access is also possible with the data service of SAP Cloud Platform Integration, but it's not a key focus.

In contrast, SAP Data Hub focuses on data integration, making it possible to share, pipeline, govern, and orchestrate (mass) data in complex landscapes. It supports the expansion of traditional data warehousing by incorporating Big Data stores and the ingestion and processing of IoT data. SAP Data Hub enriches existing software, such as SAP Data Services or SAP HANA smart data integration, by modernizing data flows and leveraging new functionality and algorithms, including machine learning and image processing. Typically, data from enterprise applications is accessed on the database level (table, view)[19] outside a transactional business context. The following table summarizes the key characteristics of both integration technologies.

Features of SAP® Cloud Platform Integration and SAP Data Hub

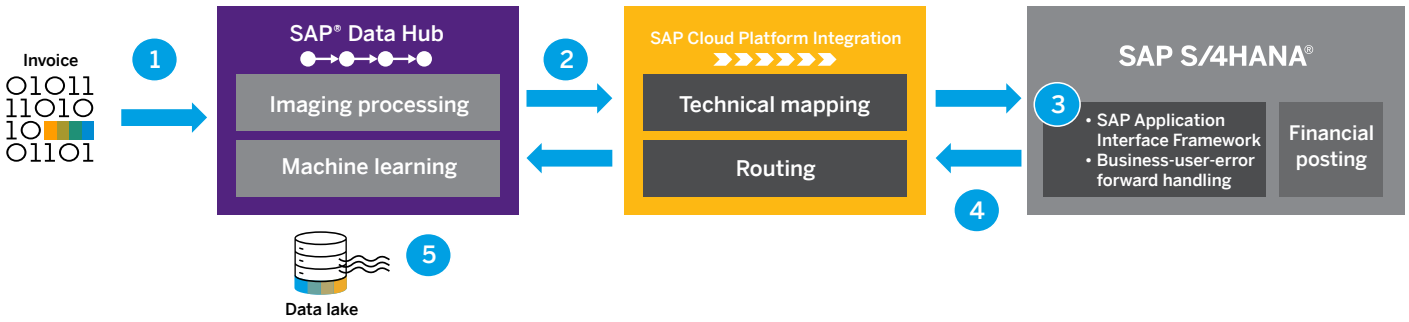
	SAP® Cloud Platform Integration	SAP Data Hub
Objective	Chaining distributed business processes in hybrid landscapes	Pipelining and orchestrating Big Data in hybrid landscapes
Use cases	• Application to application • Business to business, business to government • Master data synchronization	• Intelligent data warehousing • Data science and machine learning • Internet of Things • SAP Leonardo Data Intelligence • Data tiering
Coupling to application	API focused (synchronous, asynchronous, business events)	Data focused (table, table views, storage, technical events)
Integration content	Available for a broad range of integration scenarios for SAP® applications (hybrid, cloud, third party)	Available as predefined templates for operations and pipelines
Specific capabilities	• Message-based processing (monitoring, alerting, error handling) • Transactional integrity (reliable messaging) • Process-centric integration flows	• Distributed data processing • High-frequency event processing • Advanced data transformations and processing (for example, machine learning, predictive, code) • Data-centric integration flows

19. API-level access is also possible with SAP Data Hub, but it's not the key focus.

As shown in Figure 29, both integration technologies are complementary and can be used in combined scenarios.[20] For example, transactional data can be passed from SAP Cloud Platform Integration to SAP Data Hub.

Conversely, SAP Data Hub can integrate with SAP Cloud Platform Integration when a deep transactional integration with enterprise applications is required.

Figure 29: SAP Cloud Platform Integration and SAP Data Hub – An Integration Scenario



In the sample scenario in Figure 29, an invoice received as an image is read by an image processing service orchestrated by SAP Data Hub, and the invoice is converted into structured data. The structured data is then converted into the target format for SAP S/4HANA by SAP Cloud Platform Integration and routed to the target system of SAP S/4HANA. In case of errors in the inbound processing for SAP S/4HANA, business users can correct the invoice message with the SAP Application Interface Framework tool. The information about the corrected parts of the invoice is sent back to SAP Data Hub and stored in the data lake. This is used to train the machine learning algorithms to improve the image processing.

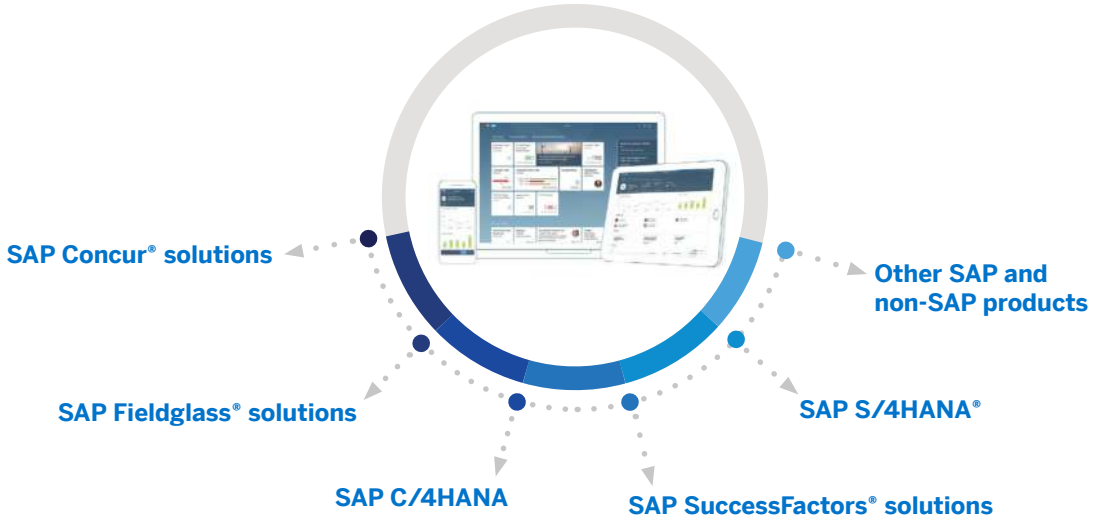
20. Currently, the mechanism is a message-based data exchange (REST, OData) in proof-of-concept status.

UX Integration

SAP Fiori UX is the leading design for all SAP applications, providing a harmonized user experience across on-premise and cloud solutions. In line with this document's focus on process and data integration, this section discusses the underlying architecture that provides data to the user interfaces built with SAP Fiori UX.

One important aspect of a harmonized user experience is a central entry point[21] for users to all SAP and non-SAP business applications. SAP Fiori launchpad is such a central entry point (see Figure 30). This section examines the different deployment options for SAP Fiori launchpad and the different data provisioning options for SAP Fiori apps.

Figure 30: SAP Fiori Launchpad as Central Entry Point



DEPLOYMENT OPTIONS FOR SAP FIORI UX

When deploying the underlying architecture of SAP Fiori, several deployment options are available to ensure efficient, secure data provisioning to SAP Fiori apps and their UI elements. All options integrate the UI layer with your business logic and platform services.

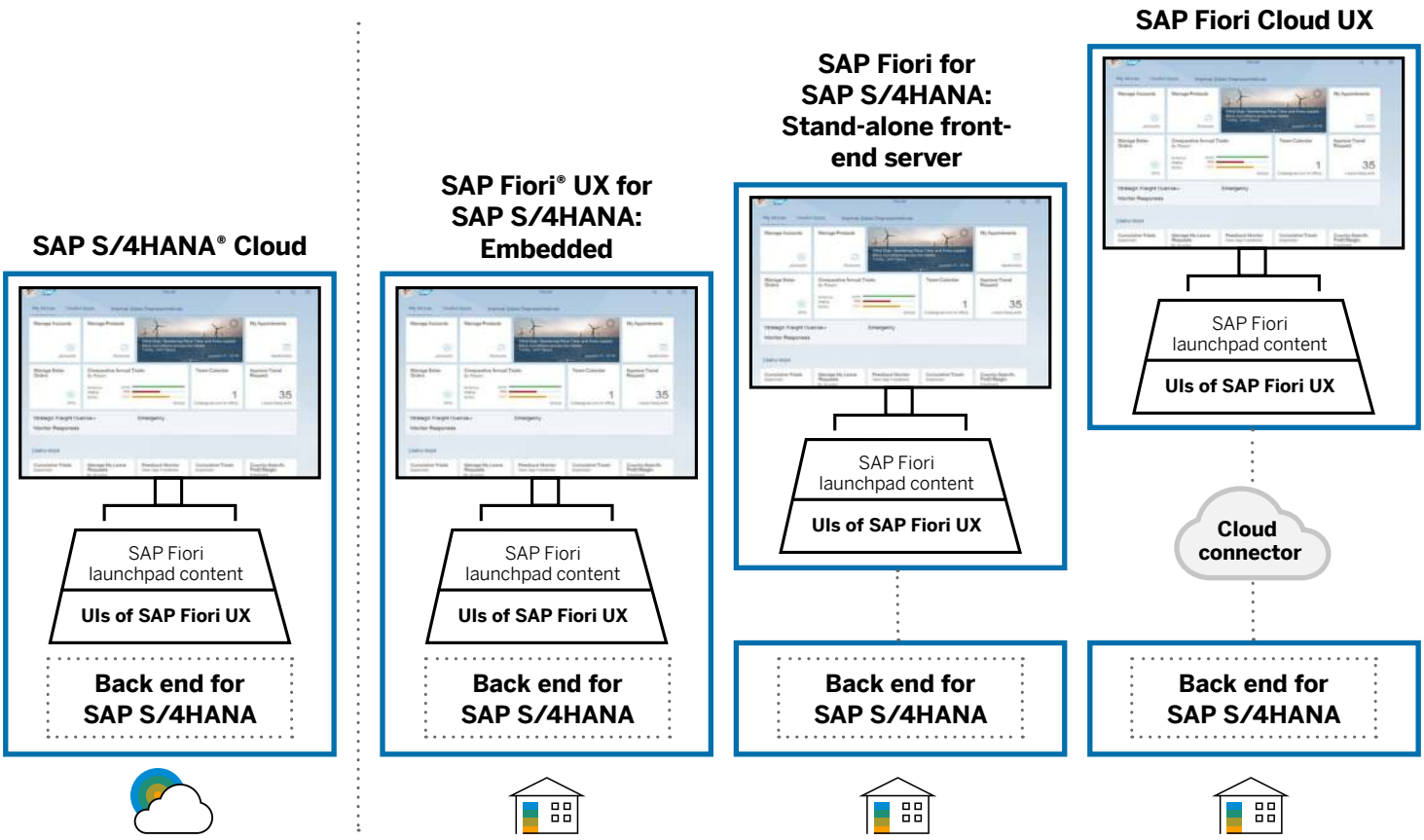
Figure 31 shows the deployment options available for SAP Fiori for SAP S/4HANA. SAP Fiori for SAP S/4HANA can be consumed in pure on-premise scenarios with an SAP Fiori front-end server. The server can be embedded or deployed on a dedicated server (hub deployment).

The cloud deployment option for SAP Fiori was introduced in 2015 to offer an alternative hybrid deployment option for SAP S/4HANA with the standard content packages and SAP Fiori apps on SAP Cloud Platform. The content is suitable for SAP S/4HANA release 1610 (finance) and 1709. Please note that additional content packages for SAP Fiori Cloud will not be delivered. Please see details about SAP Fiori in the SAP Fiori apps reference library.

Finally, SAP S/4HANA Cloud is a purely cloud-based solution, with all components and back ends of SAP Fiori UX deployed in the cloud. This variant is not discussed in this document.

21. Please check either of the following links for a detailed description of SAP Fiori launchpad: https://experience.sap.com/fiori or www.sap.com/products/fiori.html.

Figure 31: Deployment Options for SAP Fiori for SAP S/4HANA



For detailed information about the different deployment options, please refer to SAP Fiori Deployment Options and System Landscape Recommendations.

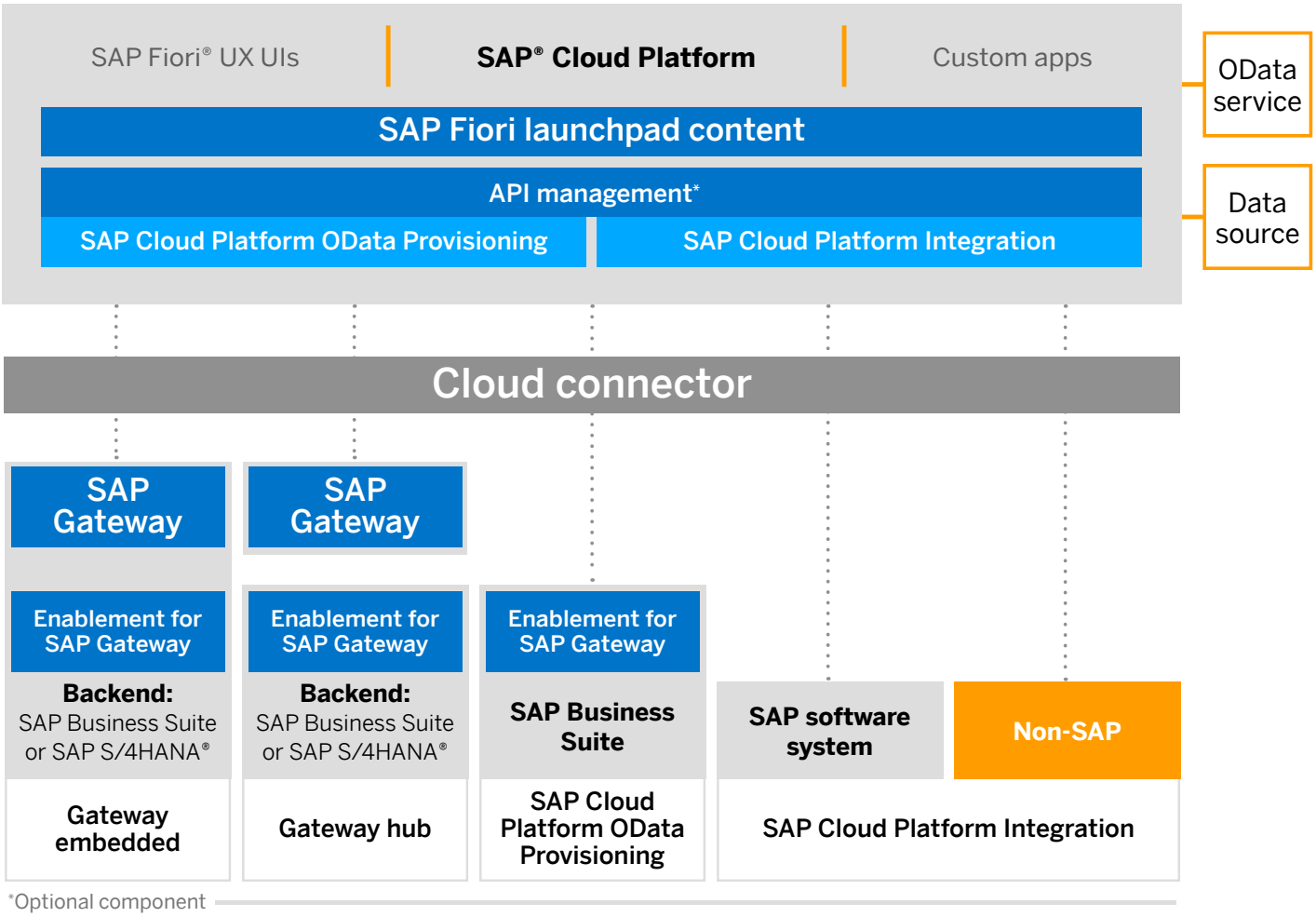
Data Provisioning Options

When SAP Fiori apps are deployed on premise, the UI components are installed on the SAP Fiori front-end server as hub or embedded deployment. The SAP Gateway component on the front-end server handles OData service calls to access business data on the back end.

On SAP Cloud Platform, customers can run, extend, and develop Fiori apps in the cloud while connecting to on-premise systems through the cloud connector. The OData requests are then handled by SAP Gateway in the same way as for the on-premise setup.

For SAP Business Suite back ends, the SAP Cloud Platform OData Provisioning service can be used as a lightweight alternative to SAP Gateway. See the link to the related SAP Note on page 76.

Figure 32: Data Provisioning Options for Hybrid Scenarios



If not all data sources are based on OData, SAP Cloud Platform Integration is the recommended service to connect any kind of data sources from an on-premise system (whether SAP or non-SAP) or from the cloud. For further information, please refer to the SAP Help Portal site and to the blog "OData Service Project Versus Integration Project: When to Use What in Cloud Platform Integration."

The considerations, recommendations, and restrictions concerning embedded or hub deployment are pretty much the same for the SAP Fiori front-end server in pure on-premise scenarios and the SAP Gateway technology in hybrid scenarios. For that reason, they are summarized in the following table. Again, please find detailed information in the document linked above.

Differences Between Deployment Options

	Hub	Embedded
Administration	Central configuration, but complex for lifecycle and upgrade operations	Multiple configuration, administration
Availability	High-availability concept required	In line with high-availability concept of embedding systems
Central functionalities	Support for central functionalities, such as in-box and search	Need for an additional approach, as central functionalities are not directly supported in an embedded deployment
Content	Support for composition scenarios, potentially complex	Limited content scope per system
Interoperability	Requirement that hub version be in sync with back ends	Possibility to deploy appropriate version per back end
Landscape	Separate systems required, performance impact in globally distributed environments	Reuse of existing landscape, local access to content of SAP Fiori® user experience, and apps to improve performance
Ownership	Ownership of hub and content possibly distributed	Ownership of system probably in one hand
Roles and authorization	Decoupled from back end	In one place
Scalability	Dedicated resources for UI requests	Possible necessity to resize entire back end
Security	Decoupled from back ends	Potential risk in Internet scenarios when coupling with back ends

The benefits of the SAP Cloud Platform OData Provisioning service are similar to the general cloud operations benefits. SAP handles upgrades, scaling, and security as well as the following aspects:

- Support for composition of multiple systems
- Based on SAP Cloud Platform, which supports additional authentication options
- No additional server needed for SAP Gateway technology or the SAP Fiori front-end server
- Service implementation with direct local access to metadata and business data, meaning easy reuse of data

For restrictions compared to a full on-premise server for SAP Gateway, please refer to SAP Note 1830712 (S-User required).

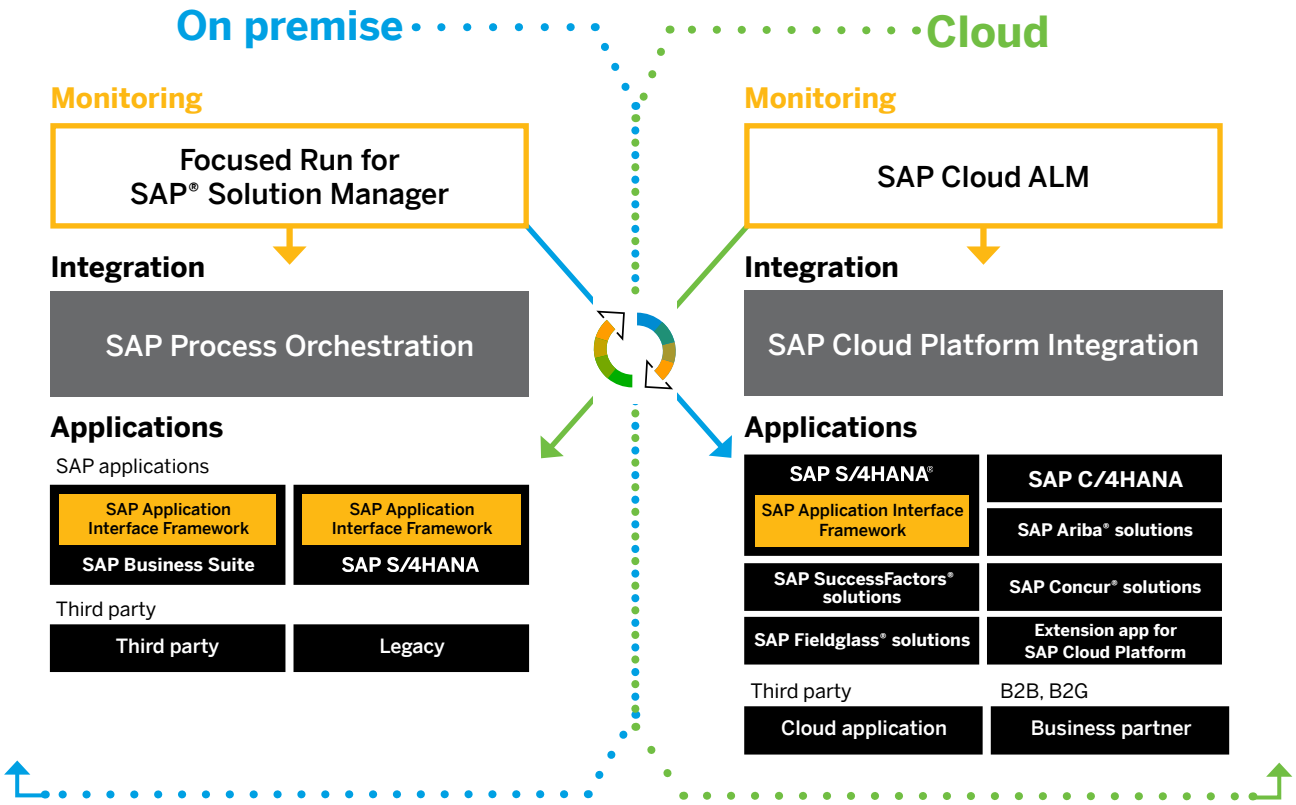
End-to-End Integration Monitoring

Reliable integration plays a central role, especially in hybrid landscapes that contain software-as-a-service (SaaS) cloud services, managed cloud components, and on-premise components. As a solution provider, SAP aims to deliver fully integrated solutions instead of single services that must be integrated by customers, who may incur implementation and maintenance costs as a result.

SAP makes sure data exchange processes operate reliably between the different solution components involved. This is relevant for cloud, on-premise, and especially hybrid scenarios. The purely technical connectivity between the different components is a prerequisite, but is by far not sufficient to ensure a reliable data exchange.

To maintain reliable operations at the application level, the different integration fragments of the components involved must be monitored. For performance, throughput, and backlog considerations, the appropriate statistical metrics must be calculated. To detect critical integration situations, exceptions need to be considered for every single component involved. One central application should monitor data, exchanged through orchestrated and nonorchestrated interfaces, for all customer landscape types as well as for all customer sizes. For that reason, SAP offers customers a flexible delivery model of the central operations platform to support deployments as a private cloud or through SaaS. This approach lets customers realize their preferred deployment environment. See Figure 33.

Figure 33: Different Deployment Models for Integration Monitoring



SAP SOLUTION MANAGER 7.2 – ON-PREMISE AND HYBRID LANDSCAPES

In SAP Solution Manager 7.2, SAP provides different integration monitoring capabilities. They include monitoring of the SAP Process Orchestration software (with special focus on the SAP Process Integration offering), message flow monitoring for orchestrated integration, and interface and connection monitoring for direct communication.

The goal of centrally monitoring SAP Process Orchestration is to provide central monitoring for multiple integration domains. The scope of the functionality covers component-specific self-checks and availability checks, process integration channel status checks, and component-specific monitoring based on aggregated message data. Message search capabilities as well as message alerting complement this functionality.

Through message flow monitoring for SAP Process Orchestration, message fragments collected from different components of SAP Process Orchestration can be assembled in so-called message flow instances. To do this, specific integration model information based on the integration visibility component is utilized.

Direct communications can be monitored with interface and connection monitoring. This supports monitoring exceptions, response times, and utilization at statistical levels. Alerts can be generated when certain thresholds are reached. Besides monitoring direct communication between on-premise components, monitoring of communications in hybrid landscapes is supported. Exceptions can be collected from most of the cloud solutions from SAP, including SAP Cloud Platform, SAP Ariba solutions, SAP SuccessFactors solutions, and the SAP Sales Cloud solution.

Target groups for integration monitoring as part of SAP Solution Manager 7.2 are customers with large on-premise and hybrid deployments as well as customers of the "classic" SAP Solution Manager software.

Focused Run for SAP Solution Manager

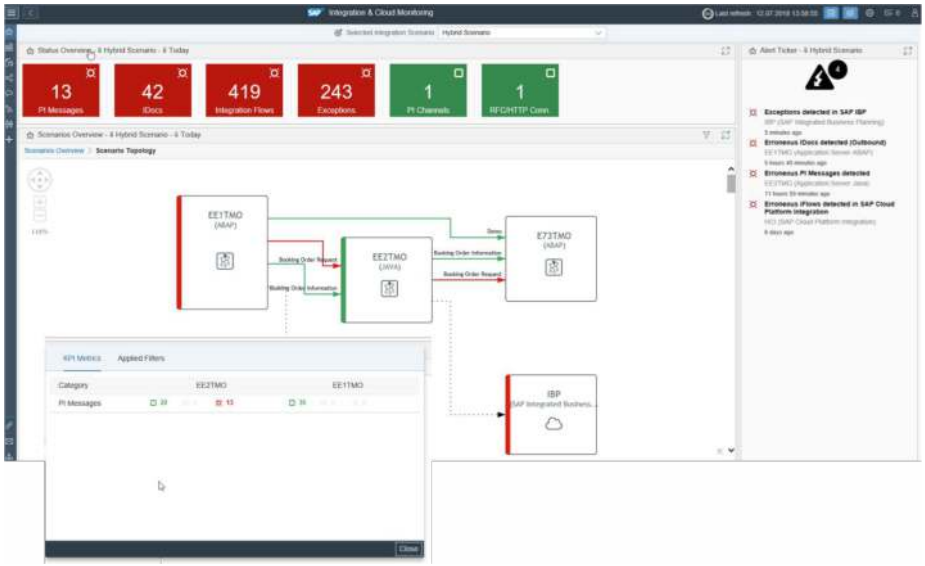
Focused Run for SAP Solution Manager[22] is a spin-off of SAP Solution Manager 7.2 and concentrates on the specific need for high-volume monitoring, alerts, root-cause analysis, and analytics use cases for IT operations.

Part of Focused Run is advanced integration monitoring, which helps customers manage complex and integrated landscapes with millions of interface calls and message flows (see **Figure 34**). It covers the monitoring and alerting of single message flows, processed by SAP Process Orchestration or SAP Cloud Platform Integration. It also supports peer-to-peer interface technologies, such as IDocs, Web service, and RFC on a single execution level.

An advanced integration monitoring cockpit can be started from the launchpad for Focused Run. Its entry and overview screens are similar to those in SAP Solution Manager. In Focused Run, however, a deeper drill-down functionality all the way to the level of single process messages is possible.

22. More information on Focused Run can be found at **https://support.sap.com/en/solution-manager/focused-solutions/focused-run.html**.

Figure 34: Integration and Cloud Monitoring: Part of Advanced Integration Monitoring



The entry point to advanced integration monitoring can be single managed objects, for example, systems or cloud services, or alternatively integration scenarios. Based on the fact that integration fragments are collected on the most detailed level, the different integration artifacts can be correlated to end-to-end message flows and messages can be tracked throughout the landscape.

In addition, you can handle integration exceptions related to cloud solutions from SAP, such as SAP Cloud Platform, SAP Ariba solutions, SAP SuccessFactors solutions, and SAP Fieldglass solutions. The service provides instant visibility of the capabilities of SAP Cloud Platform Integration.

Target groups for advanced integration monitoring as part of Focused Run for SAP Solution Manager are service providers, very large customers, and any customers with the need to monitor, create alerts, and track on a single interface or message level.

SAP Cloud ALM

Today, SAP provides Focused Run for customers as an on-premise product. As a result of the increasing importance for customers of the SAP Cloud portfolio, it is planned to provide the solution as an SaaS offering running with SAP Cloud Platform.

Target groups for this SAP Cloud ALM solution[23] will be small and midsize customers, cloud-only customers, and cloud-first customers. (Cloud-first customers have a hybrid landscape and prefer to run their application operations platform in the cloud.) It will be delivered as part of SAP Enterprise Support services and the cloud solution subscription. SAP Cloud ALM addresses the specific needs of cloud-centric SAP customers who run a majority of their IT infrastructure in the cloud. More details about SAP Cloud ALM can be found **here**.

23. https://news.sap.com/2018/09/sap-cloud-alm-tailored-application-lifecycle-management

Transition Path to SAP S/4HANA and Cloud Integration

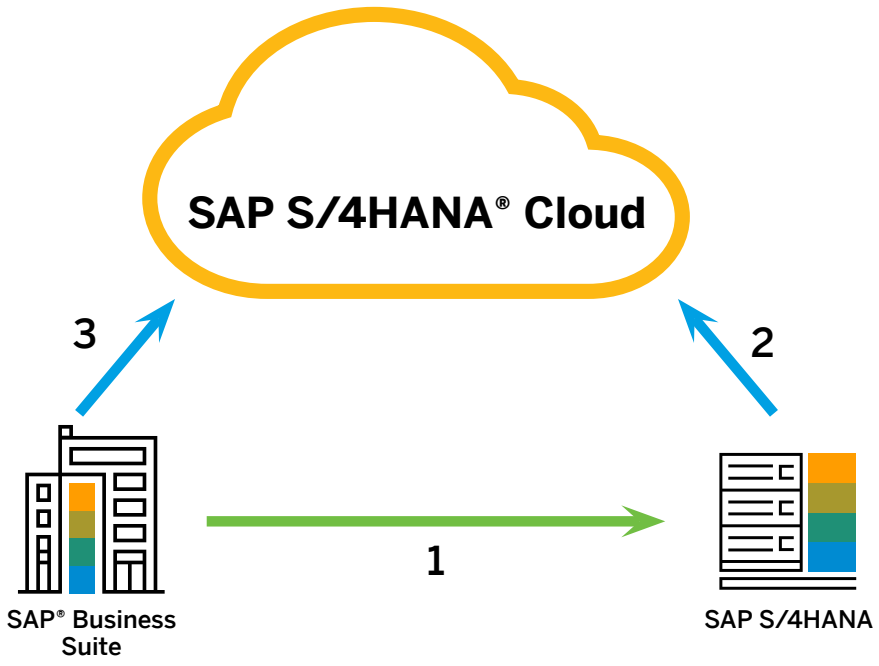
SAP S/4HANA is the next-generation digital core business suite that provides innovative and tightly coupled solutions. This section gives guidance on how to transition from SAP Business Suite to the on-premise version of SAP S/4HANA and to SAP S/4HANA Cloud and what it means from an integration perspective. Guidance for integration protocols and APIs is also provided.

TRANSITION PATHS TO SAP S/4HANA

SAP is committed to supporting customers in their transition from SAP Business Suite software to SAP S/4HANA and SAP S/4HANA Cloud. There are three possible paths along which this transition can occur. Each path has possible advantages and disadvantages that customers should evaluate in light of their needs, goals, and preferences.

As a start, you should consider the following aspects of the three paths shown in Figure 35.

Figure 35: Three Relevant Transition Paths



FROM SAP BUSINESS SUITE (SAP ECC) TO ON-PREMISE SAP S/4HANA

There are two scenarios for this transition path: an in-place system conversion and a side-by-side installation.

In-Place System Conversion

In the in-place system conversion scenario, the existing SAP Business Suite system is converted to SAP S/4HANA. The system ID (SID) and its existing customizations, data, and integrations are retained.

In general, you can convert with no impact on existing integration scenarios and can continue to use previous investments in integration technologies, such as SAP Process Orchestration, and existing integration scenarios.

Any exceptions, for example, due to simplification or alignment of interfaces in SAP S/4HANA, are described in the **simplification item catalog** (S-user required). This resource provides a description of all relevant changes that might have an impact when converting from SAP ERP Central Component (SAP ECC) to SAP S/4HANA.

Within each topic, referred to as a "simplification item," corresponding notes in the SAP Notes tool and mitigation possibilities are documented.

Side-by-Side Installation

In the side-by-side installation scenario, a new installation of SAP S/4HANA with a new SID is set up in parallel to the existing SAP Business Suite system. Integrations with the new SAP S/4HANA system are set up new.

You can continue to use previous investments in integration technologies, such as SAP Process Orchestration, and existing integration scenarios. However, existing integration scenarios must be migrated to the new system and adjusted to new destinations (SIDs, URIs). Any other effects inherent in the new side-by-side installation must also be attended to.

Any exceptions to this principle of "may have to be newly set up, but can be set up the same way as before" are described in the **simplification item catalog** (S-user required).

FROM ON-PREMISE SAP S/4HANA TO SAP S/4HANA CLOUD

It is planned that the integration scenarios delivered for SAP S/4HANA Cloud will be delivered for the on-premise version of SAP S/4HANA in the very next release. For this transition path, please keep the following points in mind:

- All public APIs and integration packages and their feature scope are listed and documented in SAP API Business Hub (see "APIs and Integration Content in SAP API Business Hub").
- SAP S/4HANA Cloud provides best-practice information for many integration scenarios. You can choose to build customer-driven integration using public APIs.
- In SAP S/4HANA Cloud, integrations built on on-premise interface technologies will have to be rebuilt with cloud technologies over time.
- In many scenarios, the business user experience may remain the same even though the integration scenarios must be set up anew during the transition.

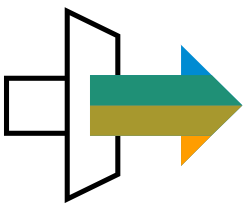
FROM SAP BUSINESS SUITE (SAP ECC) TO SAP S/4HANA CLOUD

With SAP S/4HANA Cloud, you will be the first customer of all new integration scenarios. For this transition path, please keep the following points in mind:

- All public APIs and integration packages and their feature scope are listed and documented in SAP API Business Hub (see "APIs and Integration Content in SAP API Business Hub").
- SAP S/4HANA Cloud provides best-practice information for many integration scenarios. You can choose to build customer-driven integration using public APIs.
- In SAP S/4HANA Cloud, integrations built on on-premise interface technologies will have to be rebuilt with cloud technologies over time.

NOTES ABOUT TRANSITION PATHS

The on-premise version of SAP S/4HANA supports all integration technologies and interfaces originally released with SAP ECC. This simplifies the integration of SAP S/4HANA with existing landscapes, such as SAP ECC or the SAP Customer Relationship Management application. For some scenarios, SAP S/4HANA Cloud supports the same integration technologies and interfaces as SAP S/4HANA. However, SAP plans to gradually replace these interfaces with equivalent Web technologies.



The on-premise version of SAP S/4HANA supports all integration technologies and interfaces released with SAP ECC. This **simplifies the integration** of SAP S/4HANA with existing landscapes, such as the SAP Customer Relationship Management application.

The side-by-side transition from SAP ECC to SAP S/4HANA is explained above in "Side-by-Side Installation." This transition lets you replace integration scenarios in a phased or selected approach instead of committing to a big bang, which the in-place system conversion represents (described under "In-Place System Conversion.") In a side-by-side scenario, the business downtime for integration scenarios is minimized because existing integration scenarios are switched over only after the newly-set-up integration scenarios are up and running. Existing middleware content logic can be reused. Additionally, the side-by-side approach allows you to keep a fallback solution and to validate integration processes and results better.

APIs for SAP S/4HANA are largely compatible with those for SAP ECC and can be used. Only APIs that are the target of simplification or become incompatible due to simplification will be disabled for external use. A **simplification item catalog for SAP S/4HANA** has been set up. It explains in detail how the conversion from SAP Business Suite applications to SAP S/4HANA will affect specific transactions and application functionality. Also, it provides recommendations for necessary adaptations. SAP plans to keep traditional capabilities available as a "compatibility scope" to support their migration on a predominantly technical basis.

APIs in the cloud will generally be based on Web technologies such as REST, OData, and SOAP. It is planned that these new interfaces will first be available in SAP S/4HANA Cloud, following the cloud-first approach. Later releases will include support for the on-premise version of SAP S/4HANA. OData services are recommended for synchronous communication, such as direct business-object manipulation (CRUD – create, read, update, delete), as an alternative to objects written for the BAPI® programming interface. SOAP services for asynchronous message-based communication are the cloud alternative to IDocs (for example, for A2A and B2B scenarios). Technologies used by SAP ECC – IDocs, BAPI and RFC, and ABAP proxies – can still be used in SAP S/4HANA. In select cases, they can be used through the cloud connector to integrate SAP S/4HANA Cloud with on-premise SAP solutions.

A side-by-side transition from SAP ECC to SAP S/4HANA lets you **replace integration scenarios** in a phased or selected approach instead of the big bang of an in-place system conversion.

With SAP S/4HANA, you can install and use integration add-ons (for example, SAP Ariba Cloud Integration Gateway, add-on for SAP S/4HANA) to connect to standard SAP software. In some cases, this is even required to connect to cloud solutions, such as SAP Ariba solutions (see "SAP Ariba Cloud Integration Gateway") or SAP SuccessFactors solutions. For SAP S/4HANA Cloud, add-ons are embedded. There is no need to install them.

INTEGRATION SCENARIOS FOR SAP S/4HANA

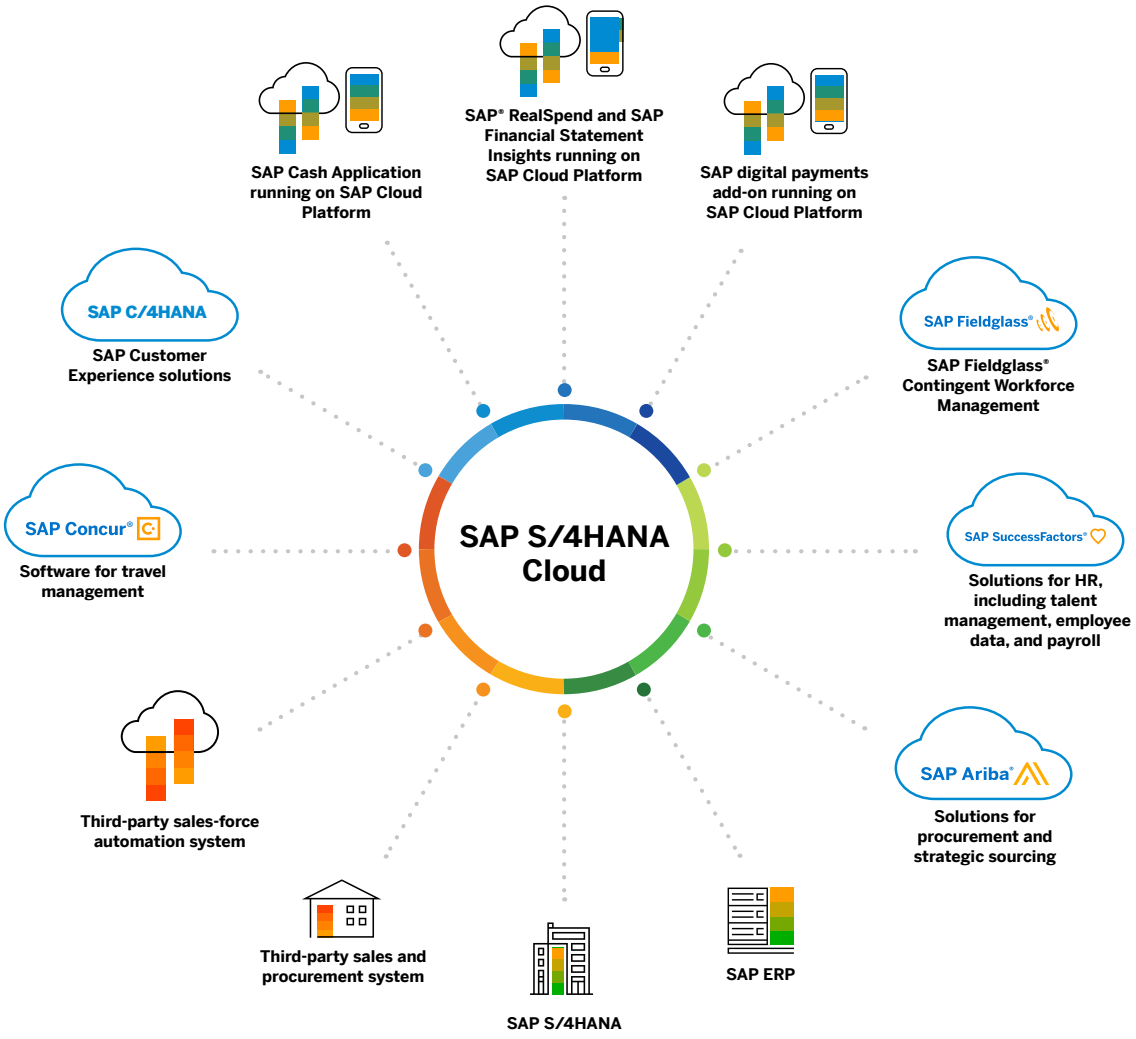
SAP provides prepackaged integration scenarios to integrate with on-premise SAP software, cloud solutions from SAP, and third-party applications. These include SAP Ariba, SAP SuccessFactors, SAP Fieldglass, SAP Concur, and SAP Customer Experience solutions. They also include the SAP Sales Cloud solution, the SAP Analytics Cloud solution, and the SAP Multi-Bank Connectivity solution (see Figure 36). These integration scenarios consist of public APIs and integration content for the SAP Cloud Platform Integration service, all available from SAP API Business Hub, including around 180 APIs covering more than 1,600 operations. It is planned to continue the growth of API coverage every quarter. SAP has committed to delivering new integration content for SAP S/4HANA Cloud first.

SAP also provides APIs to help you integrate with other cloud solutions from SAP, on-premise SAP software, and third-party solutions, as well as build your own cloud apps on SAP Cloud Platform. SAP S/4HANA Cloud offers different types of APIs based on Web technologies, such as OData, REST, and SOAP. It also provides the option to expose core data service views[24] as custom OData services. Figure 36 shows the SAP-to-SAP integration scenarios for SAP S/4HANA Cloud.

SAP provides **prepackaged integration scenarios** to integrate the on-premise version of SAP S/4HANA with cloud solutions from SAP.

24. Core data services (CDS) is a modeling environment for applications powered by SAP HANA. SAP S/4HANA is based on CDS models. It is planned to release a cloud-based version of CDS to be used for purposes outside of SAP S/4HANA. For a general summary of CDS, see https://blogs.sap.com/2016/09/26/core-data-services-cds-in-sap-s4-hana.

Figure 36: SAP-to-SAP Integration for SAP S/4HANA Cloud



Further information is provided in the blog "SAP S/4HANA Cloud Integration Checklist." It gives guidance on finding the best approach and includes related technical content and best-practice information for cloud integration scenarios in the context of SAP S/4HANA Cloud.

Further information is provided in the blog "SAP S/4HANA Cloud Integration Checklist."

Integration Automation

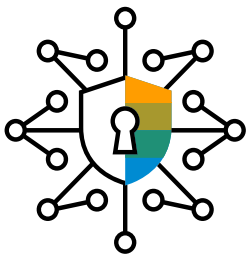
Setting up the technical configuration for integrating cloud solutions with other cloud or on-premise solutions is often a complex process. This section describes the Cloud Integration Automation service. It simplifies the integration of different solutions by automating the steps involved in setting up the technical configuration in the customer landscape.

CHALLENGE

Usually, the integration of two or more solutions means far more than setting up a directional or bidirectional connection between two applications. Multiple players must be configured and set up. Currently, the process of setting up such an integration is often a manual process involving scattered documentation and several experts. These experts must align closely to execute the appropriate configuration steps in the corresponding components. Otherwise, permissions may be missing, configuration targets may be incompatible, and performance of similar steps may result in redundant effort. Although the overall process is time-consuming, very little automation of such configuration tasks has been available.

SIMPLIFYING THE PROCESS WITH INTEGRATION AUTOMATION

SAP is offering a central service that is used by SAP solutions to define and automate integration scenarios in a standardized way. These scenarios are executed from a single execution engine, which is available as a cloud service that plugs into all the components involved.



SAP is offering a central service to define and automate integration scenarios. Integration scenarios are executed from a **single execution engine** available as a cloud service that plugs into all the components involved.

The approach provides a consistent user experience and a central entry point to integration scenarios delivered by SAP. A structured, tailored, customized description of the customer-specific configuration steps is intended to facilitate and standardize the integration configuration processes. For integration scenarios enabled for the service,[25] it is also intended that large parts of the setup will run automatically.

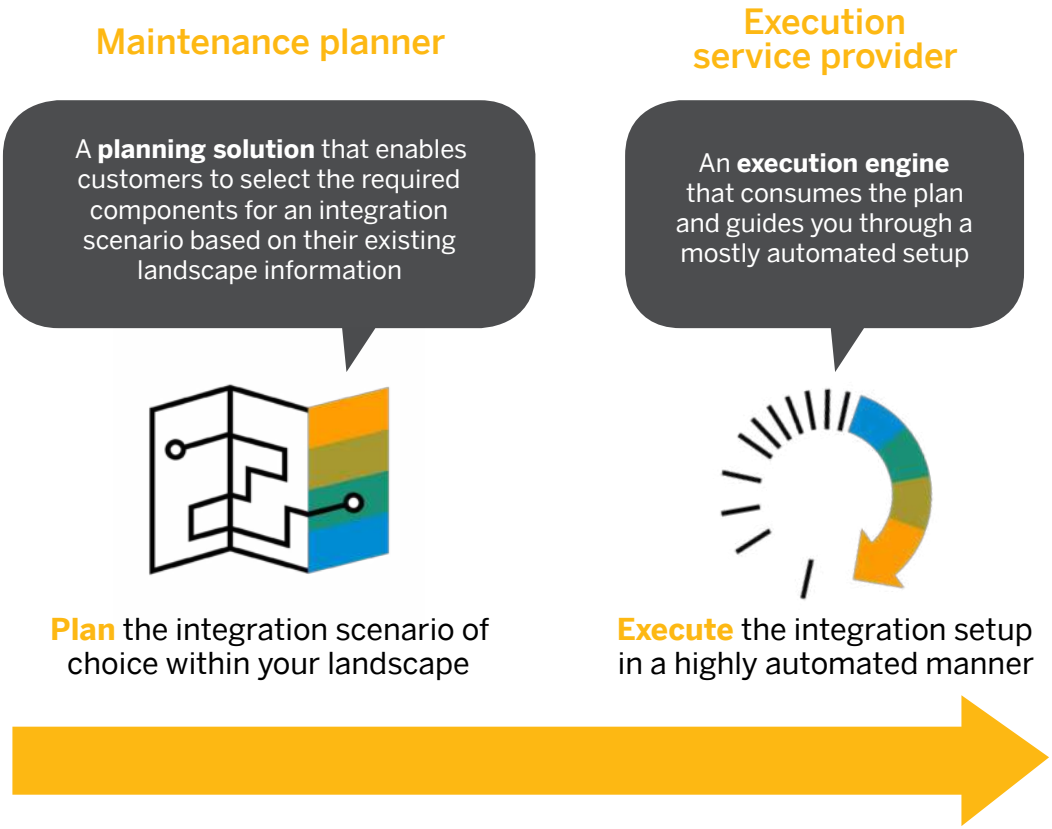
"Customized" here means that every description will point to the actual end points within the customer's on-premise and cloud software landscape. These hyperlinks and other configuration values derived from the customer landscape can be used throughout the integration process. While the Cloud Integration Automation service provides the infrastructure, each cloud solution will deliver integration content and the respective configuration APIs.

The Cloud Integration Automation service runs on SAP Cloud Platform and is populated by the integration configurations of the various cloud solutions from SAP. Enhancements are planned to facilitate future extensibility and options for third-party contributions. Figure 37 shows the two services that make up the Cloud Integration Automation service on the customer side.

The approach provides a **consistent user experience** and a central entry point to integration scenarios delivered by SAP.

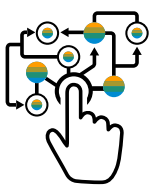
25. For integration scenarios that are technically possible but not fully enabled for the service, only documentation will be offered.

Figure 37: Two Central Services to Automate Technical Configurations



From the customer point of view:

- The **maintenance planner** service is available to all customers with an SAP support contract. The maintenance planner allows users to select an integration scenario for the automation process. The process will have access to the configuration content and to information about the customer's software landscape and cloud tenants. In this way, the generic information for an integration scenario will be combined with the available customer-specific configuration data, such as system IDs.
- The **execution service provider** offers a customer-specific integration workflow that helps customers set up the configuration for their integration scenarios. It guides customers through the workflow that was created based on the results of the maintenance planner and enables automatic integration setup.



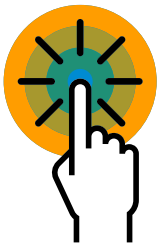
The execution service provider offers a **customer-specific integration workflow** that helps customers set up the configuration for their integration scenarios.

The cloud-based maintenance planner of SAP Solution Manager is a well-established cloud-based service used to plan maintenance events – such as installations, upgrades, and updates – for on-premise system landscapes. With the Cloud Integration Automation service for the maintenance planner, the scope has been extended to cloud solutions. The service now also serves as the user interface and central entry point for integration planning. Cloud-only customers should consider this a preliminary solution for delivering integration automation quickly. It is planned that other tools for this purpose may be added as alternatives to the maintenance planner.

The planning solution (see Figure 37) guides you through the planning phase with wizard-like dialogs, enabling you to:

1. Select an integration scenario along with some key options, for example, for integration without a middleware solution
2. Verify version interdependencies between products, required add-ons, and related cloud solutions and services; identify version conflicts; and receive suggestions for maintenance steps to resolve them
3. Select the relevant systems and tenants from within your landscape

Once the scenario and systems have been defined, a workflow is created. This workflow consists of all steps that were defined as part of the integration scenario by SAP. Individual users are assigned to certain integration roles (for example, integration administrator), which group tasks per responsibility. Global parameters to be reused throughout the process can also be provided. The SAP Cloud Platform Workflow service (see "SAP Cloud Platform Workflow") executes the workflow and guides users who need to contribute to the configuration through the appropriate steps. This corresponds to the user mapping (for example, the administrator for SAP S/4HANA or for SAP SuccessFactors solutions) previously performed.



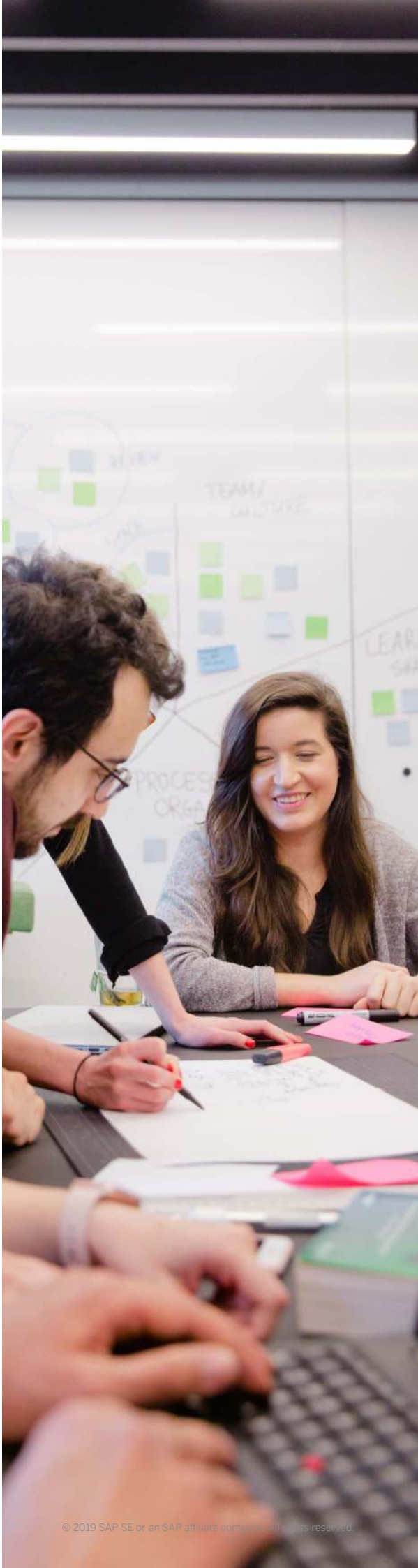
The SAP Cloud Platform Workflow service executes the workflow and **guides users** who need to contribute to the configuration through the appropriate steps.

The workflow service provides an overview of the overall progress and guides users through the workflow step by step. It sends items to the users involved through the "My Inbox" app on SAP Cloud Platform. For those users, processing the workflow items is easy, with individual configuration steps presented to them in personalized instructions. The workflow uses the landscape information to insert into the instructions hyperlinks (for example, to administration UIs) or values for required parameters.

If the corresponding SAP solution provided the necessary content for automated configuration of the integration, the user will have a button to trigger the automatic execution of the step. The technical configuration of the integration scenario is complete when all steps of the workflow have been processed.

Complete plug-and-play functionality may not be possible due to some constraints, notably security barriers. Nevertheless, the personalized workflow, including automated configuration steps, is planned to be a significant enhancement to the process of setting up the technical configuration of integration scenarios.

The workflow service provides an **overview of the overall progress** and guides users through the workflow step by step.



Summary, Outlook, and Finding Out More

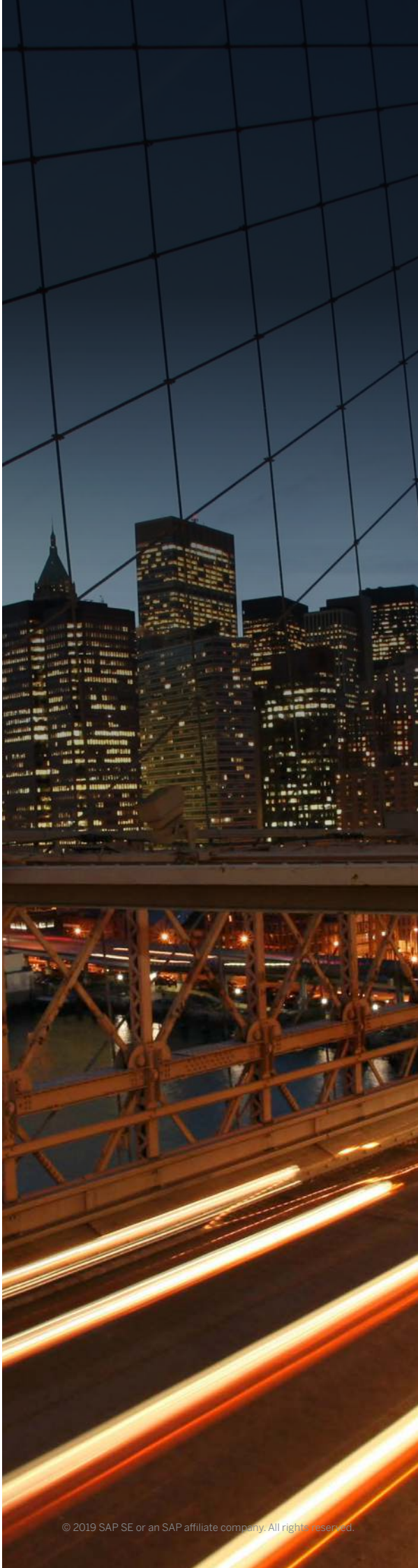
This CIO guide marks a step on the way toward the "CIO Guide: SAP Vision for Integrating SAP Applications in Cloud and Hybrid Environments." It provides important updates in many aspects of integration, such as positioning and guidance on using process and data integration technologies. It covers the role of APIs, the services around them, and new technologies to assist you in future integration projects. It provides updated guidance for specific integration areas, such as B2B and SAP S/4HANA.

It is planned to provide updates of this guide on technologies, methodologies, and approaches and possibly additional documents marking the next steps in this area. The following resources provide more detailed information about the topics covered.

- **SAP's vision for integration:** CIO Guide: SAP Vision for Integrating SAP Applications in Cloud and Hybrid Environments
- **Identity and access management:** CIO Guide: Identity Lifecycle in Hybrid Landscapes
- Integration Solution Advisory Methodology
- Integration services of SAP Cloud Platform
- Documentation for SAP Cloud Platform
- SAP Cloud Platform Integration
- SAP Process Orchestration
- SAP Data Hub
- SAP API Business Hub
- SAP S/4HANA Cloud
- Data access and virtualization capabilities of SAP HANA
- SAP Ariba Cloud Integration Gateway
- SAP Cloud Platform Integration Advisor service
- J. Mutumba Bilay, P. Gutsche, M. Krimmel, and V. Stiehl, SAP Cloud Platform Integration: The Comprehensive Guide, SAP Press, 2018.
- SAP Cloud Platform API Management
- SAP Cloud Platform Integration (documentation)
- SAP Application Interface Framework
- Modeling guide for SAP HANA smart data integration and SAP HANA smart data quality.
- Maintenance Planner
- **Related topic:** Extending SAP S/4HANA

List of Abbreviations

A2A	Application to application
API	Application programming interface
AS2	Applicability Statement 2
ASC X12	ANSI ASC X12 (American National Standards Institute Accredited Standards Committee)
B2B	Business to business
B2G	Business to government
CIO	Chief information officer
cXML	commerce eXtensible Markup Language
EANCOM	European Article Number Communication
EDI	Electronic data interchange
EIM	Enterprise information management
GUSI	Global upstream supply initiative
HTTP	Hypertext transfer protocol
IDoc	Intermediate document
IPaaS	Integration platform as a service
IoT	Internet of Things
ISA-M	Integration Solution Advisory Methodology
OAGIS	Open Application Group Integration Specification
OData	Open Data Protocol
PIDX	Petroleum Industry Data Exchange
REST	Representational state transfer
RFC	Remote function call
SAP ECC	SAP ERP Central Component or SAP Business Suite
SOAP	Simple Object Access Protocol
SOCKS5	Socket Secure (protocol)
UX	User experience
UN/EDIFACT	United Nations/Electronic Data Interchange for Administration, Commerce, and Transport
xCBL	XML Common Business Library



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