



1ST EDITION

# Architecting Solutions with SAP Business Technology Platform

An architectural guide to integrating, extending, and innovating enterprise solutions using SAP BTP



SERDAR SIMSEKLER | ERIC DU

# Chapter 1

## Images

### Intelligent Enterprise

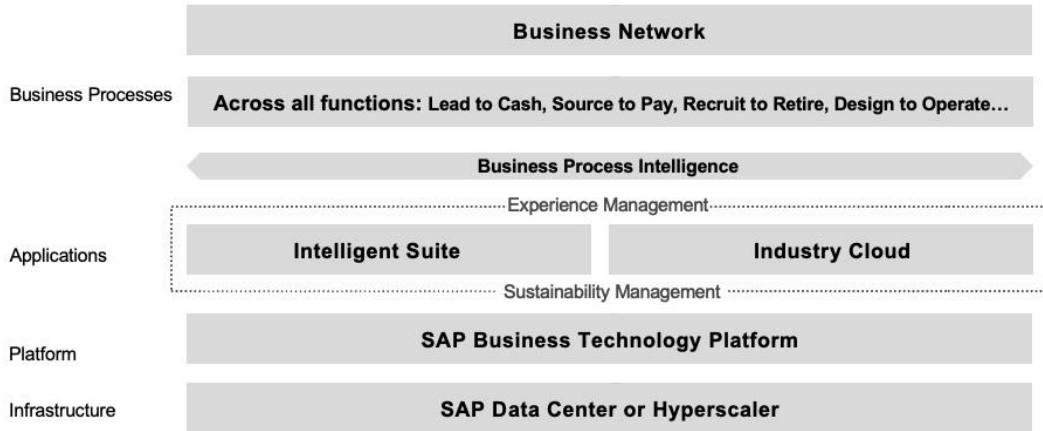


Figure 1.1: Intelligent Enterprise overview

# Chapter 2

## Images

### SAP BTP as the Platform for Intelligent Enterprise

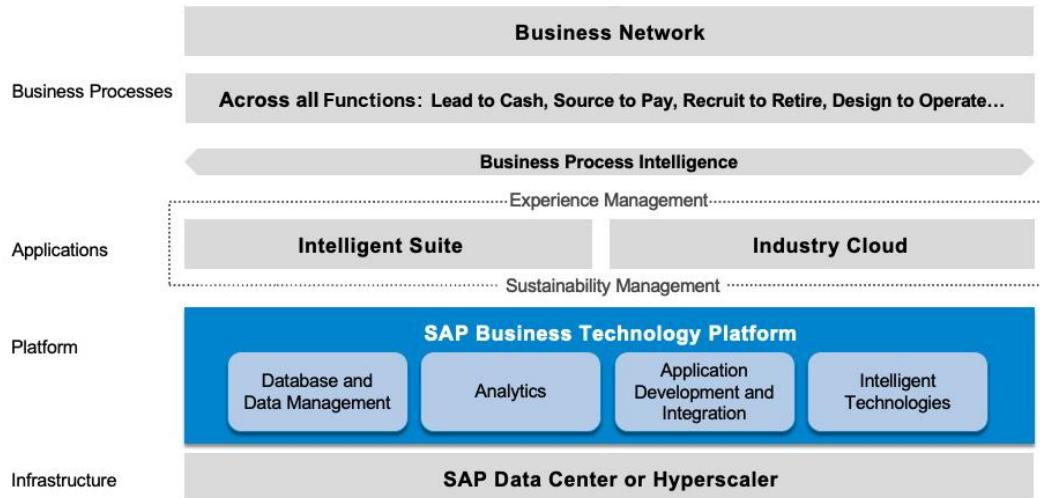


Figure 2.1: SAP BTP in Intelligent Enterprise

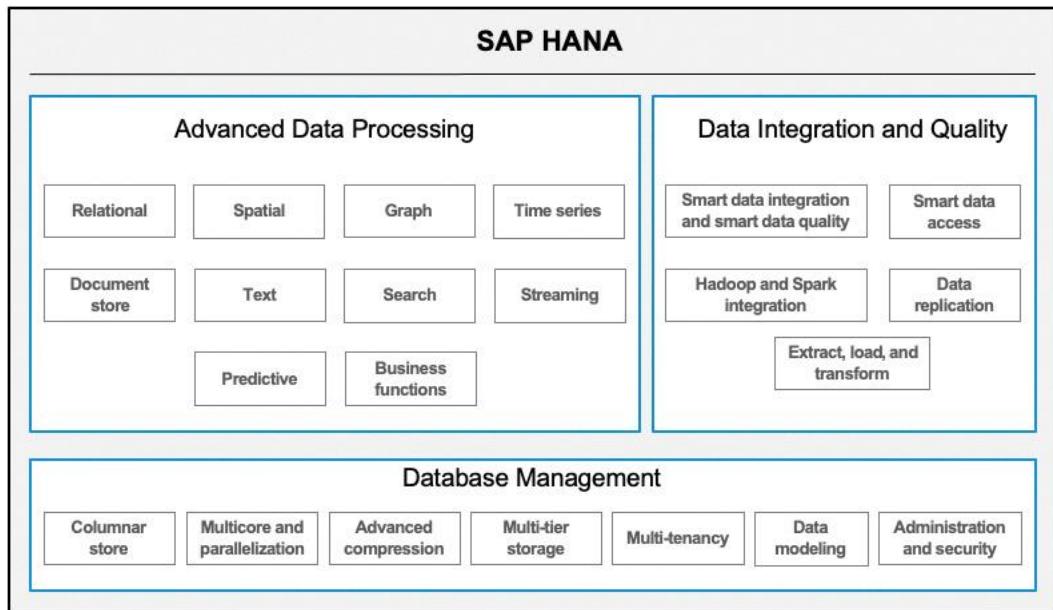


Figure 2.2: SAP HANA capabilities overview

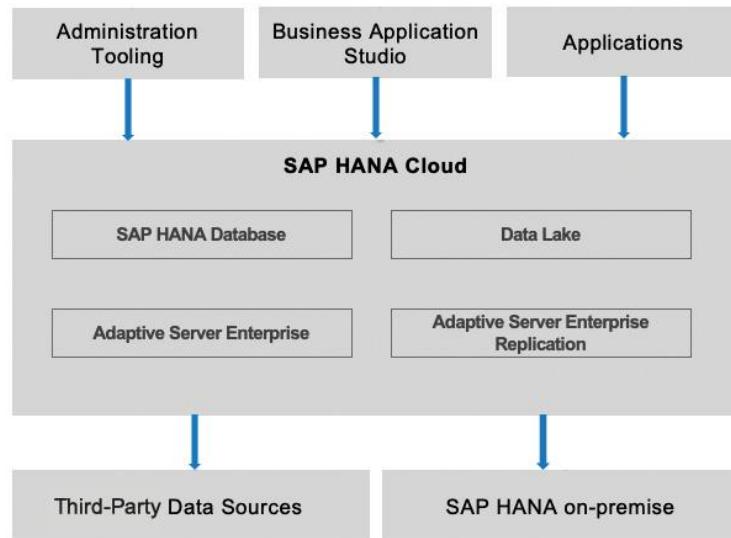


Figure 2.3: Overview of connections to SAP HANA Cloud

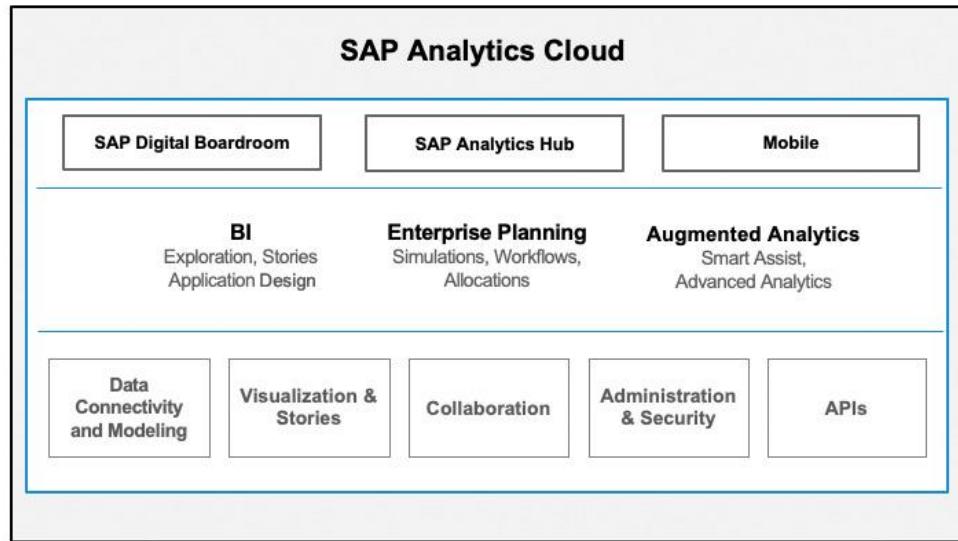


Figure 2.4: SAP Analytics Cloud overview

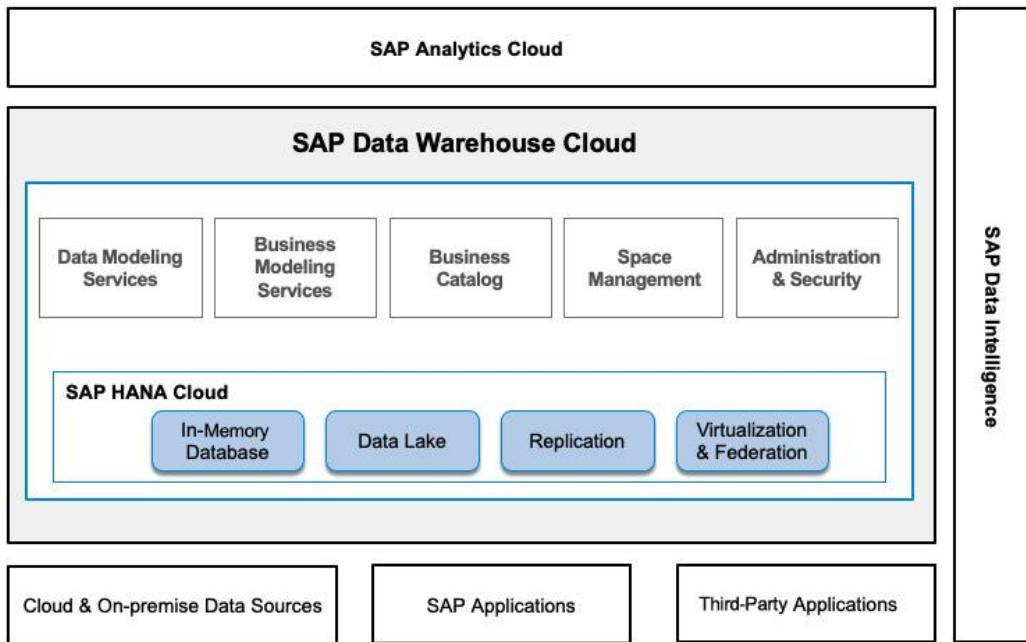


Figure 2.5: SAP Data Warehouse Cloud overview

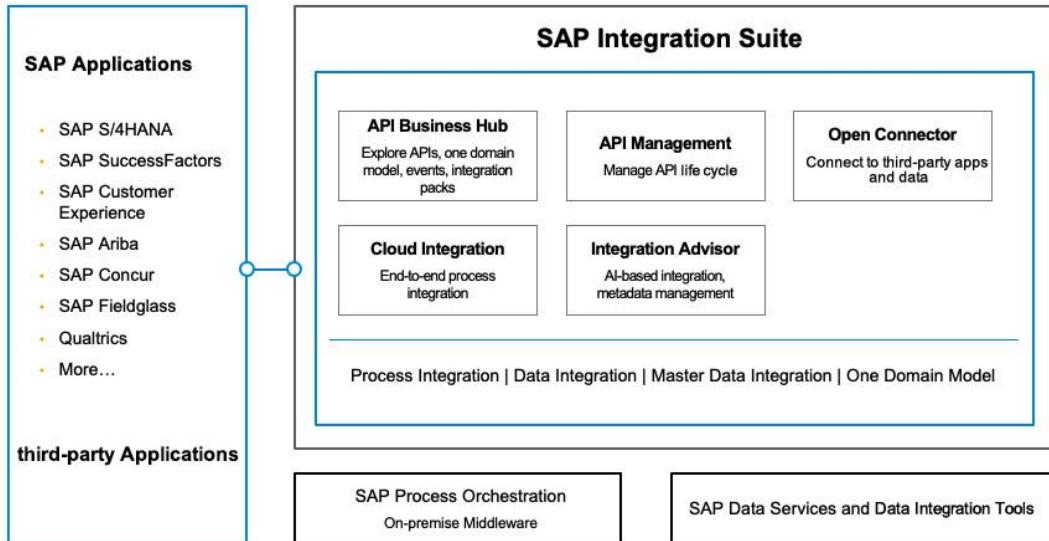


Figure 2.6: SAP Integration Suite overview

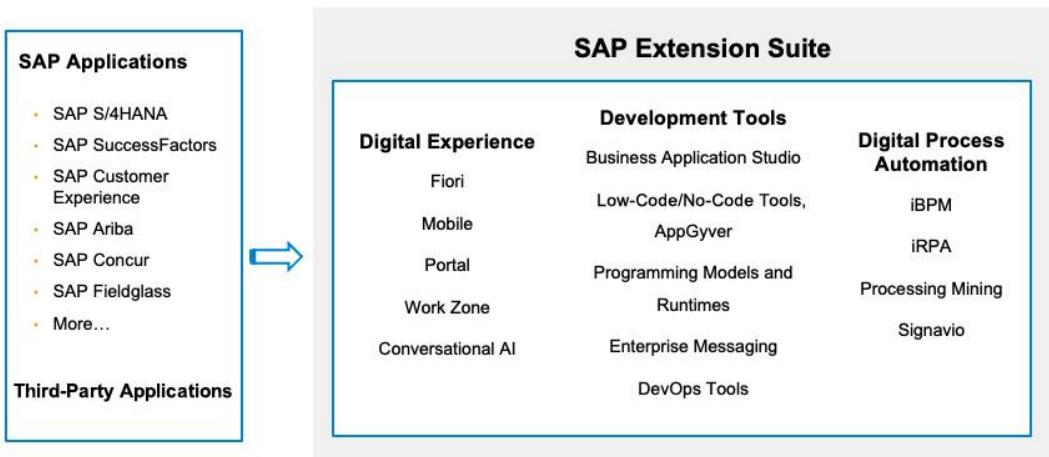


Figure 2.7: SAP Extension Suite overview

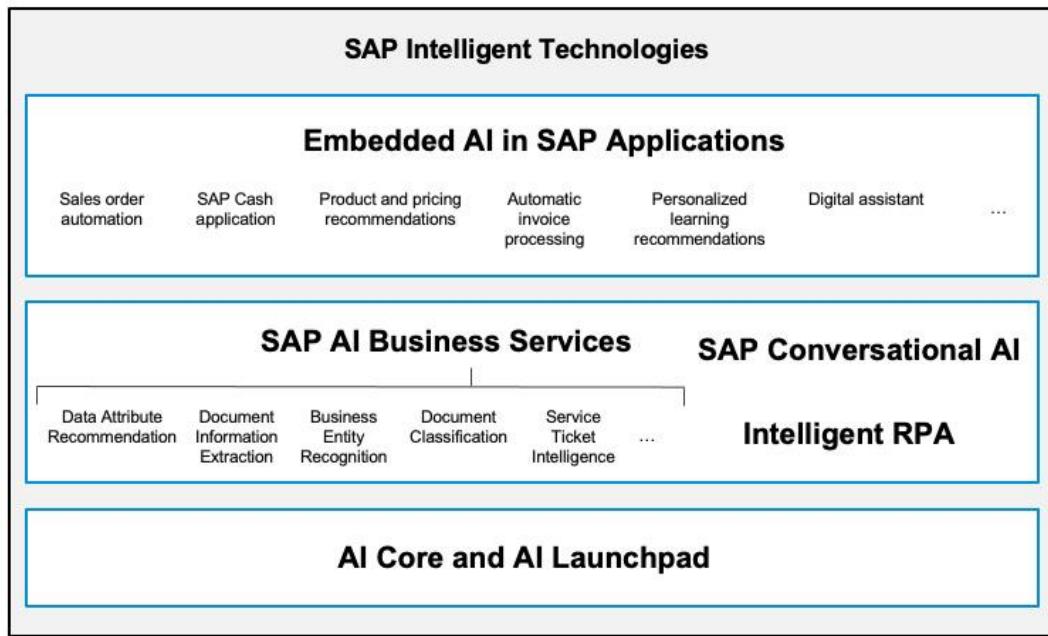


Figure 2.8: SAP AI capability overview

# Chapter 3

## Images

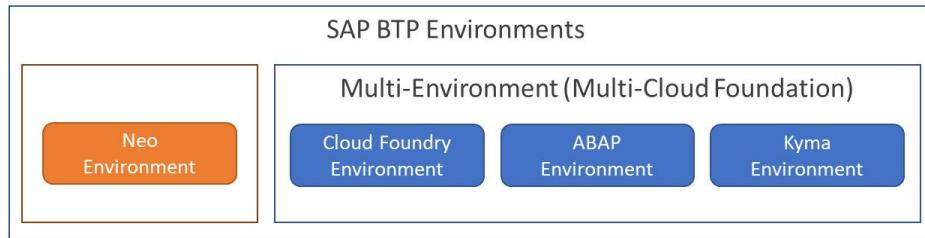


Figure 3.1: SAP BTP environments

The screenshot shows the SAP STORE purchase interface. At the top, there is a navigation bar with the SAP logo, "STORE", a search bar, "Help", a United Kingdom flag, "United Kingdom", and "Log On". Below the navigation bar, the user is at step 1: "Your Selection" with Cart ID: 164341294.

A yellow callout box highlights a note: "(!) This item has the following prerequisite(s):" followed by a list: "■ SAP Cloud Platform Portal" and "■ SAP Business Application Studio". It also says, "If you have any questions about these prerequisites or need assistance in placing an order, please [contact us](#)".

The main content area shows the product details for "SAP Workflow Management":

SAP Workflow Management		Price per user per month	Subtotal
Provided by SAP (UK) Ltd.	SAP Workflow Management	GBP 2.58	GBP 774.00
Users	100	(Min 100)	
Duration	3 month		
Start Date	05-Sep-2021		

At the bottom, there is a link "Enter a promotion code" and a summary table:

Estimated Tax	GBP 154.80
<b>TOTAL</b>	<b>GBP 928.80</b>

Figure 3.2: Making a purchase in SAP Store

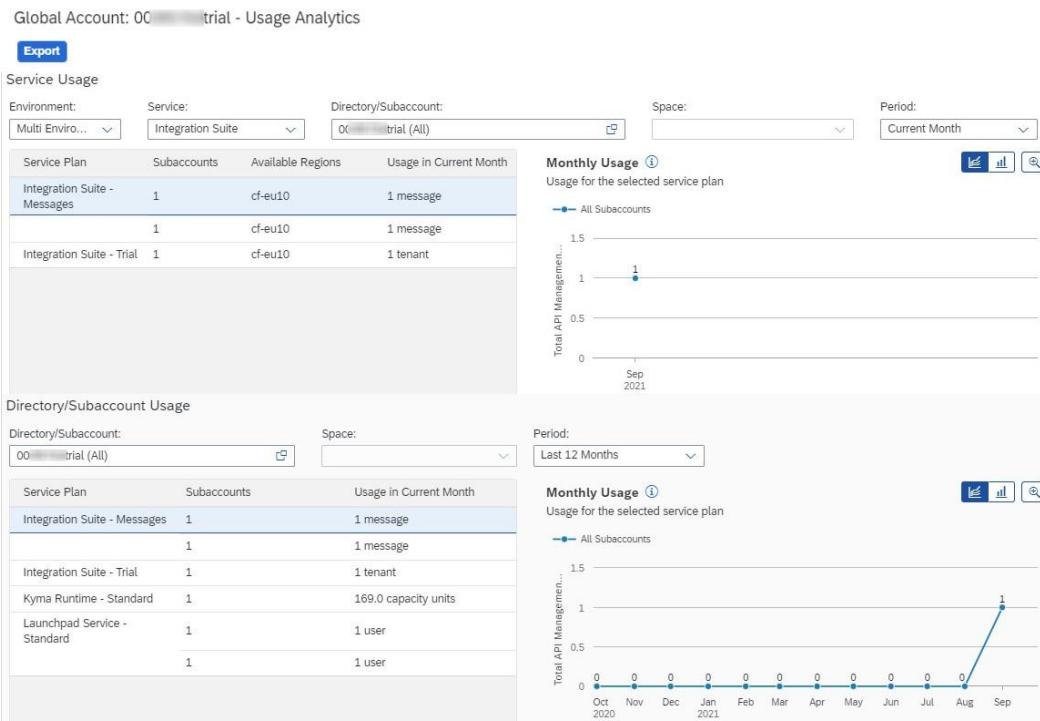
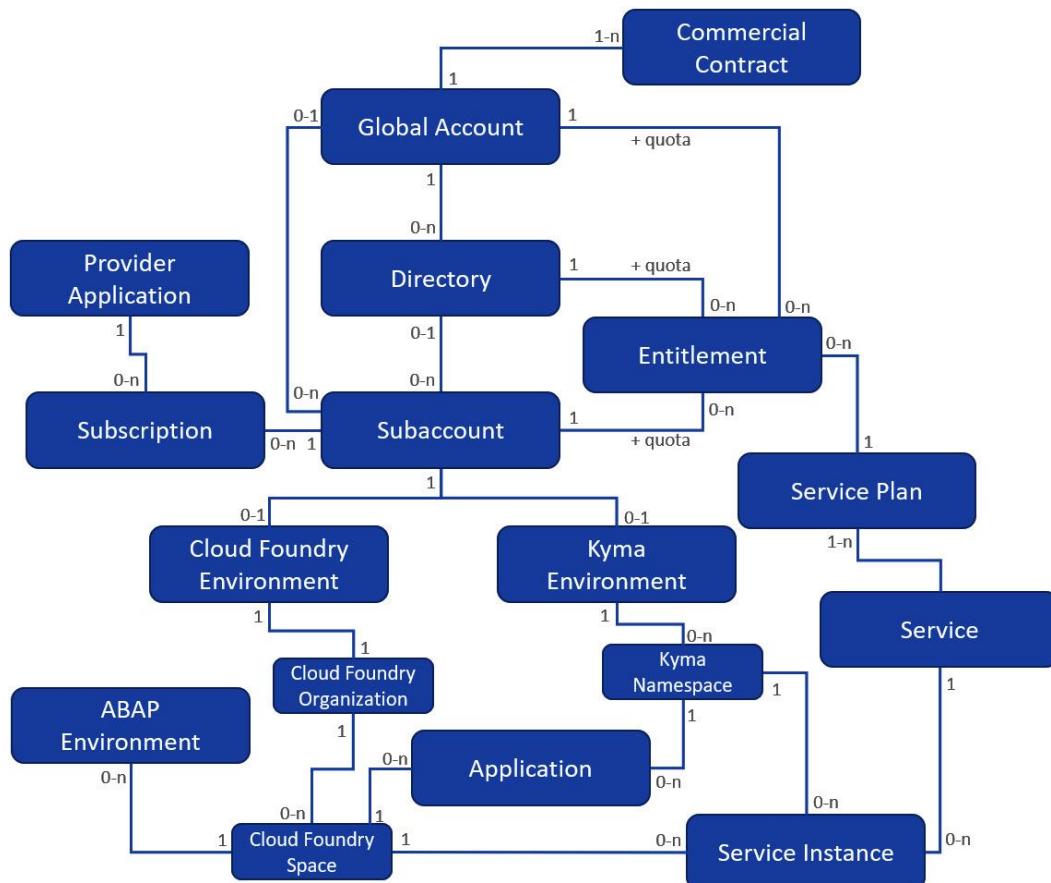


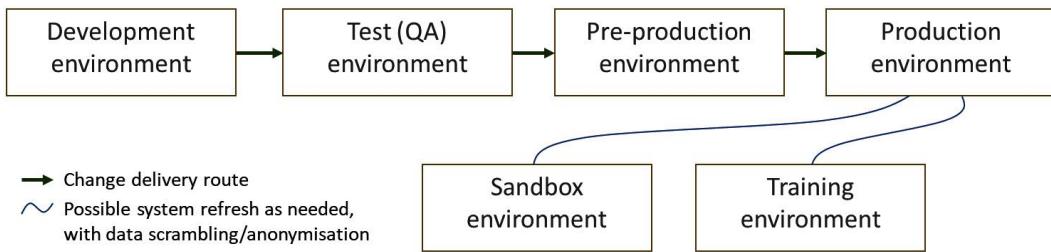
Figure 3.3: Usage analytics for a global account



**Figure 3.4: SAP BTP account-model elements**

Name	Type	Environment	Provider	Region	Changed On
003f676dtrial	Global Account				Sep 21, 2021, 14:19
Acme	Directory				Sep 5, 2021, 23:43
Acme - Production	Directory (Managed)				Sep 6, 2021, 00:02
Acme - Product...	Subaccount	Multi-Environment	Amazon Web Services (A...	Europe (Frankfurt)	Sep 5, 2021, 20:32
Acme - Product...	Subaccount	Multi-Environment	Microsoft Azure	Singapore	Sep 5, 2021, 20:34
Acme Non-produ...	Directory				Sep 5, 2021, 20:31
Acme - Develo...	Subaccount	Multi-Environment	Amazon Web Services (A...	Europe (Frankfurt)	Sep 5, 2021, 20:31
Acme - QA	Subaccount	Multi-Environment	Amazon Web Services (A...	Europe (Frankfurt)	Sep 5, 2021, 20:31
Emca	Directory				Sep 5, 2021, 20:32
Emca - Non-prod...	Directory				Sep 5, 2021, 20:33
Emca - Develo...	Subaccount	Multi-Environment	Amazon Web Services (A...	US East (VA)	Sep 5, 2021, 20:35
Emca - Pre-pro...	Subaccount	Multi-Environment	Amazon Web Services (A...	US East (VA)	Sep 5, 2021, 20:36
Emca - QA	Subaccount	Multi-Environment	Amazon Web Services (A...	US East (VA)	Sep 5, 2021, 20:35
Emca - Production	Directory				Sep 5, 2021, 20:33
Emca - Product...	Subaccount	Multi-Environment	Amazon Web Services (A...	US East (VA)	Sep 5, 2021, 20:36

**Figure 3.5: Account Explorer page of a global account (trial) in SAP BTP Cockpit**



**Figure 3.6: A typical set of landscape environments**

Business Unit 1 Region A Multi-Environment	Development	Test	Pre-Production	Production	Training	Sandbox
Business Unit 1 Region B Multi-Environment			Pre-Production	Production		
Business Unit 1 Region A Multi-Environment Product X	Development	Test	Pre-Production	Production		
Business Unit 2 Region A Neo Environment	Development	Test	Pre-Production	Production		
Business Unit 2 Region A Multi-Environment	Development	Test	Pre-Production	Production	Training	

Figure 3.7: An example landscape fulfilling the requirements in the exercise

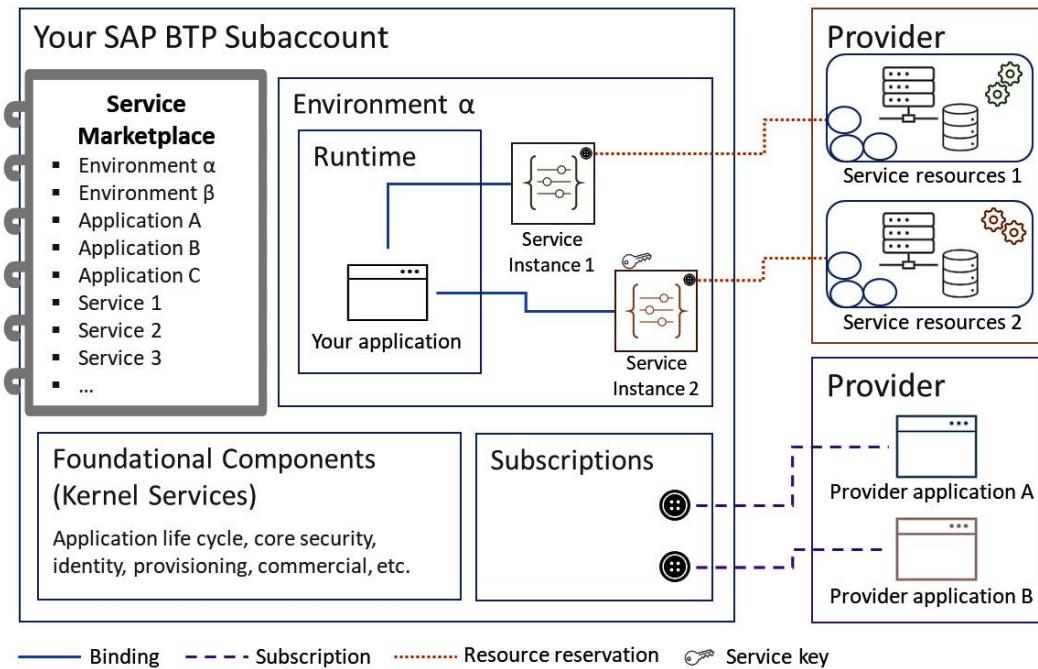


Figure 3.8: SAP BTP service types overview

Integration	Data-to-Value	Extensibility
<ul style="list-style-type: none"> <li>▪ SAP Integration Suite           <ul style="list-style-type: none"> <li>▪ Cloud Integration</li> <li>▪ API Management</li> <li>▪ API Business Hub</li> <li>▪ Open Connectors</li> <li>▪ Integration Advisor</li> </ul> </li> <li>▪ Event Mesh</li> <li>▪ ...</li> </ul>	<ul style="list-style-type: none"> <li>▪ SAP HANA Cloud           <ul style="list-style-type: none"> <li>▪ HANA DB, ASE, Data Lake</li> </ul> </li> <li>▪ SAP Analytics Cloud</li> <li>▪ Data Warehouse Cloud</li> <li>▪ PostgreSQL (Hyperscaler)</li> <li>▪ Redis (Hyperscaler)</li> <li>▪ Object Store</li> <li>▪ ...</li> </ul>	<ul style="list-style-type: none"> <li>▪ SAP Workflow Management</li> <li>▪ SAP Intelligent RPA (iRPA)</li> <li>▪ Cloud Foundry and Kyma Runtimes</li> <li>▪ Authorization and Trust Management</li> <li>▪ Business Application Studio</li> <li>▪ Continuous Integration and Delivery</li> <li>▪ ...</li> </ul>

Figure 3.9: A basic categorization of SAP BTP services

The screenshot shows the SAP Discovery Center interface. At the top, there's a navigation bar with the SAP logo, 'SAP Discovery Center', a search icon, and a 'Log On' button. Below the navigation bar, the page title is 'SAP Launchpad Service'. It includes a brief description: 'Simplify access to business apps with a role based, personalized launchpad site.' There are tabs for 'Overview', 'Pricing', 'Related Missions', 'Roadmap', and 'Customer Stories'. On the left, a 'Features' section describes the service as enabling central access to SAP applications. It includes a video thumbnail titled 'SAP Launchpad Service Overview Video' and a link to 'Introducing the SAP Launchpad Service'. Below this, sections for 'Application Integration' and 'Intuitive and Engaging User Experience' are shown. On the right, there are three columns of 'Resources': 'Help Portal Product Page', 'What is SAP Launchpad service', 'Initial Setup', 'Feature Scope Description', 'What's New', 'Fiori Design Guidelines', 'SAP Fiori Deployment Options and System Landscape Recommendations', and 'Establish a central point of access with SAP Launchpad service'. Another column contains a 'Tutorials & Learning' section with a link to 'Trial Starter Scenario: Deliver Your First SAP Fiori Launchpad Site'. The final column contains a 'Support' section with a link to 'How to report an incident'.

Figure 3.10: SAP Discovery Center overview page for SAP Launchpad service

**SAP Launchpad Service**

Simplify access to business apps with a role based, personalized launchpad site.

Add to Estimator

Overview Pricing Related Missions Roadmap Customer Stories

Provider: All SAP-managed - 2 Service Plan: All - 2 Regions: All - 11 Change Currency

(1) Service plans for CPEA (Cloud Platform Enterprise Agreement) is a consumption based license model.

Free Add to Estimator  
The free plan is available for an unlimited period of time. Only community support is available for free tier service plans and these are not subject to SLAs.

Standard Add to Estimator

**Prices:**  
For the following regions:  
AWS: Australia (Sydney), Brazil (São Paulo), Canada (Montreal), Europe (Frankfurt), Japan (Tokyo), Singapore, South Korea (Seoul), US East (VA)  
Microsoft Azure: Australia (Sydney), Europe (Netherlands), Japan (Tokyo), Singapore, US East (VA), US West (WA)

Metric	Ranges	Fixed Fee	Unit Price per Month	Description
Active Users	Up to 100	✓	108.00 GBP	Active Users are the number of individuals that access the Cloud Service at any time during a calendar month.
	Up to 500		1.08 GBP	
	Up to 1,000		0.93 GBP	
	Up to 5,000		0.86 GBP	
	Up to 20,000		0.79 GBP	
	Up to 50,000		0.71 GBP	

Figure 3.11: SAP Discovery Center pricing page for SAP Launchpad service



Figure 3.12: SAP Discovery Center regional map showing in which SAP BTP regions the SAP Launchpad service is available

Your Estimate

Your Discount: 10% Total Estimate Cost: GBP 5,229.00 /MONTH  
Your License Model: CPEA

Add Services Add Section Customize Estimate Reset Share Download ▾

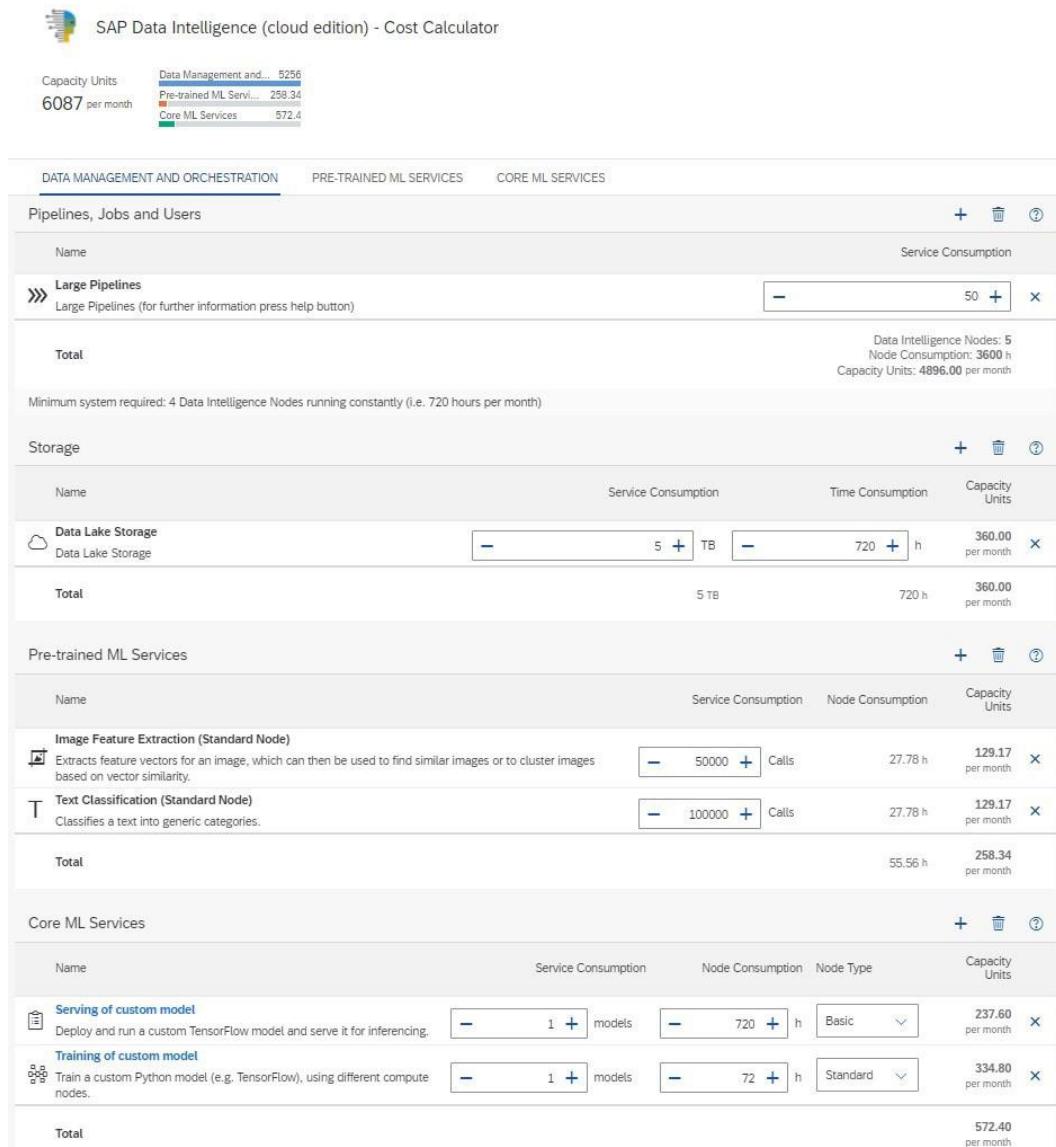
> Added from Catalog

		Default Region / Provider	Region / Provider	
> SAP Launchpad service		Europe (Frankfurt) AWS	Europe (Frankfurt) AWS	
Service Plan:	Standard	Region / Provider: Europe (Frankfurt) AWS	GBP 4,740.00 /MONTH	
> SAP Business Application Studio		Region / Provider: Europe (Frankfurt) AWS	GBP 110.00 /MONTH	
> SAP Business Technology Platform, Cloud Foundry runtime		Region / Provider: Europe (Frankfurt) AWS	GBP 960.00 /MONTH	
Service Plan: Standard - This is an enterprise-grade plan that allows you to create an org in the Cloud Foundry environment to start developing polyglot cloud-native applications. By default, a Cloud Foundry org that is created with this plan does not have any runtime memory. The global account admin must assign memory quota to the Cloud Foundry Runtime service in the cockpit so that the org has memory for its applications. GB Memory				
<a href="#">Add Services</a>				
Total Estimate Section "Added from Catalog" Cost				GBP 5,810.00 /MONTH

Total Estimate Cost

Total all Sections Cost	GBP 5,810.00 /MONTH
Your Discount is 10%	GBP -581.00 /MONTH
Total Estimate Cost	GBP 5,229.00 /MONTH

**Figure 3.13: Estimator Tool showing prices for three services**



**Figure 3.14: SAP BTP Estimator Tool – calculation of SAP Data Intelligence capacity units**

The screenshot shows the SAP BTP Cockpit interface for managing a subaccount. At the top, the navigation bar includes links for Trial Home, trial, and Acme - Development. The main title is "Subaccount: Acme - Development - Overview". Below the title, there are sections for Entitlements (73), Instances & Subscriptions (6), and Cloud Foundry Environment. The Cloud Foundry Environment section displays details like Org Name (00\_trial), API Endpoint (https://api.cf.eu10.hana.ondemand.com), and Spaces (1). The Kyma Environment section shows a single instance named dev. A summary bar at the bottom provides quick access to various management functions.

Figure 3.15: SAP BTP Cockpit – subaccount administration screen

The screenshot shows the SAP BTP Cockpit Service Marketplace. The title is "Subaccount: Acme - Development - Service Marketplace". The page lists various service offerings under the heading "Extension Suite - Development Efficiency". Services include ABAP environment, Audit Notification, Application Autoscaler, Application Logging Service, Audit Log Retrieval API v1, Audit Log Viewer, Authorization and Trust Management S..., Business Entity Recognition Trial, Cloud Foundry Runtime, Cloud Management Service, Cloud Transport Management, and Continuous Integration & Delivery. Each service has a brief description and a preview icon.

Figure 3.16: SAP BTP Cockpit – Service Marketplace

## Tables

	Subscription	Consumption	
		CPEA	Pay-As-You-Go
<b>Set of services</b>	Specific services – single or bundled	Any	Any
<b>Usage amount</b>	Defined upfront; can be increased later	Flexible as long as cumulative consumption is within the committed amount; pay list prices if you exceed, and top-up possible	Flexible as long as you pay at the end of the month
<b>Commitment</b>	Upfront with a fixed price	Upfront for the entire consumption	None
<b>Minimum usage</b>	Required	Required	Not required
<b>Term</b>	Fixed	Fixed	None
<b>Billing term</b>	Pay in advance	Annually/Quarterly	Monthly
<b>Discounts</b>	Possible	Possible	Non-discountable

**Table 3.1: Comparison of SAP BTP commercial models**

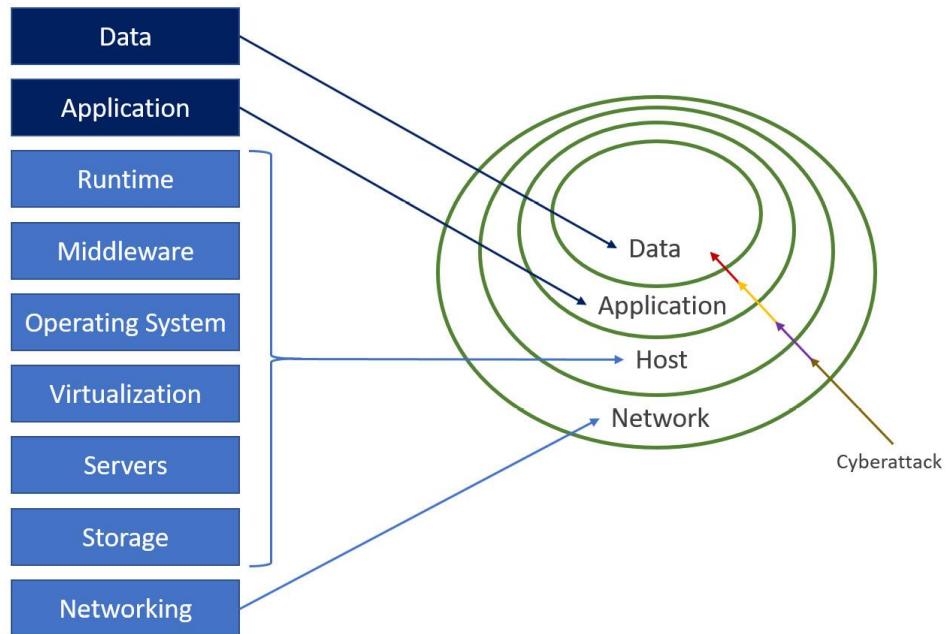
# Chapter 4

## Technical requirements

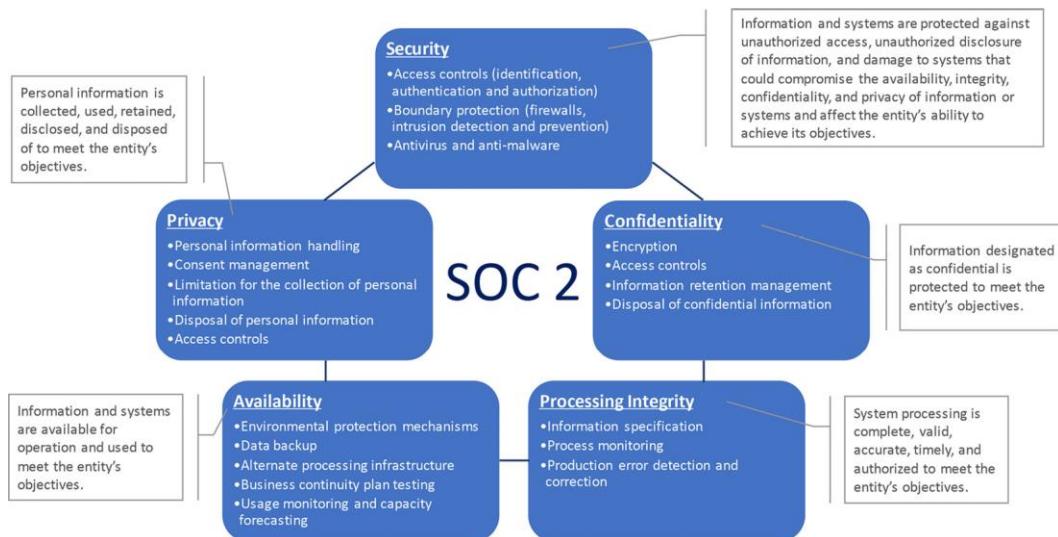
You might have already registered for an ess-ay-pee BTP trial account, as suggested in the **Technical requirements** section of *Chapter 3, Establishing the Foundation for ess-ay-pee Business Technology Platform*. If not, check it out and register for a trial account.

In this chapter, we will talk about an on-premise component called **ess-ay-pee Cloud Connector**. If you want to get your hands dirty with it, you can download it from <https://tools.hana.ondemand.com/#cloud>. Also, for trial purposes, you can install on-premise ess-ay-pee systems using ess-ay-pee CAL at <https://cal.sap.com/>. Just be careful as these systems could incur very high costs.

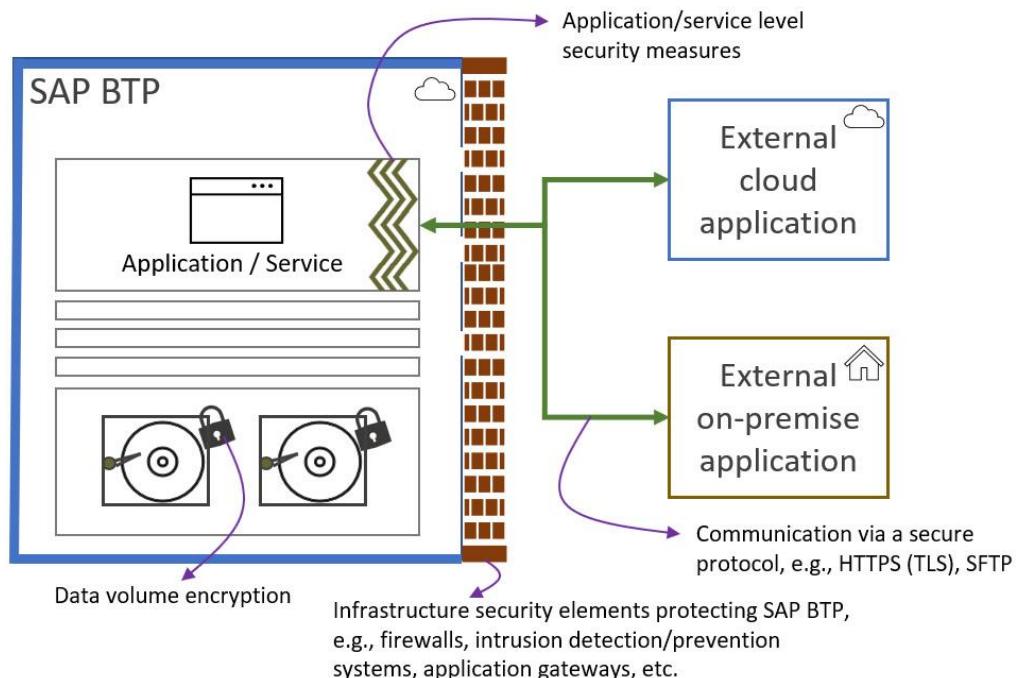
## Images



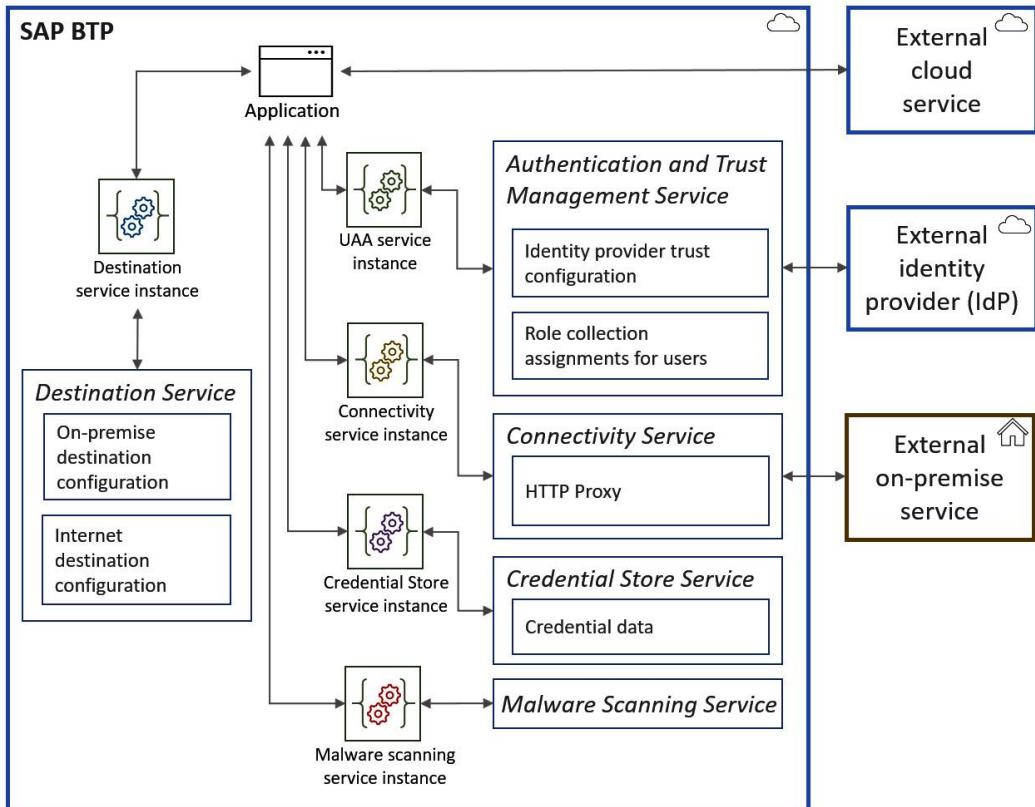
**Figure 4.1: The cloud service model and onion model layers**



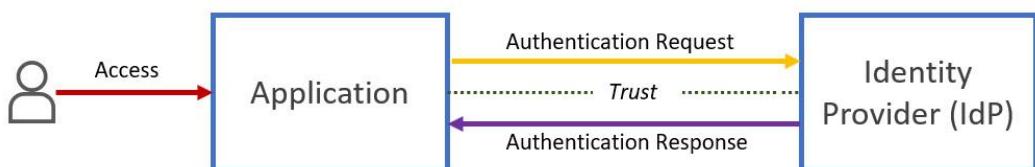
**Figure 4.2: AICPA's SOC 2 trust service categories**



**Figure 4.3: The core SAP BTP security elements**



**Figure 4.4: The SAP BTP helper services for building secure applications**



**Figure 4.5: An application delegating authentication to the IdP**

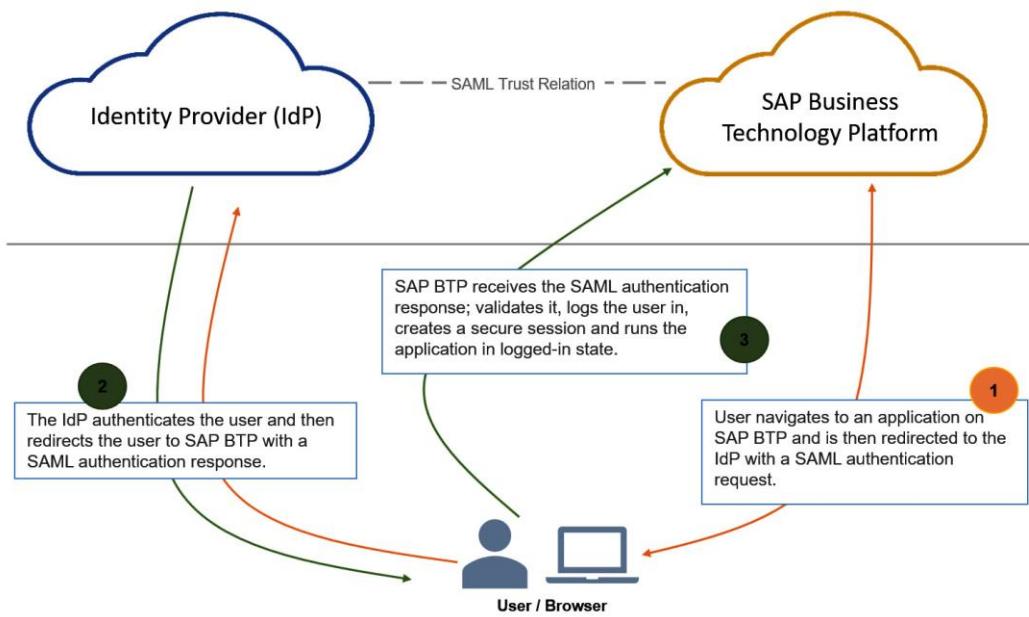


Figure 4.6: A SAML authentication flow for a user accessing an application or service in SAP BTP

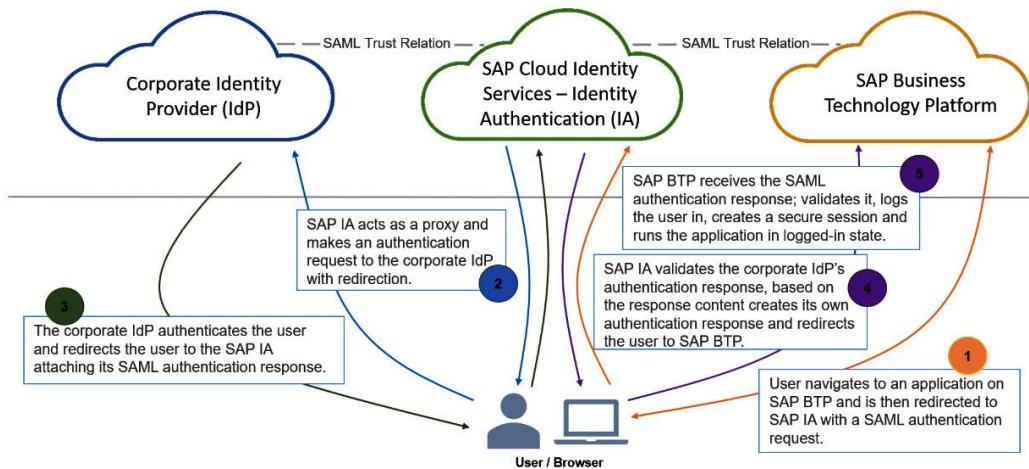


Figure 4.7: SAML authentication with SAP Cloud Identity Services – Identity Authentication

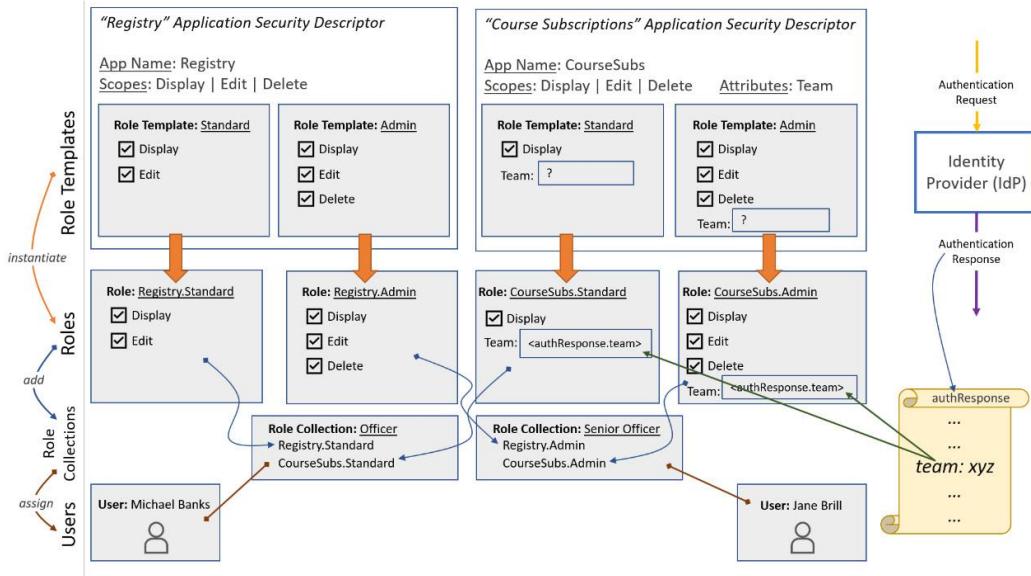


Figure 4.8: RBAC entities for the example scenario

Trial Home / trial / Acme - Development / Launchpad\_Admin

### Role Collection: Launchpad\_Admin - Overview

Description: Launchpad Admin

**Roles (4)** **Users (2)** **User Groups (1)** **Attribute Mapping (0)**

Role Name		Role Template	Application Identifier
Editor		Editor	sap-theming!b6529
Super_Admin		Super_Admin	portal-cf-service!b3664
Theme_Admin		Theme_Admin	portal-cf-service!b3664
Viewer		Viewer	sap-theming!b6529

**Users (2)**

ID	Identity Provider	E-Mail	First Name	Last Name
sim...@...com	Azure AD - [REDACTED]	sim...@...com	Serdar	Simsekler
sim...@...com	Default identity provider	sim...@...com	Serdar	Simsekler

**User Groups (1)**

Identity Provider	Name
https://sts.windows.net/9b.../	aadgrp-sapbtp-launchpad01-admin

**Attribute Mapping (0)**

Identity Provider	Attribute	Operator	Value
No Attribute Mapping			

**Figure 4.9: The Launchpad\_Admin role collection for the Launchpad Service**

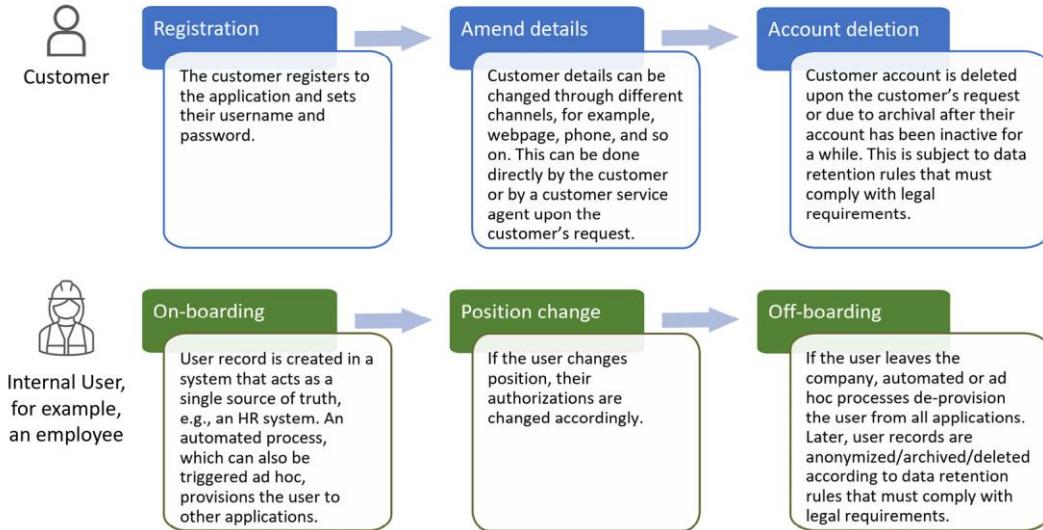


Figure 4.10: The identity life cycles for different types of users

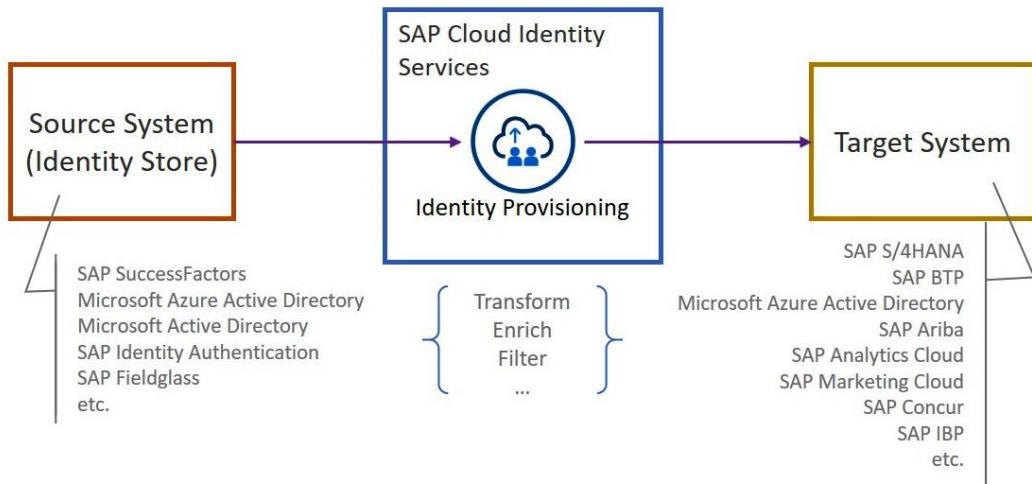


Figure 4.11: SAP Cloud Identity Services – Identity Provisioning

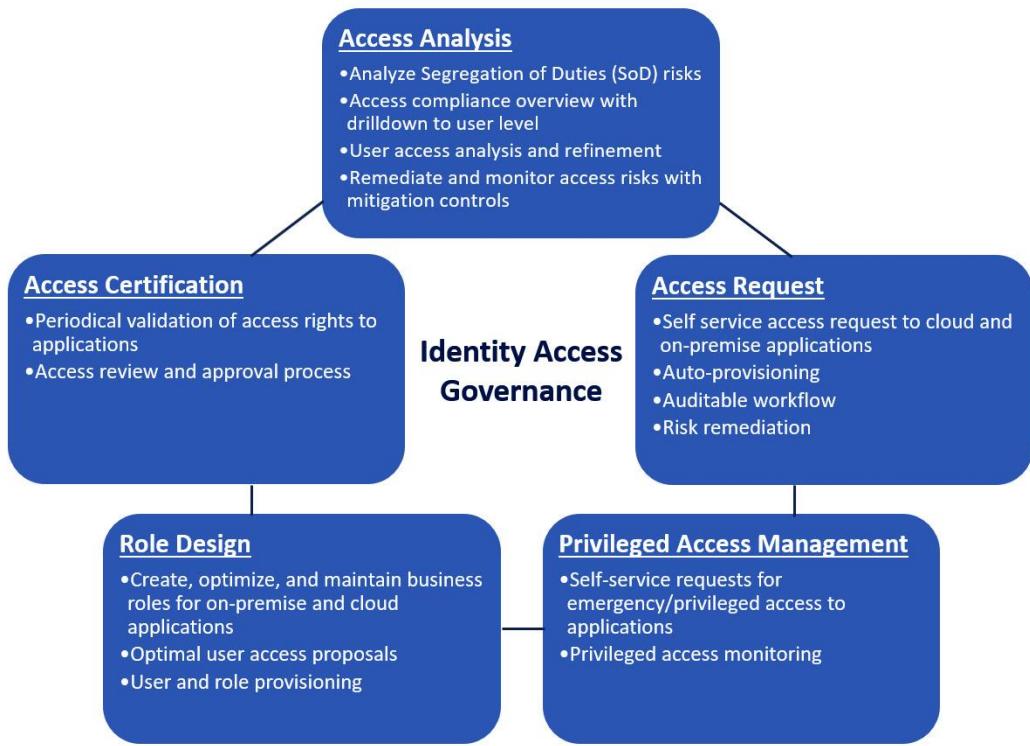
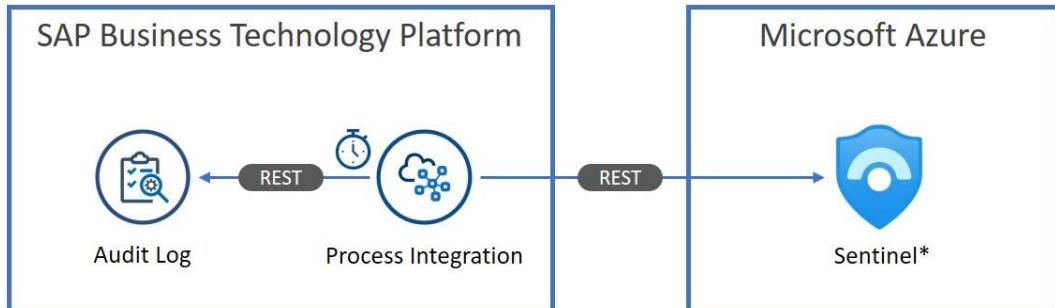


Figure 4.12: SAP IAG features



\* via Azure Monitor Data Collector API\*\*

\*\* At the time of authoring this book, this API was in preview.

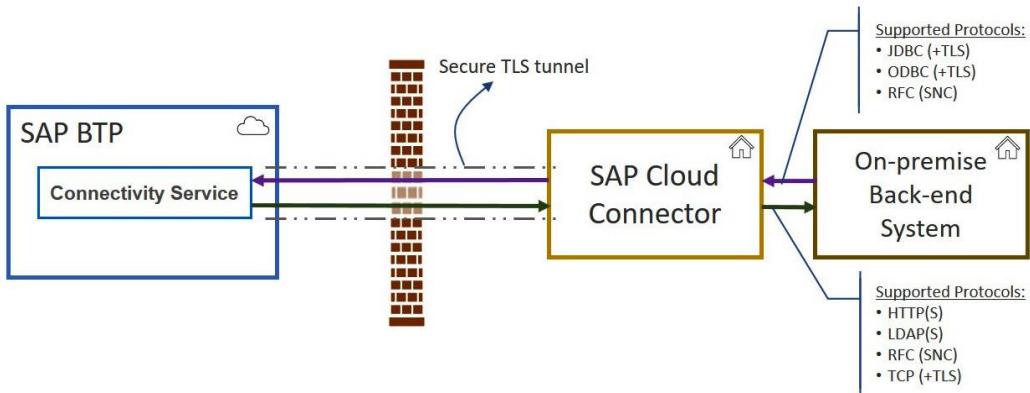


Figure 4.14: Connectivity between SAP BTP and on-premise systems with SAP Cloud Connector

The screenshot shows the SAP Cloud Connector Administration interface. The left sidebar navigation includes:

- Connector (selected)
- Security Status
- Alerting
- High Availability
- Hardware Metrics Monitor
- Configuration
- Subaccounts (Trial - Acme - Dev selected)
- Cloud To On-Premise
- On-Premise To Cloud
- Monitor
- Audits
- Log And Trace Files

The main content area is the **Connector Overview**, which includes:

- Connector ID: B4A6
- 007D Security Status: Low risk
- Local Name: sid-hdb-s4h.dummy.nodomain
- Local IP: 10.0.0.125
- Availability: High (disabled)
- Alerts: 1

Below the overview is the **Subaccount Dashboard (1)**, which lists:

Status	Subaccount	Display Name	Location ID	Region	Actions
OK	33a...	Trial - Acme - Dev		Europe (Frankfurt) - AWS	

At the bottom is the **Service Channels Overview (0)**, which is currently empty.

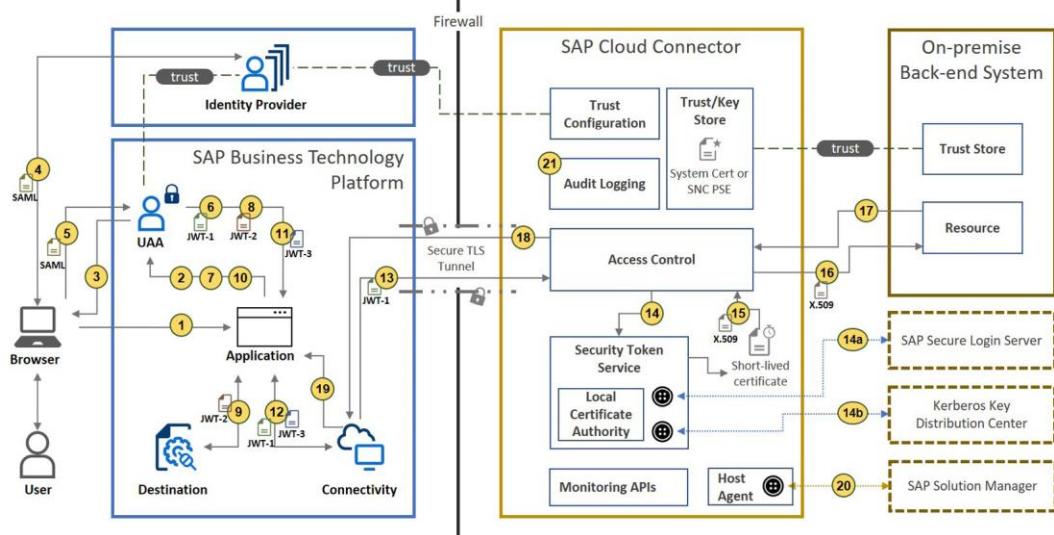
Figure 4.15: The SAP Cloud Connector overview page

The screenshot shows the SAP Cloud Connector Administration interface. The left sidebar has a 'Connector' section with sub-options: Security Status, Alerting, High Availability, Hardware Metrics Monitor, and Configuration. Under Configuration, 'Trial - Acme - Dev' is selected, which further branches into 'Cloud To On-Premise', 'On-Premise To Cloud', 'Monitor', 'Audits', and 'Log And Trace Files'. The main content area shows a subaccount 'Trial - Acme - Dev'. Below it, under 'Cloud To On-Premise', there's a table titled 'Mapping Virtual To Internal System (1)'. It lists one entry: 'Status' (Reachable), 'Virtual Host' (dev.s4h.acme:1234), 'Internal Host' (vhcals4hcs.dummy....), 'Protocol' (HTTPS), 'Back-end Type' (ABAP System). Below this is another table titled 'Resources Of dev.s4h.acme:1234 (1)'. It lists one entry: 'Status' (Reachable), 'URL Path' (/sap/opu/odata/), 'Access Policy' (Path And All Sub-Paths).

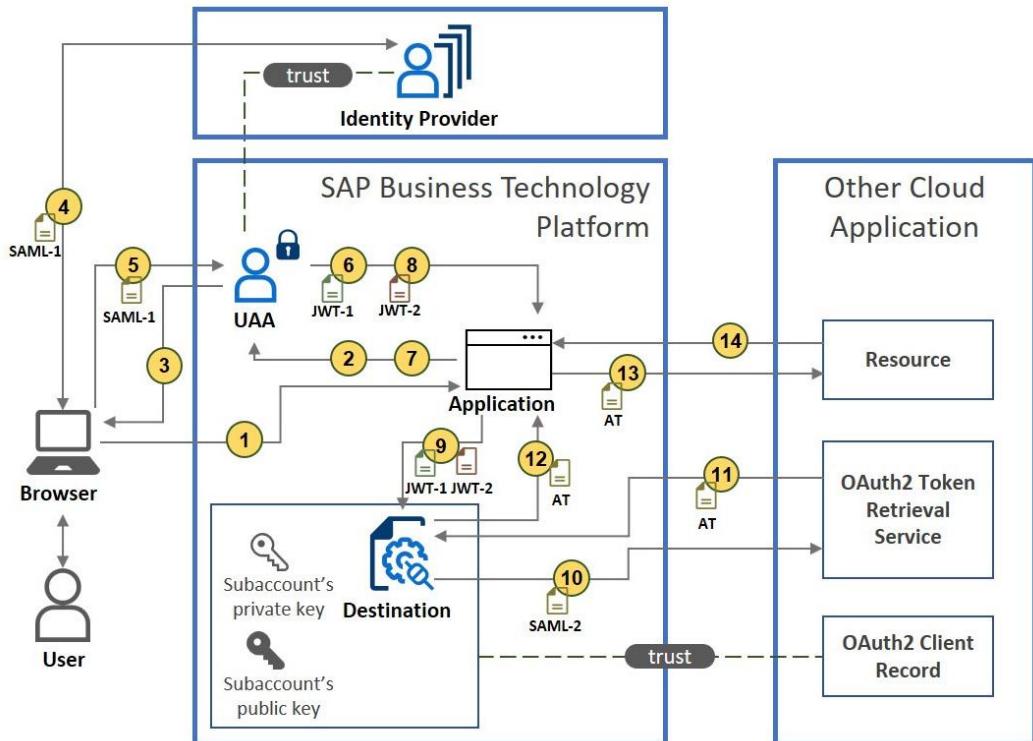
**Figure 4.16: A SAP Cloud Connector cloud to on-premise connection example**

The screenshot shows the SAP BTP Cockpit interface. The top navigation bar includes 'Join our user survey!', a notification for '33' new messages, and a user 'Serdar'. The main content area is titled 'Subaccount: Acme - Development - Destinations' with a note 'All: 2'. It shows two destination entries: 'APIPORTAL-SAPDeveloperSystemE55' (HTTP type, URL https://sapes5.sapdevcenter.com:443/sap/opu/odata) and 's4hfp02\_trial' (HTTP type, URL http://dev.s4h.acme:1234). Below these, a 'Destination Configuration' panel is open for 's4hfp02\_trial'. It contains fields for Name (s4hfp02\_trial), Type (HTTP), Description (s4hfp02\_trial), URL (http://dev.s4h.acme:1234), Proxy Type (OnPremise), Authentication (BasicAuthentication), Location ID, User (BPINST), and Password. To the right, an 'Additional Properties' table lists several properties with their values: HTML5.Dyna... (true), HTML5.Time... (60000), sap.client (100), WebIDEEnab... (true), WebIDESyst... (S4H), and WebIDEUsage (odata\_abap\_dev\_abap). At the bottom of the configuration panel are buttons for Edit, Clone, Export, Delete, and Check Connection.

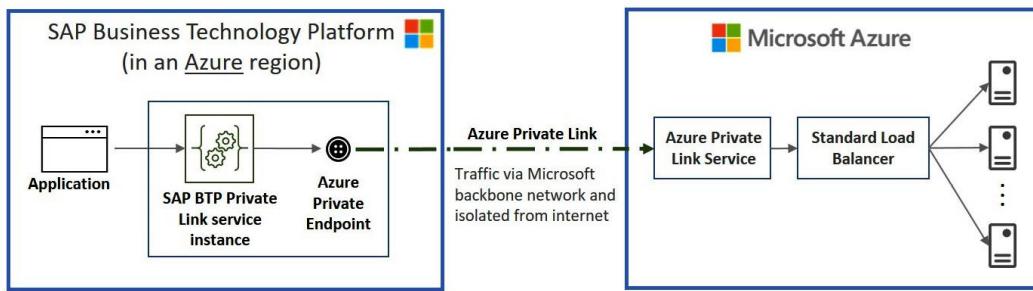
**Figure 4.17: An example on-premise destination configuration**



**Figure 4.18: The connection flow from SAP BTP to on-premise with principal propagation**



**Figure 4.19: The connection flow from SAP BTP to another cloud application with principal propagation**



**Figure 4.20: Accessing resources on Microsoft Azure via the Private Link service**

## Tables

The SAP BTP service	Security features
SAP HANA Cloud, SAP HANA Database	Support for secure connections, for example, TLS for ODBC and JDBC External IdP for database platform users that can be used for SSO RBAC IP allowlists Data masking and anonymization Audit policies Secure internal credential store and SAP HANA secure user store
SAP HANA Cloud, SAP ASE Database	Support for secure connections, for example, TLS for ODBC and JDBC Column-level encryption RBAC

	Audit logging
SAP Integration Suite	Support for secure protocols, for example, HTTPS and SFTP
	Message-level encryption, for example, PKCS#7, PGP, XML Signature, and WS-Security
	Design-time RBAC
	Authentication and authorization for inbound calls
	Malware scanner
	Audit logging
	API management policies

**Table 4.1: Examples of SAP BTP service-specific security features**

# Chapter 5

## Images

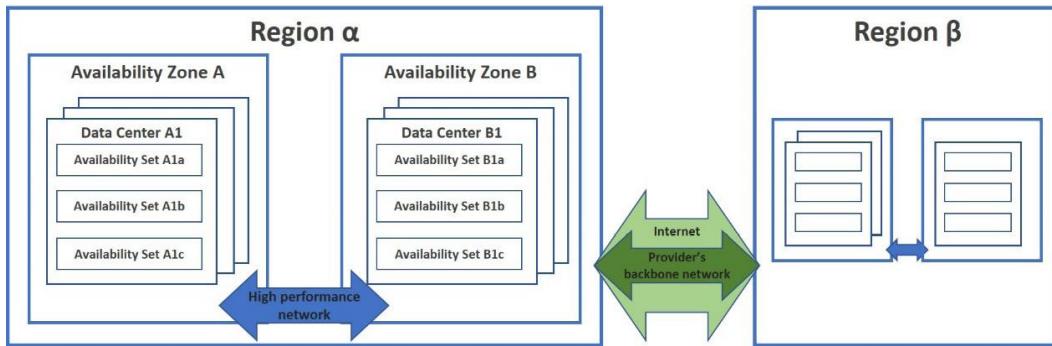


Figure 5.1: Availability level arrangements of a cloud infrastructure provider

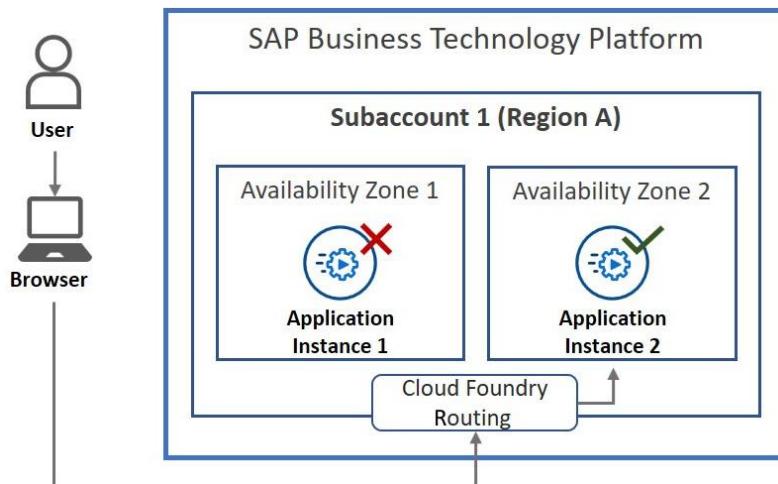


Figure 5.2: Built-in high availability setup for custom applications in the SAP BTP Cloud Foundry runtime using availability zones

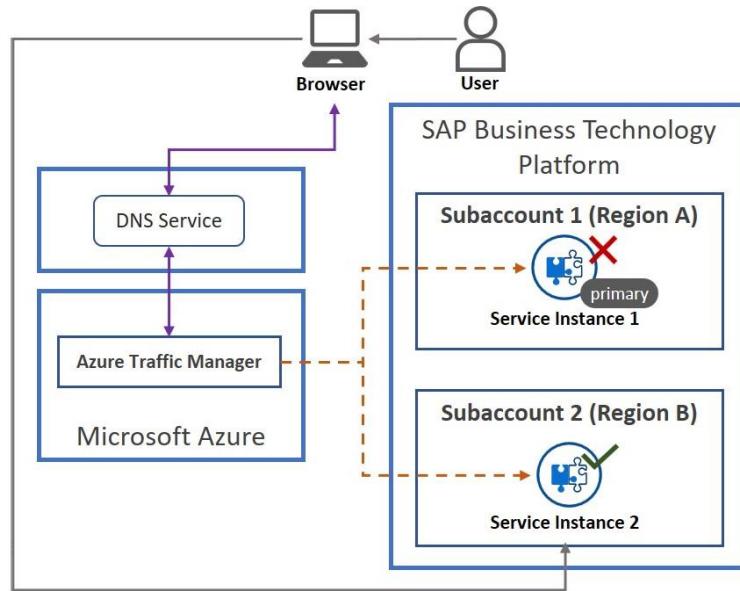


Figure 5.3: High availability setup with two service instances in different subaccounts

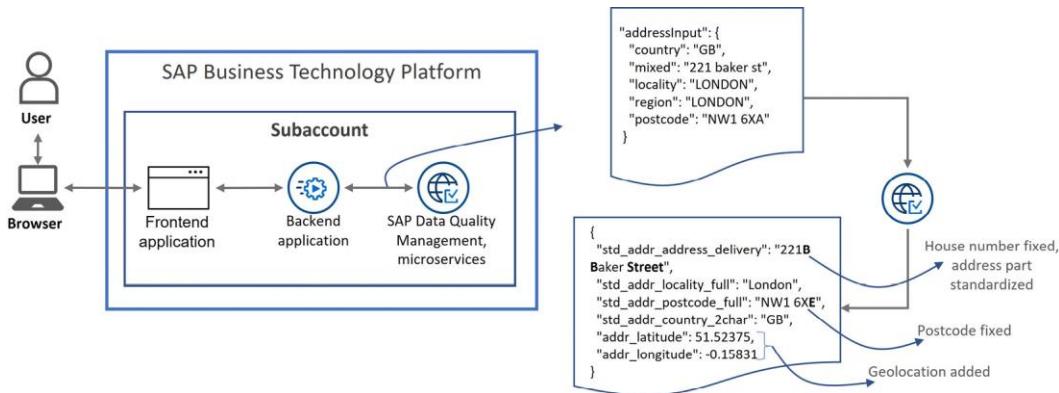


Figure 5.4: SAP BTP application using a SAP Data Quality Management location microservice

SAP HANA Database Configurations					
Name	Amount	Rate	Activity Hours	CU (per month)	
<b>Memory</b> Memory size of a SAP HANA database	— 128 + GB	0.025 CU / GB / Hour	730	2336.00 CU	
<b>Compute</b> The number of vCPUs of a SAP HANA database	— 8 + vCPUs	0.184 CU / vCPU / Hour	730	1074.56 CU	
<b>Storage</b> The disk storage space of a SAP HANA database	— 360 + GB	0.013 CU / 16 GB / Hour <small>(fixed per month)</small>	730	213.52 CU	
<b>Backup Storage</b> The backup storage space of a SAP HANA database	— 2688 + GB	0.011 CU / 64 GB / Hour <small>(fixed per month)</small>	730	337.26 CU	
<b>Network Data Transfer</b> The amount of network traffic	— 128 + GB	0.438 CU / GB	N/A	56.06 CU	
<b>SAP Cloud Connector</b> Connect to an on-premise SAP HANA database	— <input checked="" type="checkbox"/>	0.197 CU / Hour ⓘ	730	0.00 CU	
<b>Synchronous Replicas</b> Number of synchronous replicas of a SAP HANA database	— 1 + Replicas	ⓘ	730	3624.09 CU	
<b>Total Estimate</b>				7641.49 CU	

Figure 5.5: Capacity unit estimator for SAP HANA Cloud, HANA Database

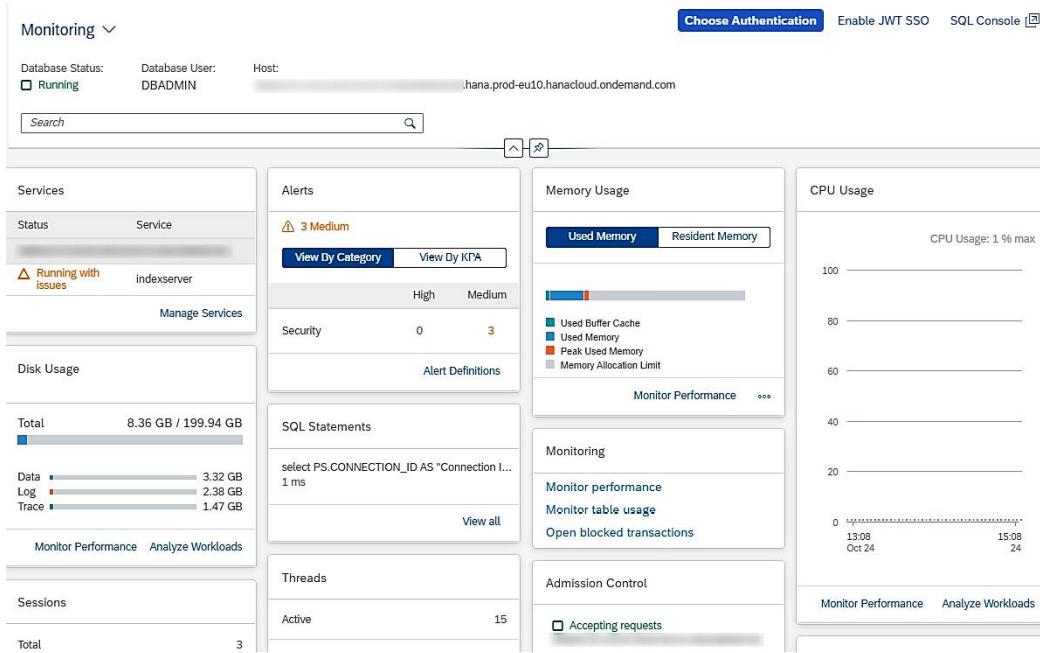


Figure 5.6: SAP HANA Cockpit – the Monitoring page

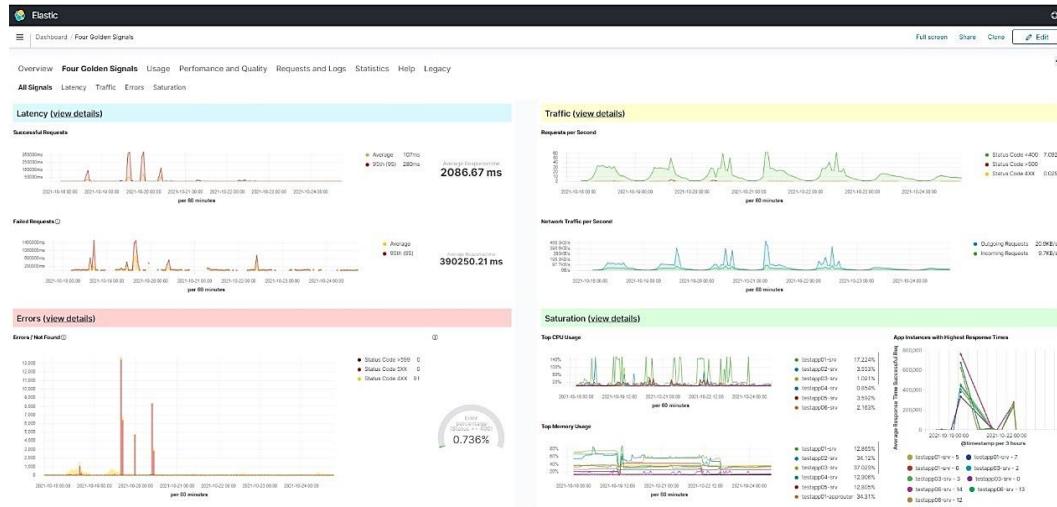


Figure 5.7 – The Kibana dashboard showing statistics for custom applications

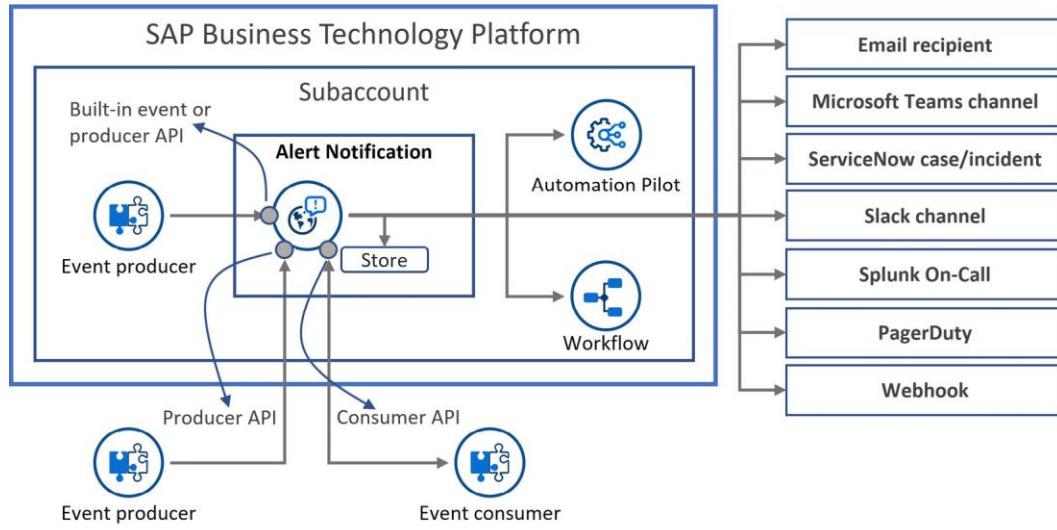


Figure 5.8: SAP Alert Notification service, sources, and delivery channels

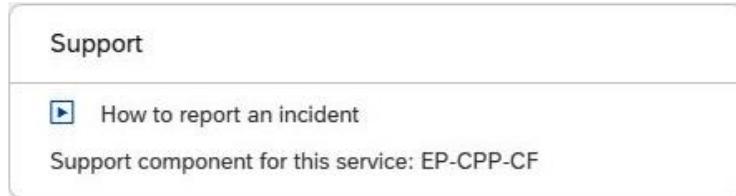


Figure 5.9 – SAP Discovery Center – support information for the SAP Launchpad Service

## Tables

SAP BTP Service	Monitoring Features
SAP HANA Cloud, SAP HANA Database	<p>Using the SAP HANA Cockpit, Monitoring page (<a href="#">Figure 5.6</a>), you can do the following:</p> <ul style="list-style-type: none"><li>Observe memory usage, CPU usage, and disk usage</li><li>Drill down to monitor CPU, memory, and disk performances with more detailed views</li><li>Drill down to analyze workloads to see the top SQL statements, background jobs, and threads</li><li>Check alerts, along with their details and proposed solutions</li><li>Monitor table usage</li></ul>
SAP Data Intelligence	<p>Using the SAP Data Intelligence Monitoring application, you can do the following:</p> <ul style="list-style-type: none"><li>Observe memory and CPU usage with filtering options for graphs, statuses, users, and time ranges</li><li>View recently executed graphs and drill down to their execution details, process logs, and metrics</li><li>View and manage schedules</li></ul>
SAP Integration Suite	<p>Using the Cloud Integration Monitoring dashboard, you can do the following:</p>

Monitor message processing and drill down to individual messages to see their statuses, properties, logs, and artifact details

Manage the logging level

Access audit logs and system log files

Using the Analytics view of the API Portal, you can do the following:

View API traffic statistics in terms of the number of calls and response times

View error statistics and error-prone APIs

SAP Integration Suite also supports out-of-the-box integration with Solution Manager and SAP Analytics Cloud.

**Table 5.1: Examples of SAP BTP service-specific monitoring features**

# Chapter 6

## Images

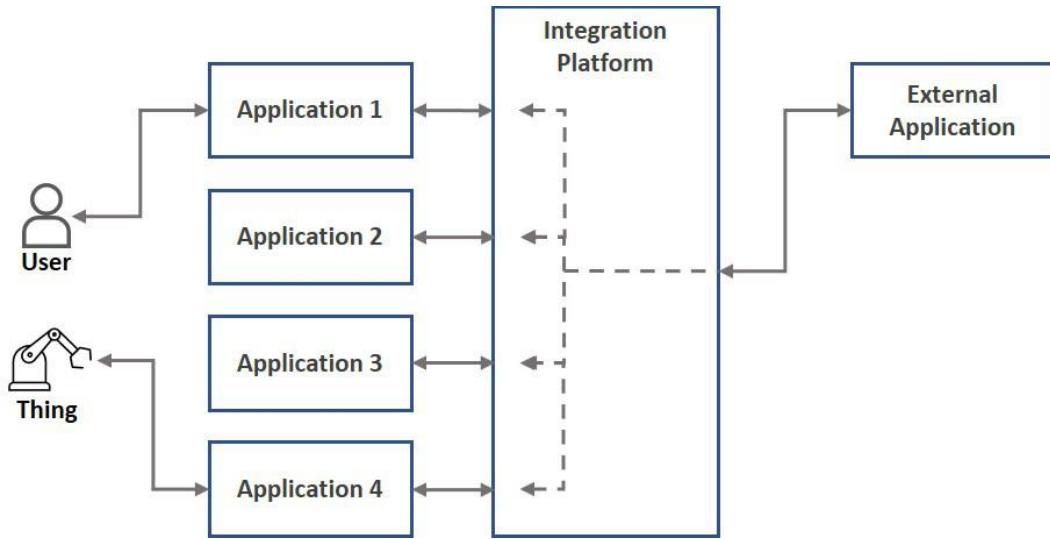


Figure 6.1: Integration actors

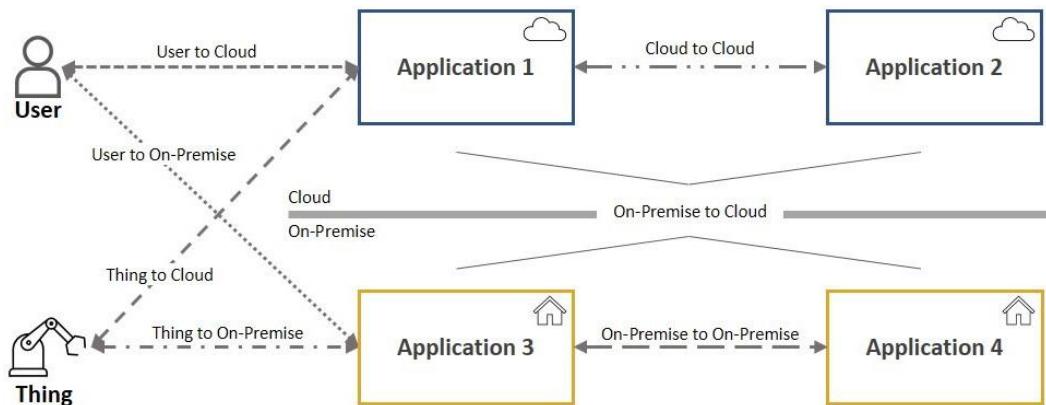
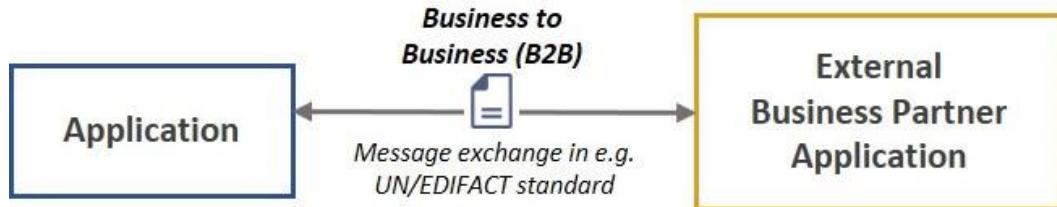


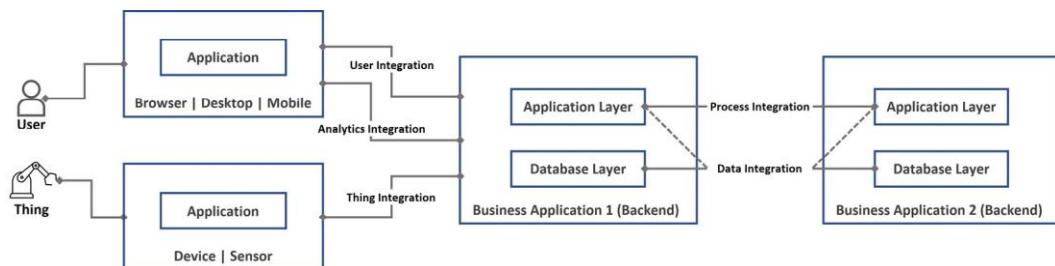
Figure 6.2: Integration domains



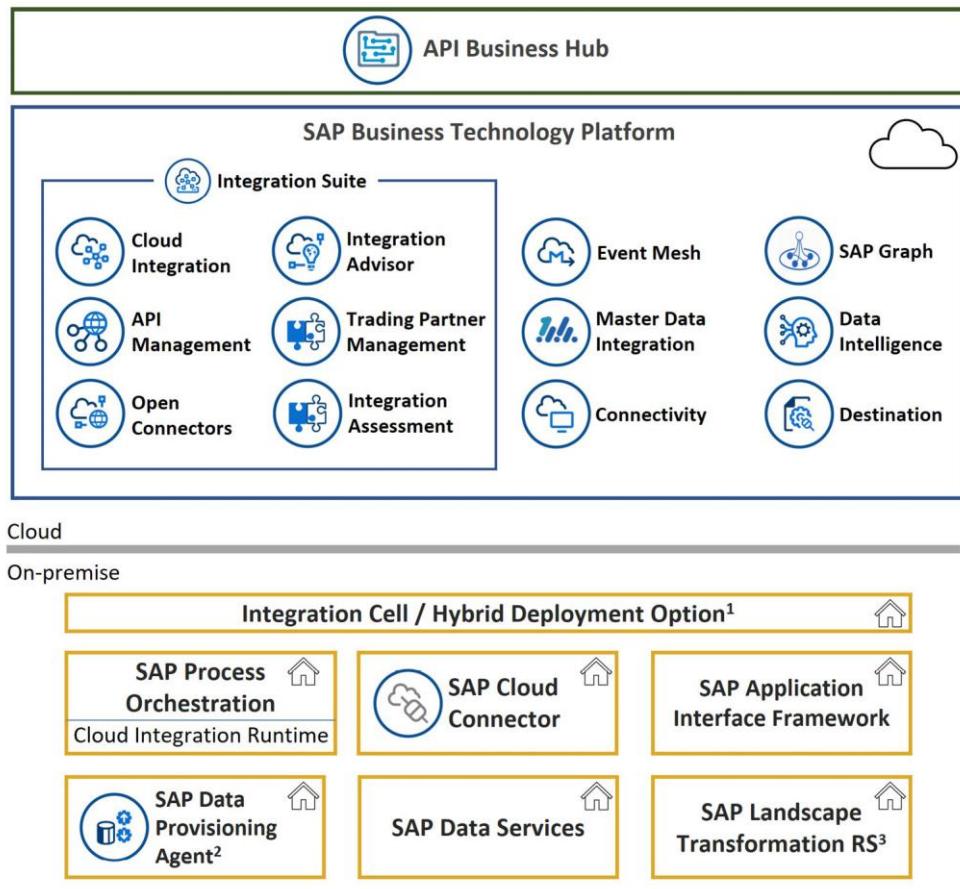
**Figure 6.3: A B2B integration use case**



**Figure 6.4: A B2G integration use case**



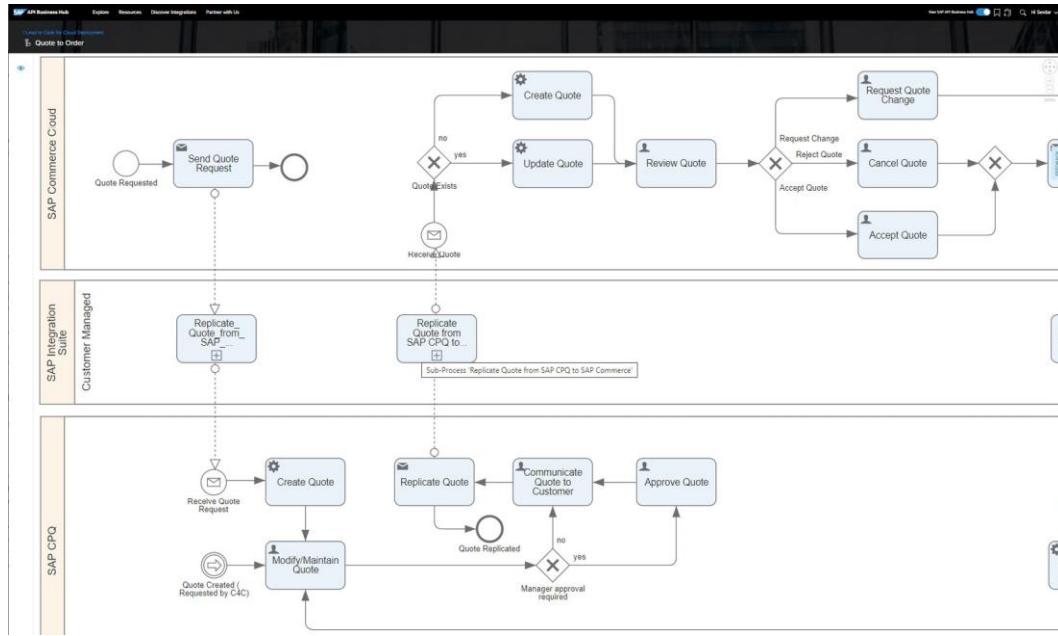
**Figure 6.5: Integration styles**



<sup>1</sup>) In the roadmap – Integration suite services and runtimes in a containerized environment.

<sup>2</sup>) SAP HANA Smart Data Integration (SDI) <sup>3</sup>) SAP Landscape Transformation Replication Server (SLT)

**Figure 6.6: SAP's hybrid integration platform**



**Figure 6.7: An example solution process flow diagram for SAP API Business Hub**

# Chapter 7

## Images

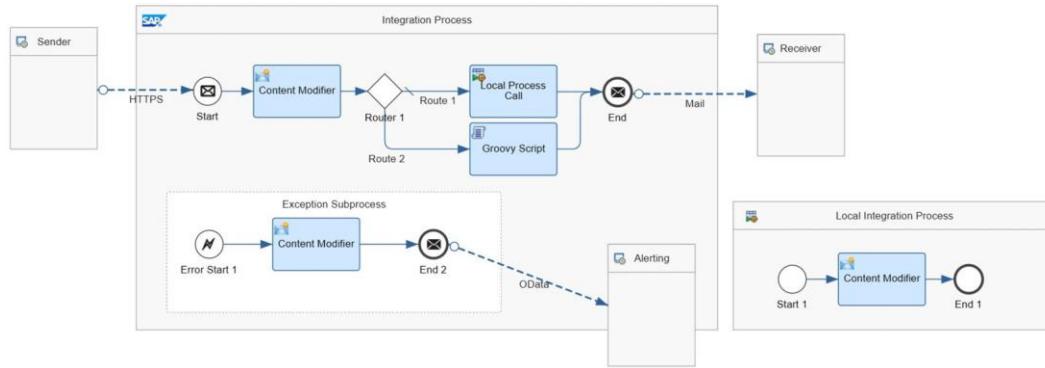


Figure 7.1: An integration flow designed in SAP Integration Suite's Cloud Integration

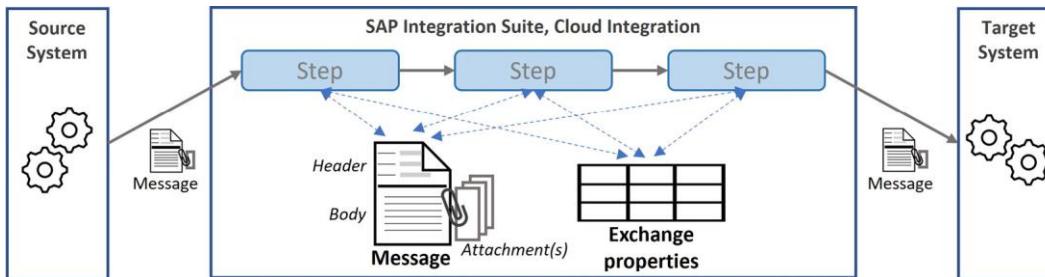


Figure 7.2: Basic message processing

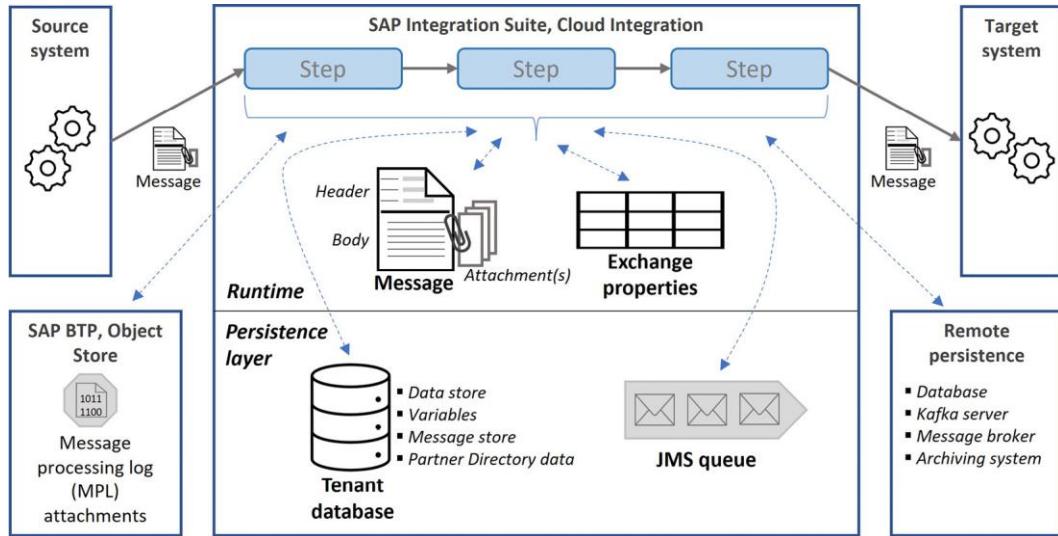


Figure 7.3: Message processing with persistence options

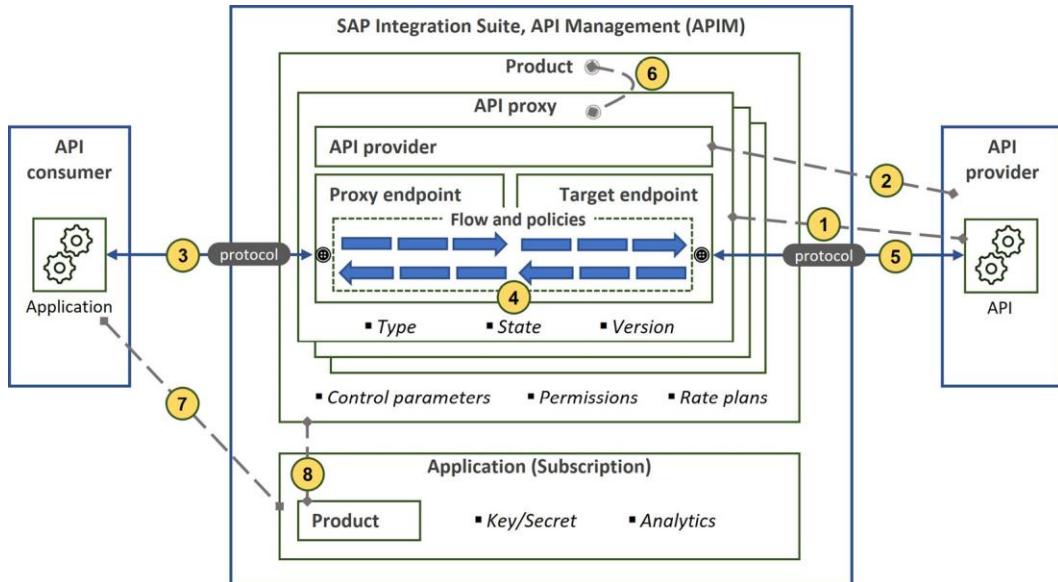


Figure 7.4: The elements of SAP APIM

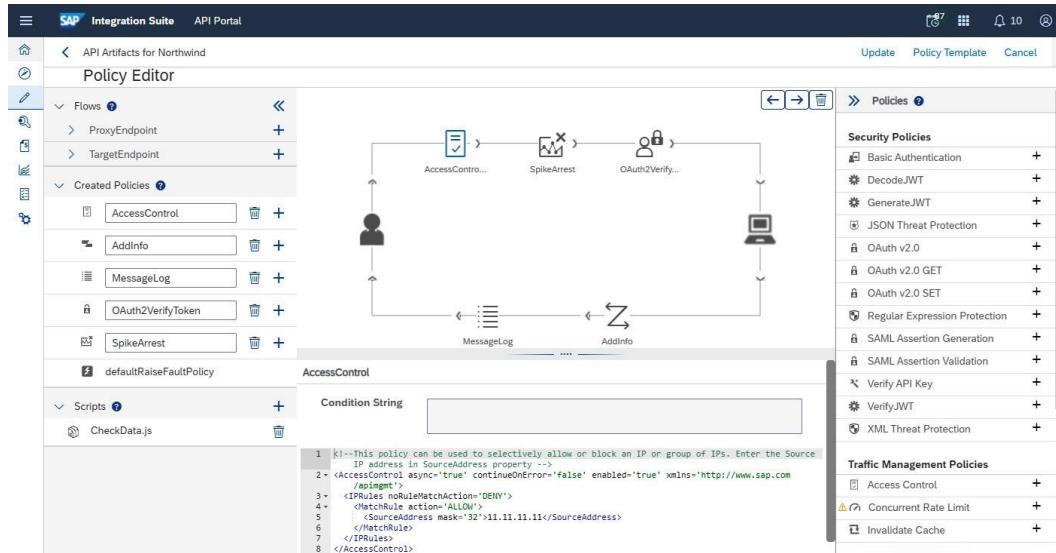


Figure 7.5: The SAP APIM flow policies editor

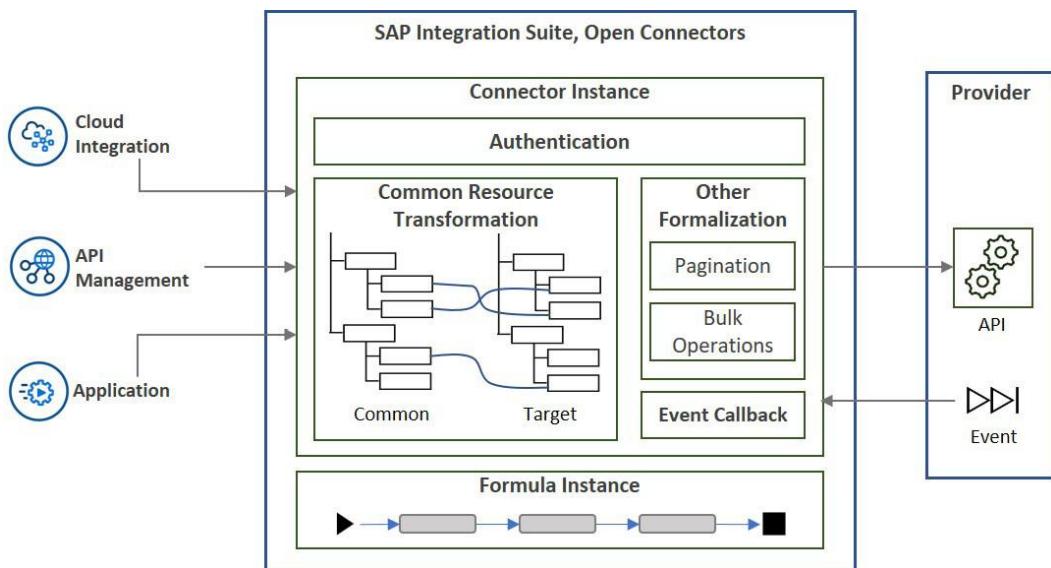
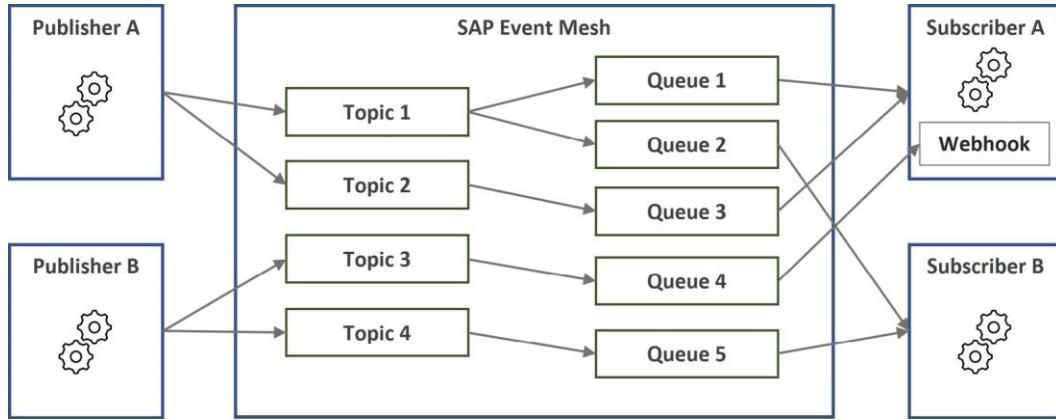
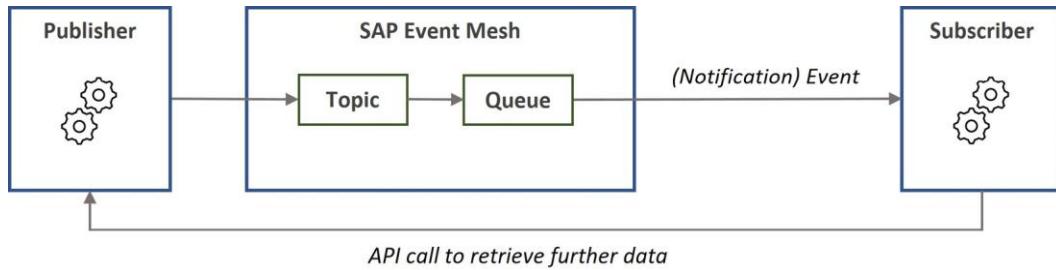


Figure 7.6: The elements of SAP Open Connectors



**Figure 7.7: A typical pub-sub flow in SAP Event Mesh**

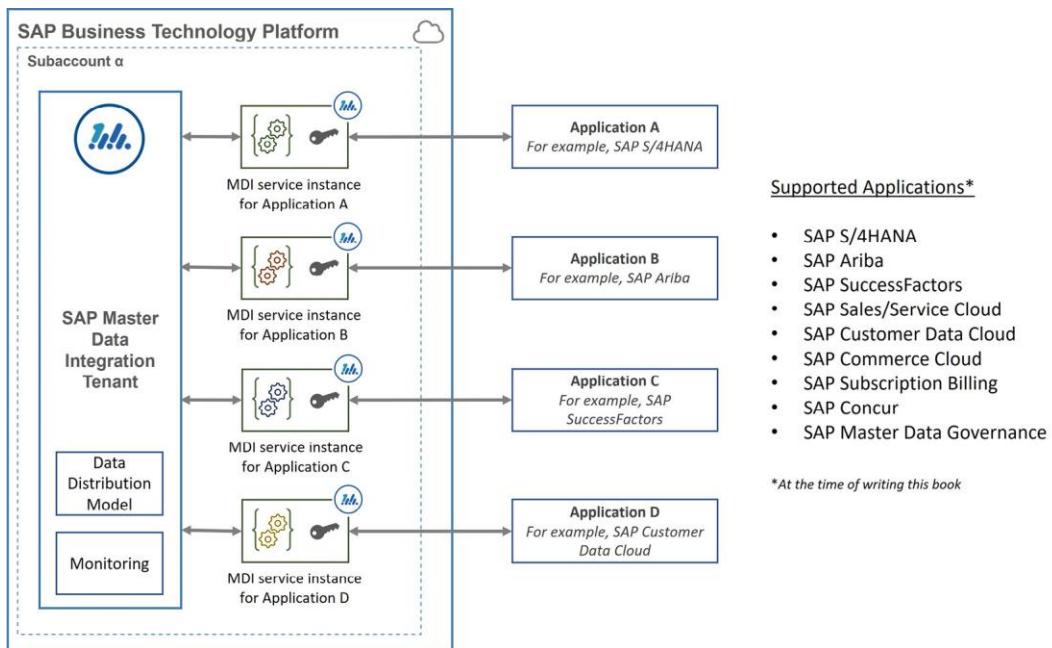


**Figure 7.8: A notification event flow followed by an API call**

```
{
  "specversion": "1.0",
  "id": "e940019e-a96b-43d1-ae1c-585219493f50",
  "source": "/default/com.ssstest.app01/1",
  "type": "com.ssstest.app01.BusinessObject.Created/v1",
  "subject": "businessObjectId:1234567",
  "time": "2022-02-06T21:36:21Z",
  "comsstestapp01extension1" : "ssimsekler",
  "ccomsstestapp01othervalue" : 11,
  "datacontenttype" : "application/json",
  "data": {
    "businessObjectId": "1234567"
  }
}
```

**Figure 7.9: An example CloudEvent**

**Figure 7.10: SAP ODM Product entity documentation in SAP API Business Hub**



**Figure 7.11: A SAP MDI setup with connected applications**

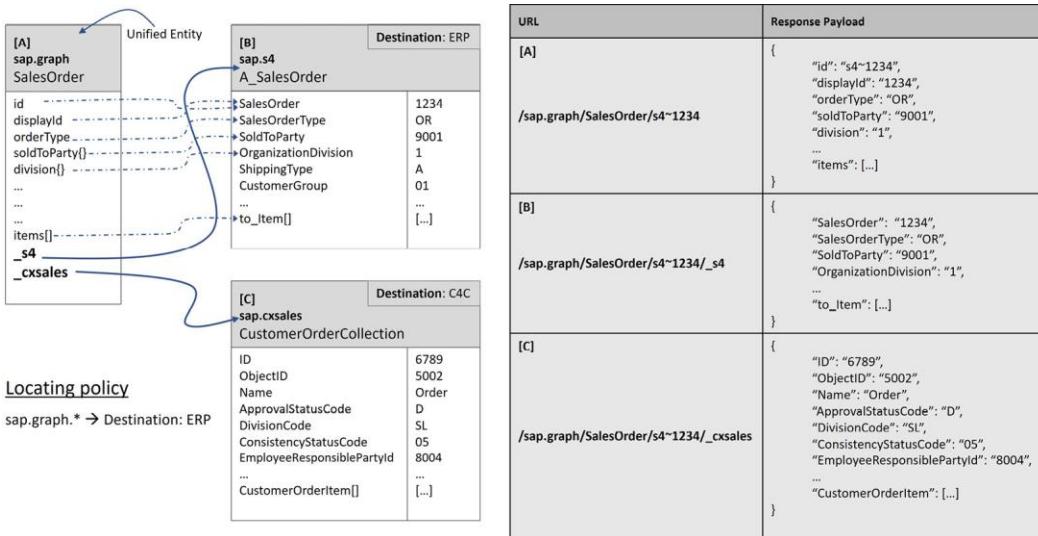


Figure 7.12: An example of entity relationships shown in SAP Graph

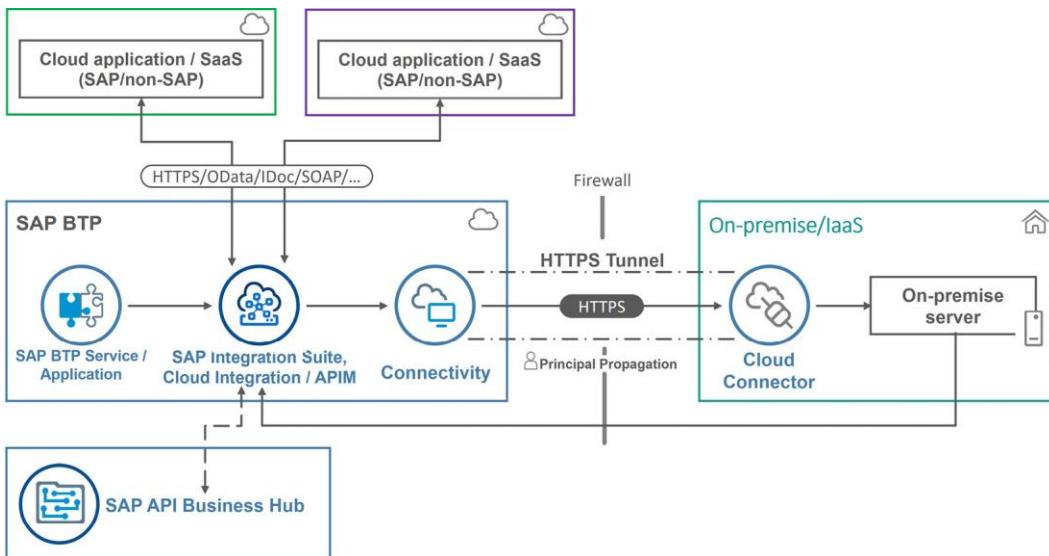
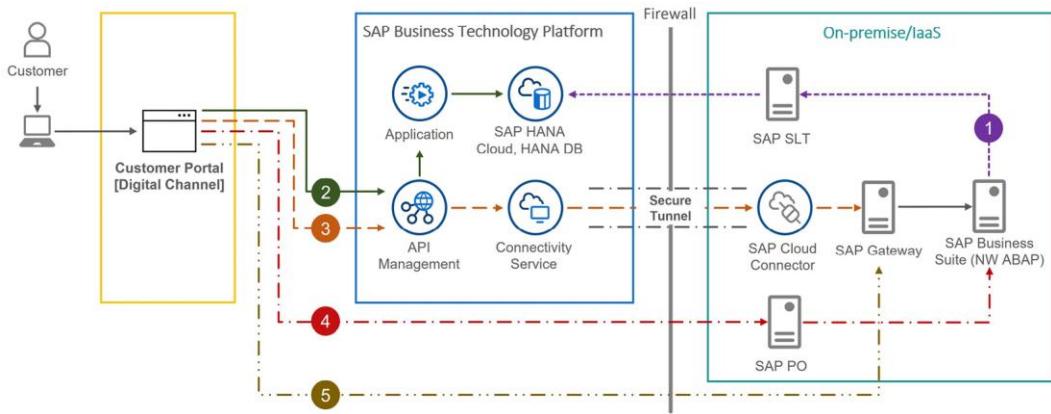


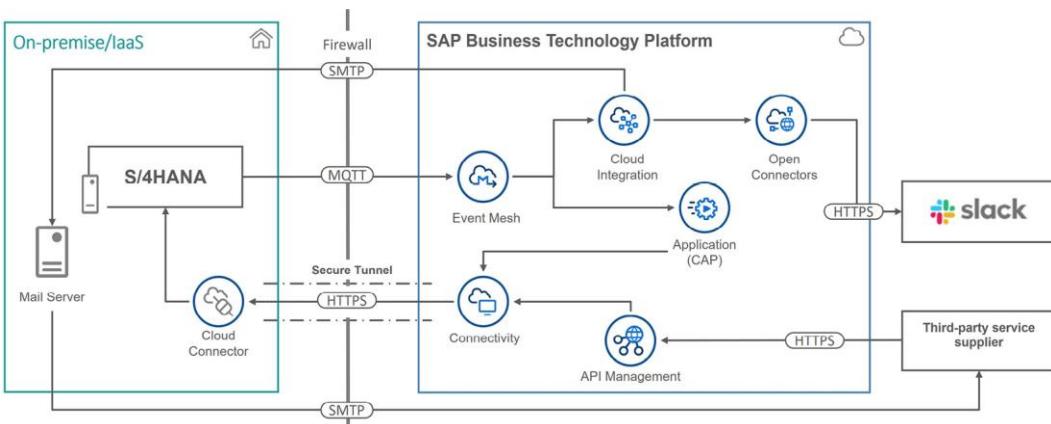
Figure 7.13: The design for a common cloud integration platform



**Figure 7.14: The design for a digital integration hub**



**Figure 7.15: A solution design for electronic tax submission**



**Figure 7.16: A solution design using events to enhance business partner data in S/4HANA**

The screenshot shows the SAP API Business Hub interface. At the top, there are navigation links: Explore, Resources, Discover Integrations, Partner with Us, and a New SAP API Business Hub button. On the right, there's a user profile with the name 'Hi Serdar' and a dropdown arrow. Below the header, there are two tabs: 'Overview' and 'Event References', with 'Event References' being the active tab. On the left, a sidebar lists 'Changed' and 'Created' sections. In the main content area, a green box indicates a 'POST' method for the endpoint '/sap/s4/beh/businesspartner/v1.BusinessPartner.Created.v1'. The title is 'Business Partner Created'. A description states: 'This event is raised when a business partner record is created.' Under 'Parameters', it says 'No parameters'. Under 'Request body', the content type is set to 'application/json'. A large black box covers the example value and schema. On the right side, there's a vertical blue bar with the word 'FEEDBACK'.

Figure 7.17: SAP API Business Hub showing Business Partner events in S/4HANA

# Chapter 8

## Images

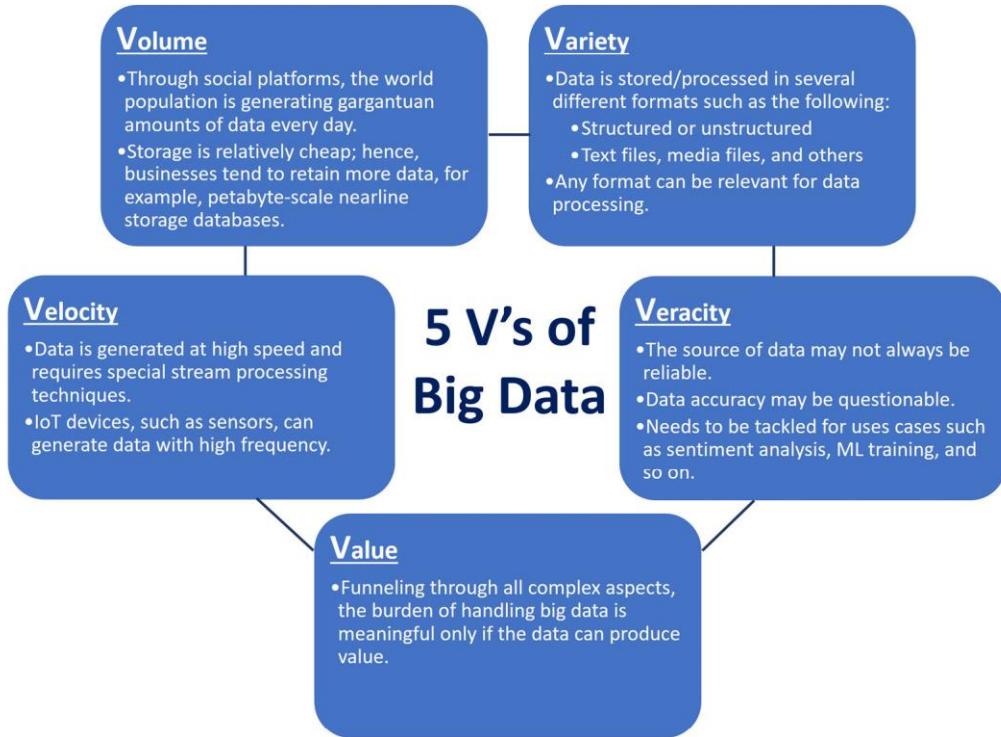


Figure 8.1: The 5 V's of big data

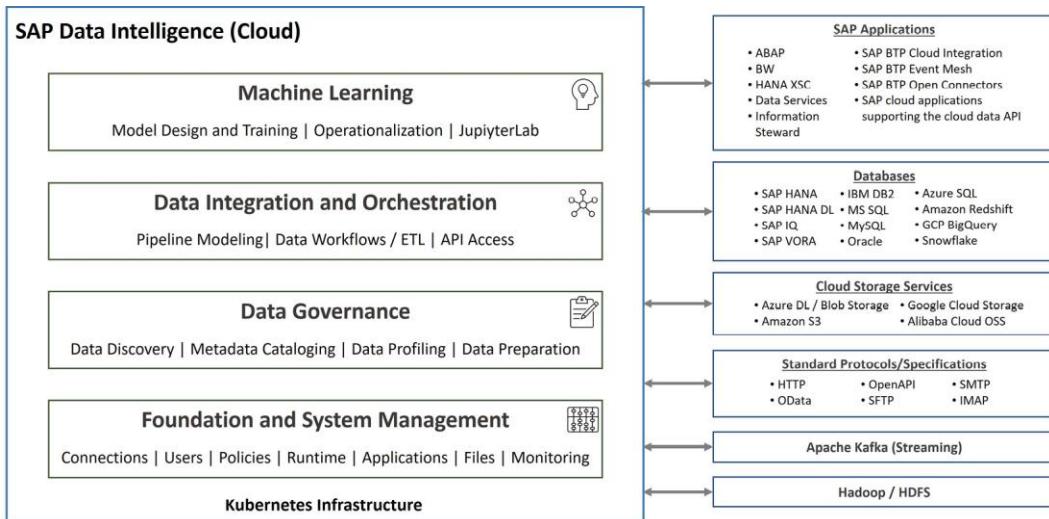


Figure 8.2: SAP Data Intelligence overview

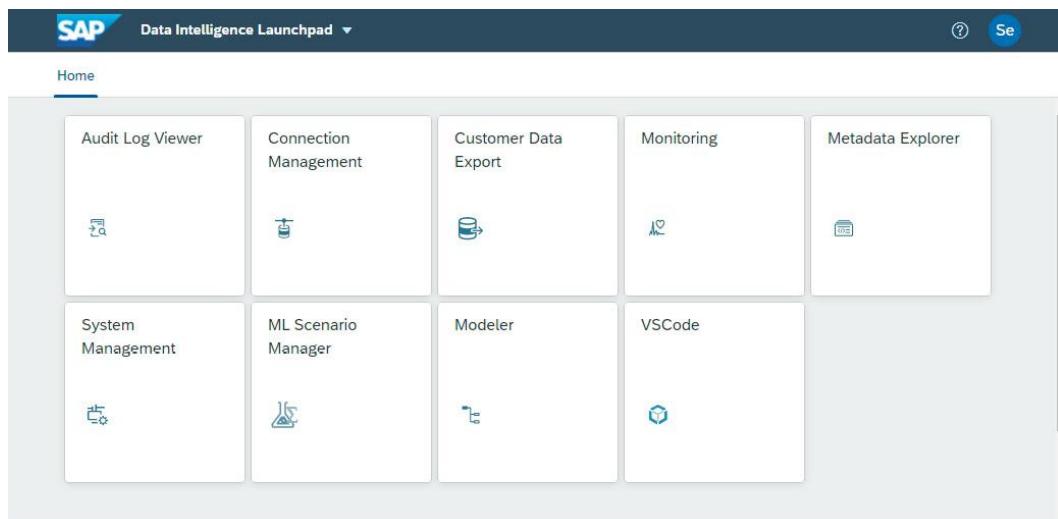


Figure 8.3: SAP Data Intelligence Launchpad

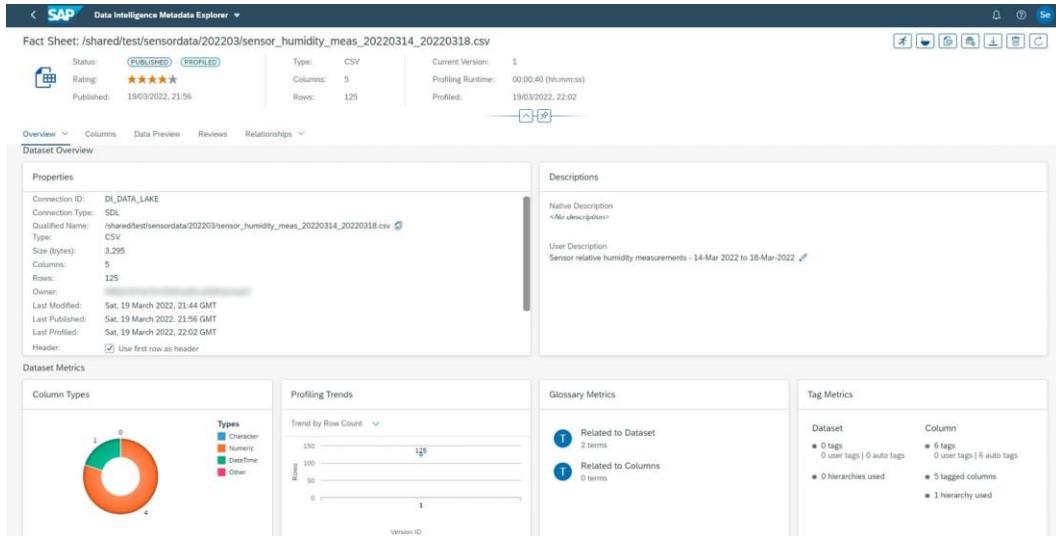


Figure 8.4: A fact sheet page for a dataset

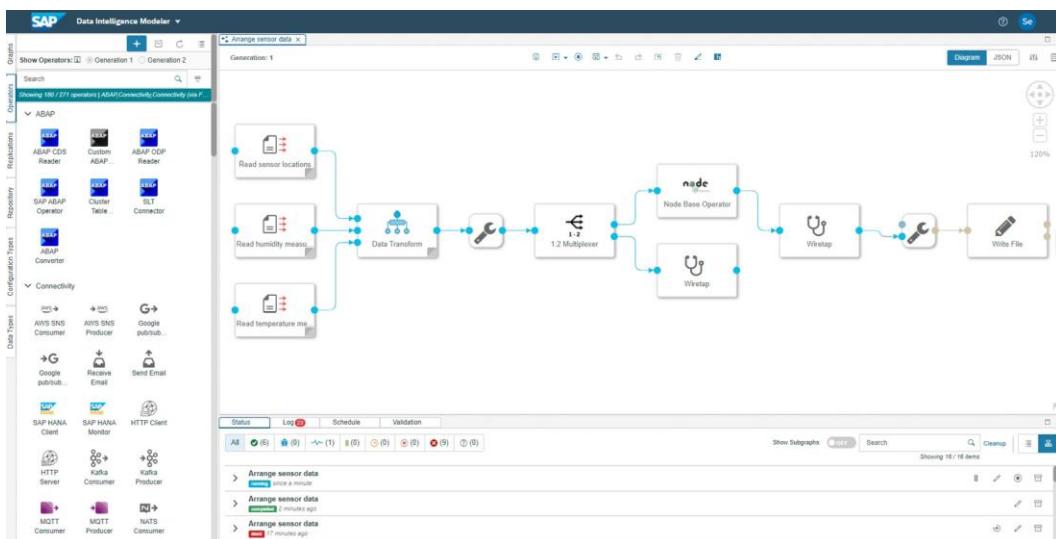
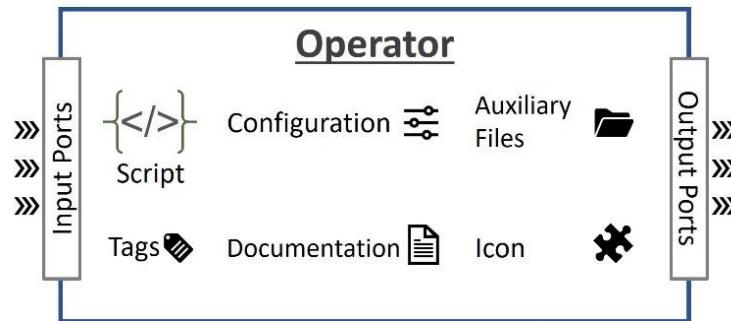


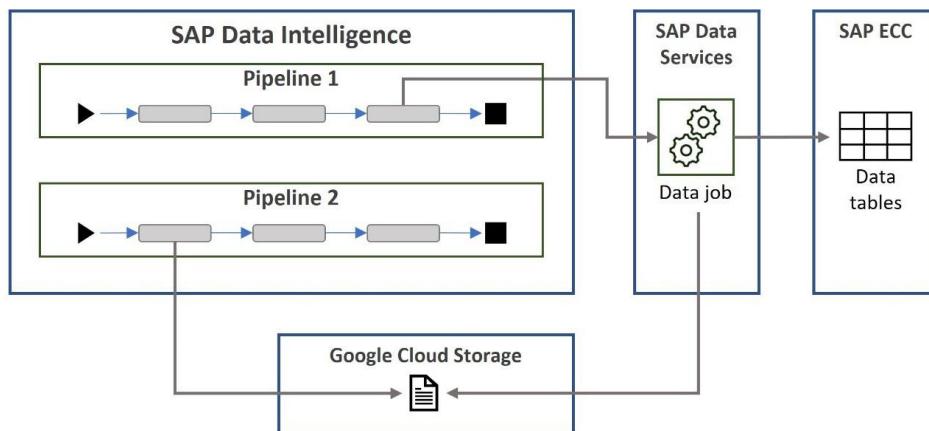
Figure 8.5: SAP Data Intelligence Modeler showing a pipeline



**Figure 8.6 – Parts of an operator specification**

```
tput install sklearn
Collecting sklearn
Requirement already satisfied: scikit-learn in /opt/conda/lib/python3.7/site-packages (from sklearn) (1.0.2)
Requirement already satisfied: scipy>=1.1.0 in /opt/conda/lib/python3.7/site-packages (from scikit-learn>sklearn) (1.7.3)
Requirement already satisfied: numpy>=1.14.5 in /opt/conda/lib/python3.7/site-packages (from scikit-learn>sklearn) (1.21.5)
Requirement already satisfied: threadpoolctl>=2.0.0 in /opt/conda/lib/python3.7/site-packages (from scikit-learn>sklearn) (3.1.0)
Requirement already satisfied: joblib>=0.11 in /opt/conda/lib/python3.7/site-packages (from scikit-learn>sklearn) (1.1.0)
Installing collected packages: sklearn
Successfully installed sklearn-0.0
```

**Figure 8.7: An example Jupyter notebook in SAP Data Intelligence**



**Figure 8.8: Data orchestration using SAP Data Services data jobs**

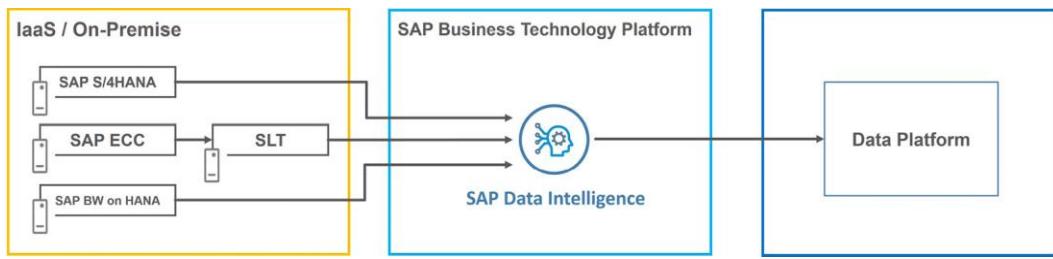


Figure 8.9: Using SAP Data Intelligence to read data from ABAP-based systems

# Chapter 9

## Images

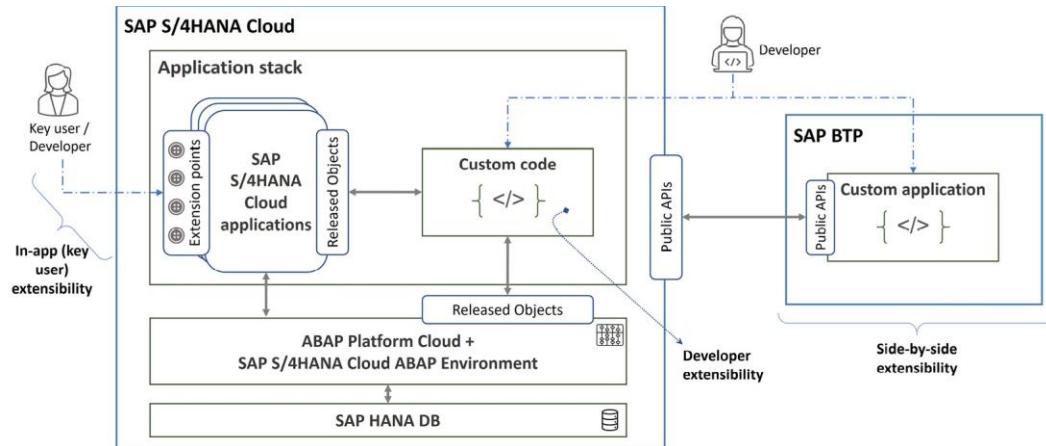


Figure 9.1 – Extensibility options for S/4HANA Cloud

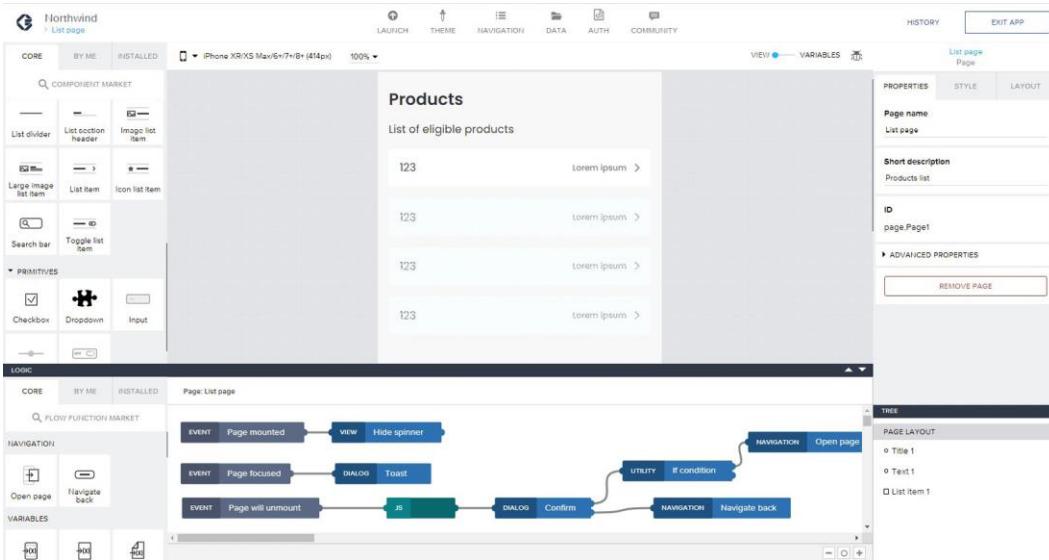
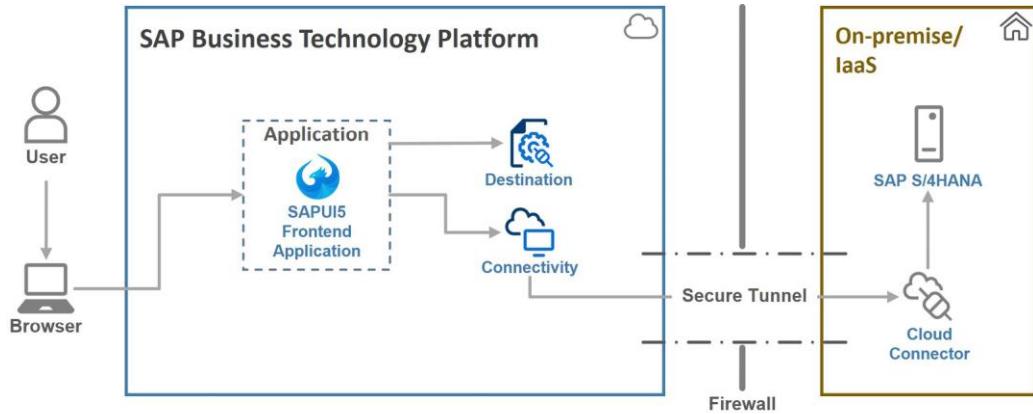


Figure 9.2 – Building a page for an SAP AppGyver application



**Figure 9.3 – Example architecture design – an SAPUI5 application and on-premise connectivity**

Standard ▾

Risks (12)		Create	Delete	Import
Title	Mitigation	Priority	Impact	
<input type="checkbox"/> CFR non-compliance	SLA violation: authorize account manager to offer service credits for recent delivery issues	ⓘ 3	ⓘ 10,000	>
<input type="checkbox"/> SLA violation with possible termination cause	SLA violation: review third party contractors to ease service delivery challenges; trigger budget review	ⓘ 2	ⓘ 90,000	>
<input type="checkbox"/> Shipment violating export control	Embargo violation: investigate source of shipment request, revoke authorization	ⓘ 1	ⓘ 200,000	>
<input type="checkbox"/> CFR non-compliance Type 2	SLA violation: authorize account manager to offer service credits for recent delivery issues	ⓘ 3	ⓘ 10,000	>
<input type="checkbox"/> Extreme SLA violation with possible termination cause	SLA violation: review third party contractors to ease service delivery challenges; trigger budget review	ⓘ 2	ⓘ 90,000	>
<input type="checkbox"/> Shipment violating export control (non-EU)	Embargo violation: investigate source of shipment request, revoke authorization	ⓘ 1	ⓘ 200,000	>
<input type="checkbox"/> CFR non-compliance Type 3	SLA violation: authorize account manager to offer service credits for recent delivery issues	ⓘ 3	ⓘ 10,000	>
<input type="checkbox"/> SLA violation with probable termination cause	SLA violation: review third party contractors to ease service delivery challenges; trigger budget review	ⓘ 2	ⓘ 90,000	>

**Figure 9.4 – An application built with SAP Fiori elements and a list report floorplan**

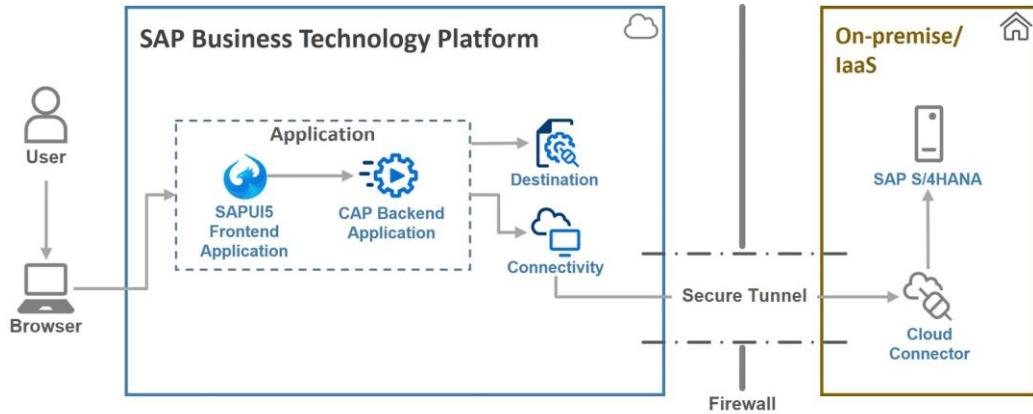


Figure 9.5 – Example architecture design – CAP application added

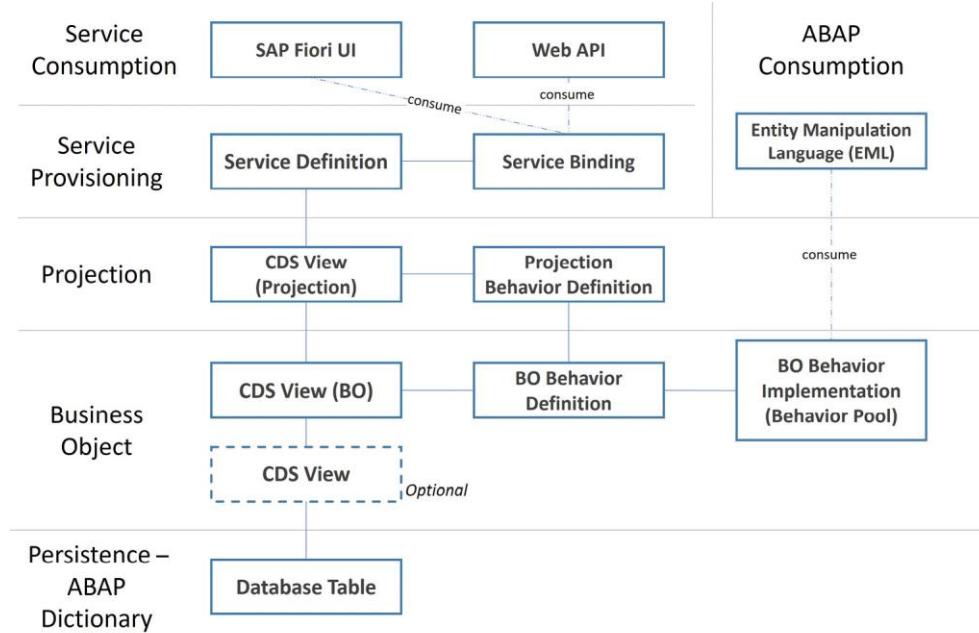


Figure 9.6 – ABAP RAP model elements

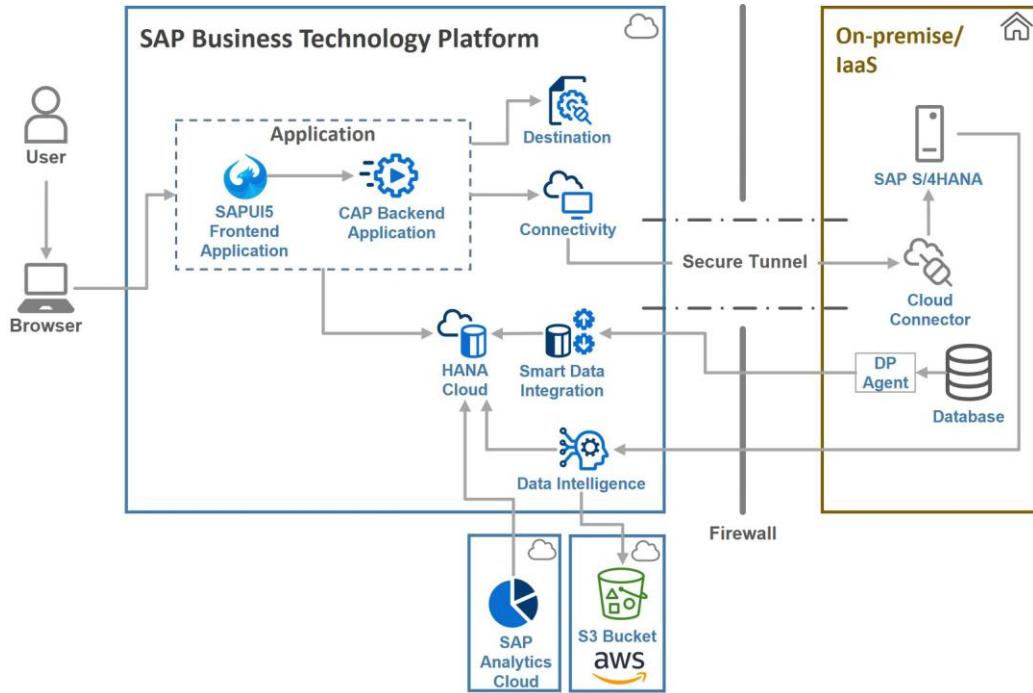


Figure 9.7 – Example architecture design – SAP HANA Cloud added

```

1 import { BusinessPartner } from '@sap/cloud-sdk-vdm-business-partner-service';
2 ...
3 getBusinessPartners(): Promise<BusinessPartner[]> {
4   return BusinessPartner.requestBuilder()
5     .getAll()
6     .top(10)
7     .select(
8       BusinessPartner.BUSINESS_PARTNER,
9       BusinessPartner.FIRST_NAME,
10      BusinessPartner.LAST_NAME,
11      BusinessPartner.TO_BUSINESS_PARTNER_ADDRESS.select(
12        BusinessPartnerAddress.BUSINESS_PARTNER,
13        BusinessPartnerAddress.COUNTRY
14      )
15    )
16    .filter(
17      BusinessPartner.BUSINESS_PARTNER_CATEGORY.equals('1')
18    )
19    .execute({
20      destinationName: 's4hc01'
21    });
22 }
~~

```

Figure 9.8 – A code snippet using SAP Cloud SDK

The screenshot shows the SAP Mobile Services - Trial interface. On the left, there's a sidebar with navigation links: Home, My Alerts, Mobile Applications (Native/MDK, SAP Mobile Cards), Features, Analytics, Settings, and Help. The main content area is titled "Native/MDK / SAP MDK Demo App" and "SAP MDK Demo App". It displays "Info" (selected), APIs, Application Links, Users, Security, Discovery, Alert, and Log Settings. Below this, the "Application Details" section shows the ID: com.sap.mdk.demo, Name: SAP MDK Demo App, Supplier: XSUAA Client ID: sb-com-sap-mdk-demo-dev, State: Started, and Licence Type: Lite. To the right, the "Assigned Features" section lists various mobile features like Mobile App Catalogue, Mobile App Update, etc. At the top right, there are buttons for Delete (with a warning icon), Export, and Lock. A "Custom Routes" section is also present.

Figure 9.9 – SAP Mobile Services Cockpit showing the admin page of an MDK application

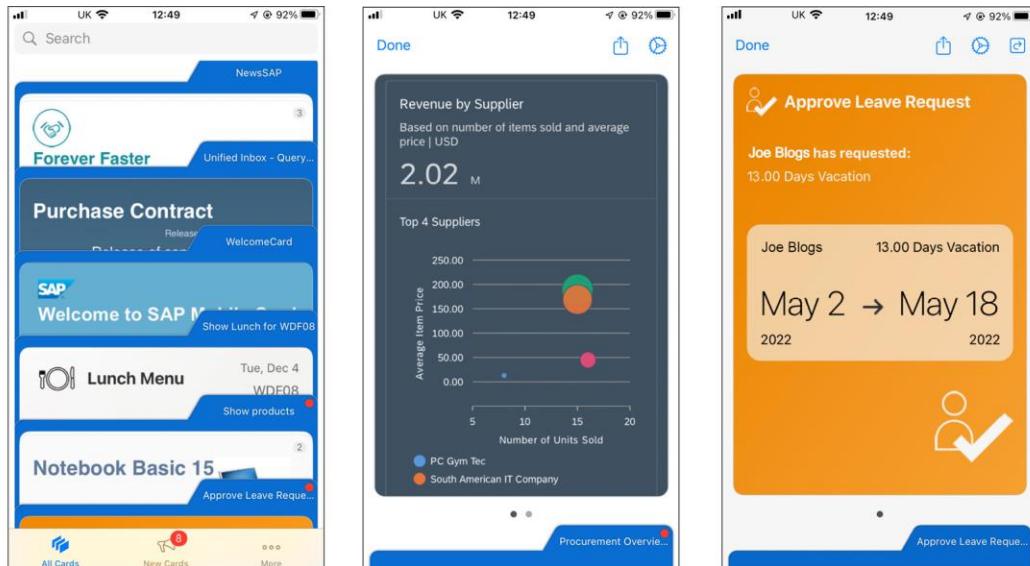


Figure 9.10 – The SAP Mobile Cards app

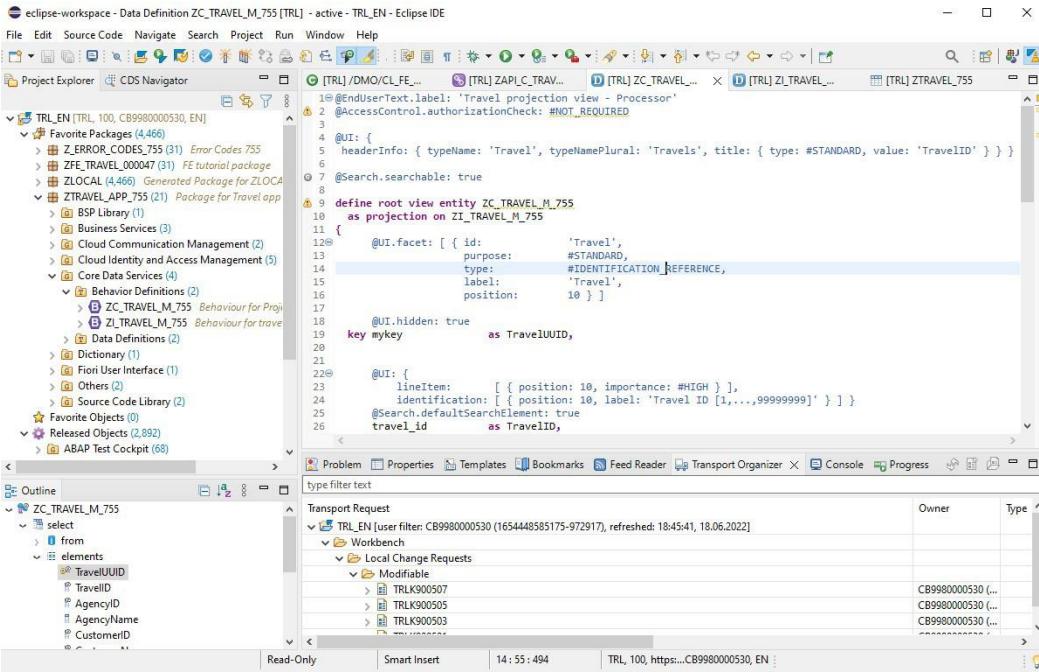
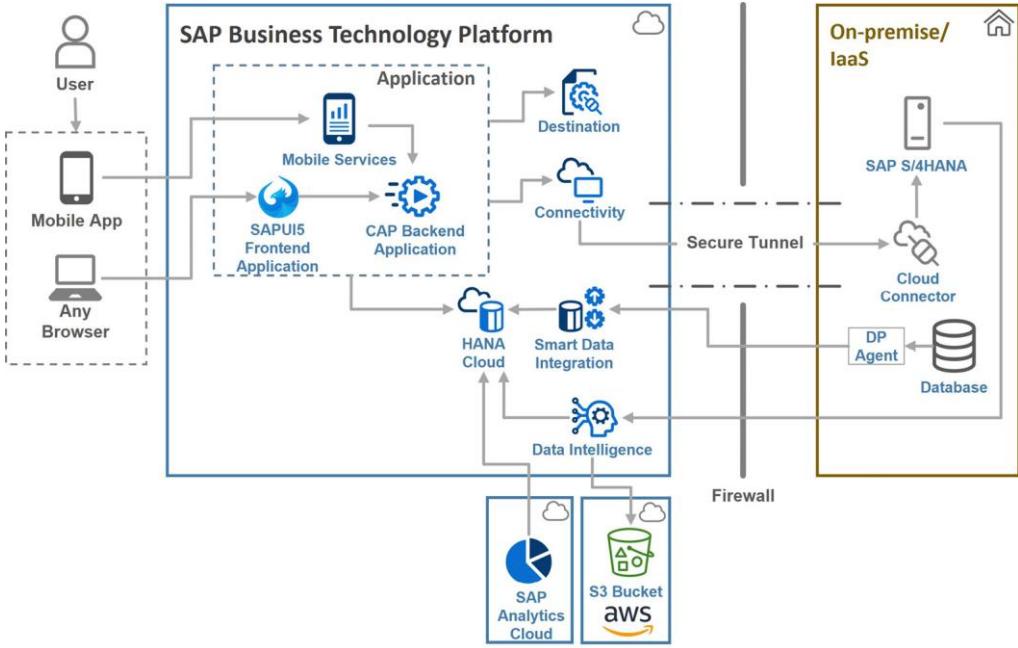


Figure 9.12 – ABAP development in the Eclipse IDE

```

risk-service.js - cloud-cap-risk-management - Visual Studio Code
File Edit Selection View Go Run Terminal Help
OPEN EDITORS
App.view.xml JS Worklist.controller.js schema.cds JS risk-service.js X JS API_BUSINESS_ ...
! mta.yaml
! App.view.xml app/mitigations\weapp\view
JS Worklist.controller.js app/mitigations\weapp\controller
schema.cds db
risk-service.cds
risk-service.js svr
JS API_BUSINESS_PARTNER.js svr\external
! bupa-service-config.json
! enterprise-messaging.json
CLOUD-CAP-RISK-MANAGEMENT
Components
index.html
manifest.json
annotations.cds
package.json
README.md
! ui5-deploy.yaml
! ui5.yaml
xs-app.json
risks
OUTLINE
(eo) cds
(eo) Risks
(eo) LOG
<unknown>
(eo) <unknown>
cds.service.impl() callback
TIMELINE
NPM SCRIPTS
! app/mitigations\package.json
deploy-config npx -p @sap/ux-ui5-tooling fiori add deploy-co...
buildit: ui5 build preload --clean-test --config ui5-deploy.yaml
install: install dependencies from package
! app\risks\package.json
deploy-config npx -p @sap/ux-ui5-tooling fiori add deploy...
events-s4hc-use
0 0 0 Connect

```

```

risk-service.js
1 const cds = require('@sap/cds');
2 const { Risks } = cds.entities;
3 const LOG = cds.Log('risk-service');
4
5 /**
6  * Implementation for Risk Management service defined in ./risk-service.cds
7  */
8
9 module.exports = cds.service.impl(async function() {
10
11     const bupa = await cds.connect.to('API_BUSINESS_PARTNER');
12
13     this.on('READ', 'Suppliers', async req => {
14         return bupa.run(req.query);
15     });
16
17     this.on('READ', 'Risks', risksData => {
18         const risks = Array.isArray(risksData) ? risksData : [risksData];
19         risks.forEach(risk => {
20             if (risk.impact >= 100000) {
21                 risk.criticality = 1;
22             } else {
23                 risk.criticality = 2;
24             }
25         });
26     });
27     // Risks?expand=supplier
28     this.on('READ', 'Risks', async (req, next) => {
29         if (!req.query.SELECT.columns) return next();
30         const expandIndex = req.query.SELECT.columns.findIndex(
31             ({ expand, ref }) => expand && ref[0] === "supplier"
32         );

```

TERMINAL AZURE SQL CONSOLE PROBLEMS OUTPUT DEBUG CONSOLE

C:\Users\Serdan\dev\cloud-cap-risk-management>cds --version  
@sap/cds: 5.9.5  
@sap/cds-compiler: 2.15.2  
@sap/cds-dk: 4.9.5  
@sap/cds-dk (global): 4.9.5

Ln 37, Col 1 (144 selected) Spaces: 4 UTF-8 CRLF ⚡ JavaScript ⚡ Prettier ⚡ Q

Figure 9.13 – CAP and UI5 development in Visual Studio Code

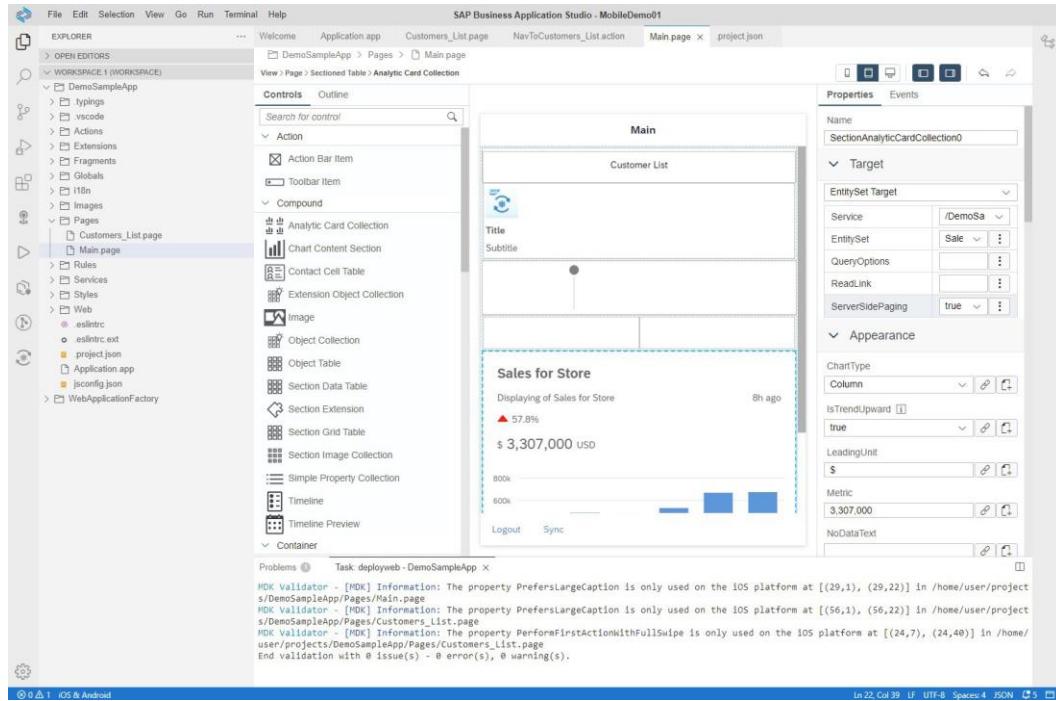
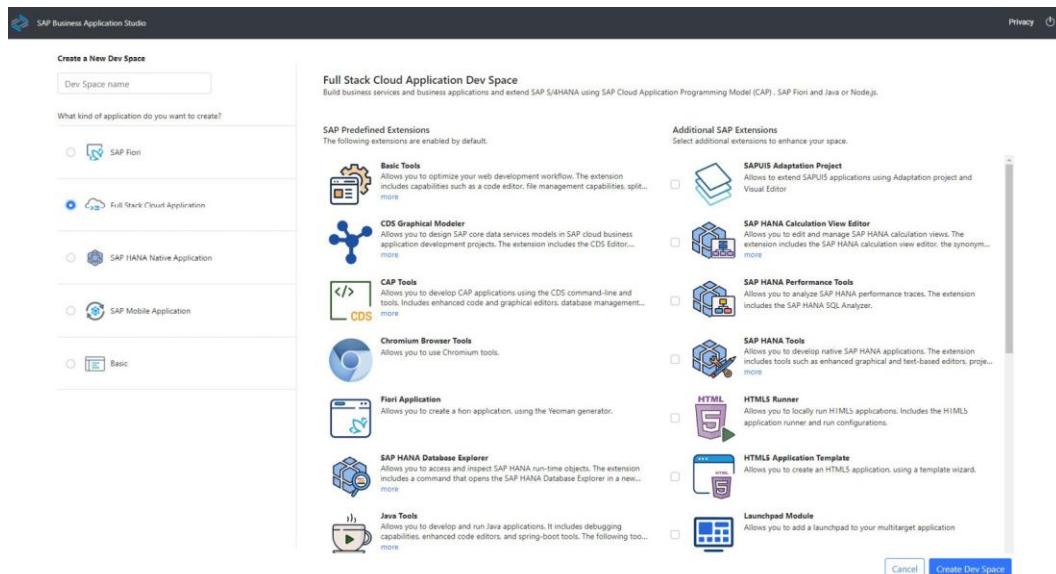


Figure 9.14 – SAP BAS – editing an SAP MDK application page



**Figure 9.15 – SAP BAS – creating a dev space**

The screenshot shows the SAP Workbench interface with the following components:

- Customer Overview:** Shows a shopping cart icon.
- My Tasks:** Shows 13 tasks.
- Intelligent Street Lights Power the Future of Modern Cities:** News item from Today, SAP News, dated August 21, 2022.
- My Timesheet:** Shows 10 days missing.
- Lunch Menu:** Shows Staines.
- Sales:**
  - Sales Wizard:** Shows 46.9 K EUR.
  - Track Sales Orders:** Shows 20.5 K EUR.
  - Sales Order Fulfillment:** Resolve Issues.
  - Confirmed Sales Order Items:** Shows 88.8% completion.
  - Process Observer - Sales:** Delayed: 11%, Early: 19%, On Time: 70%.
  - Quotation Conversion Rate:** 17.3 % Current Quarter.
- Billing:**
  - Payment Options:**
  - Payments History:** Energy Contracts, 1.8 K GBP, Year to Date.
  - Display Settlement Calendars:** Condition Contracts.
  - Debt Overview:**

At the bottom, there are several buttons: Create Sales Order Fast Entry, Sales Order Fulfillment Resolve Credit Block, Sales Order Fulfillment Resolve Billing Block, Sales Order Fulfillment Resolve Delivery Block.

**Figure 9.16 – An example SAP Launchpad site**

The screenshots show the SAP Launchpad mobile application interface:

- Start Screen:** Displays "New To-Dos", a "Work Order" card for Elena Petrova, a "Job Seeker: Erika Berg" card, and a "2500 EUR Committed Spend" summary. It also includes a "Monitoring Apps" section with "My Inbox" (11 items).
- Applications Screen:** Shows the "Customer Management" section with "My Customers" (Finance 360 View, SAP Customer Guide), "Customer Factsheet" (Customer Projects, SAP S/4HANA Professional Services), and "Customer Projects" (Commercial Services, Professional Services, 8 items). It also includes a "My Project Management" section.
- To Do Screen:** Shows "Job Posting (3)", "Time Off Requests (4)", and "Time Sheets". It details "Job Posting (3)" for John Miller (5 months ago) and "Time Off Requests (4)" for John Li. It also includes a "Monitoring Apps" section with "Time Off Requests" (4 items).

**Figure 9.17 – SAP Mobile Start app**

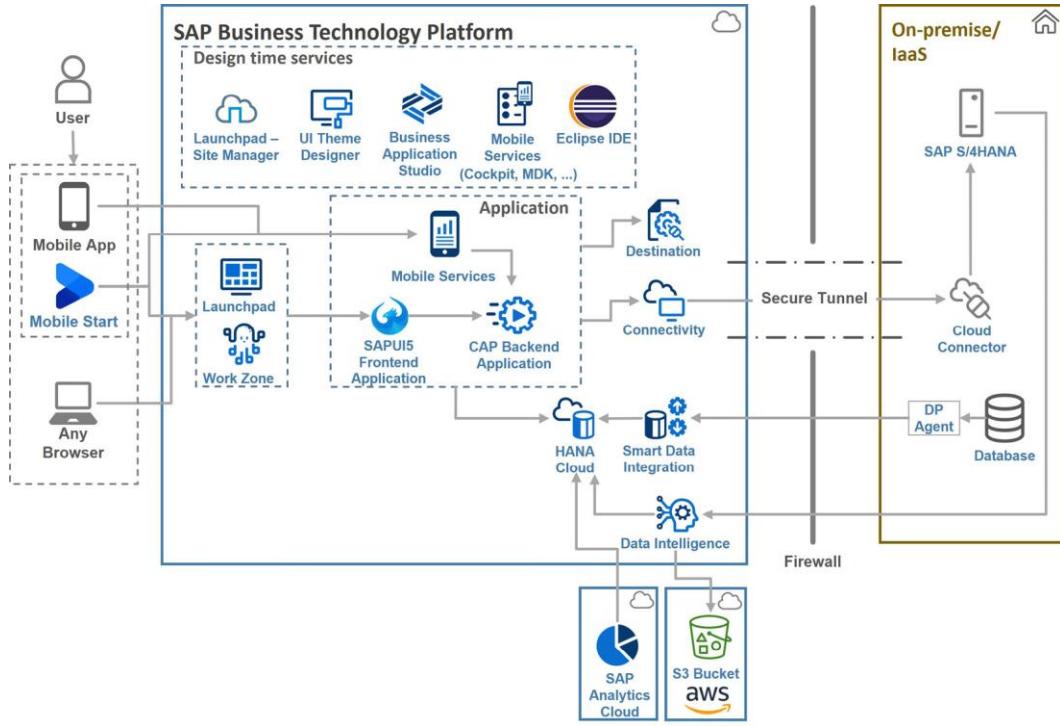


Figure 9.18 – Example architecture design – launchpad applications added

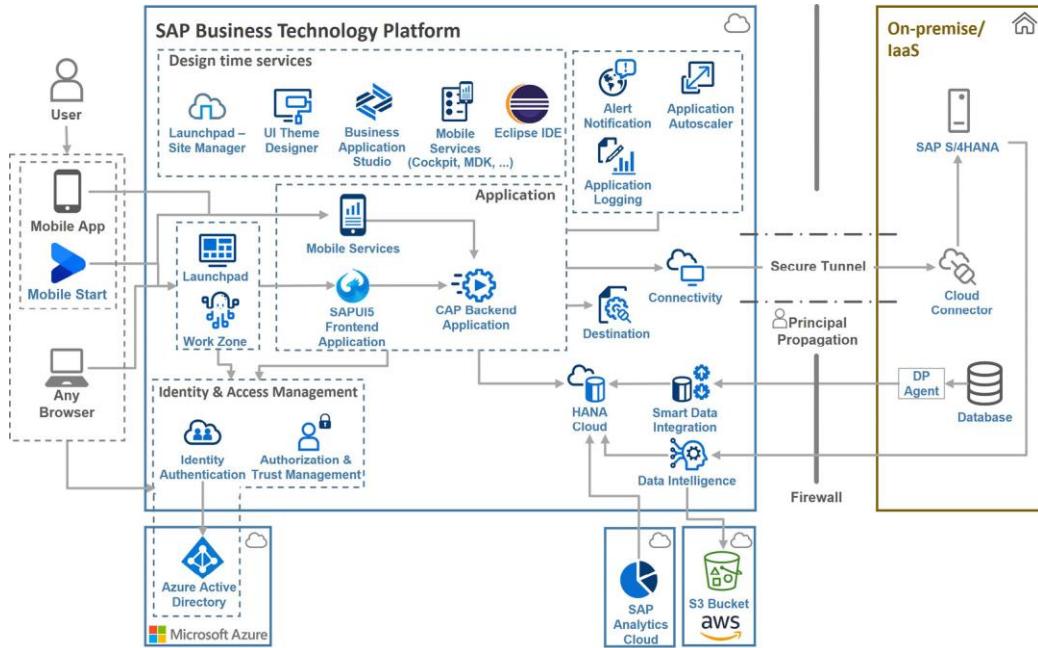
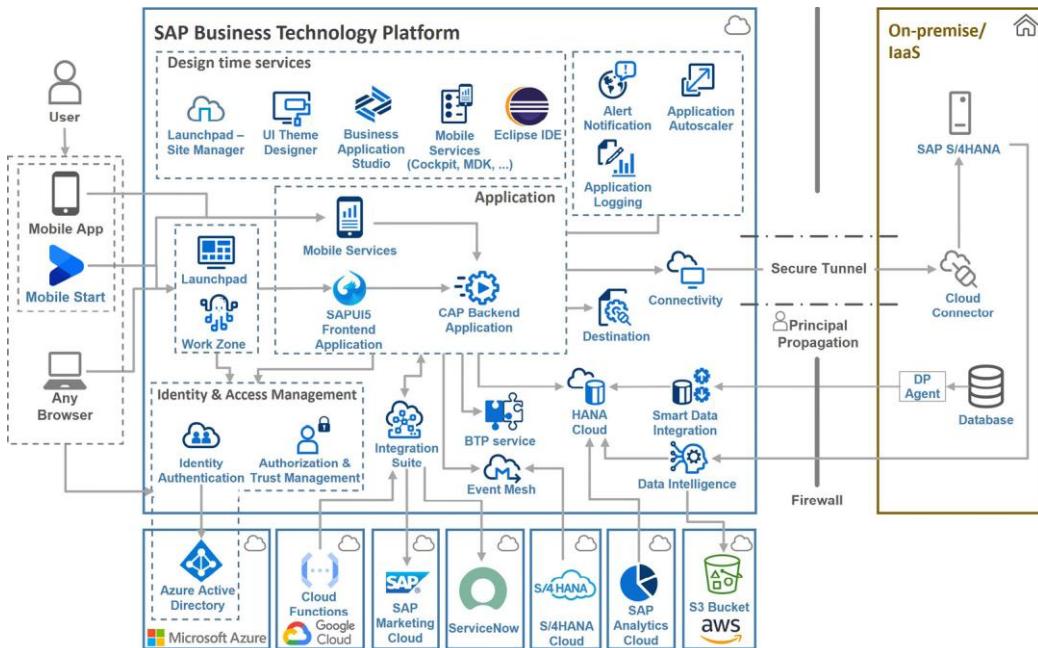
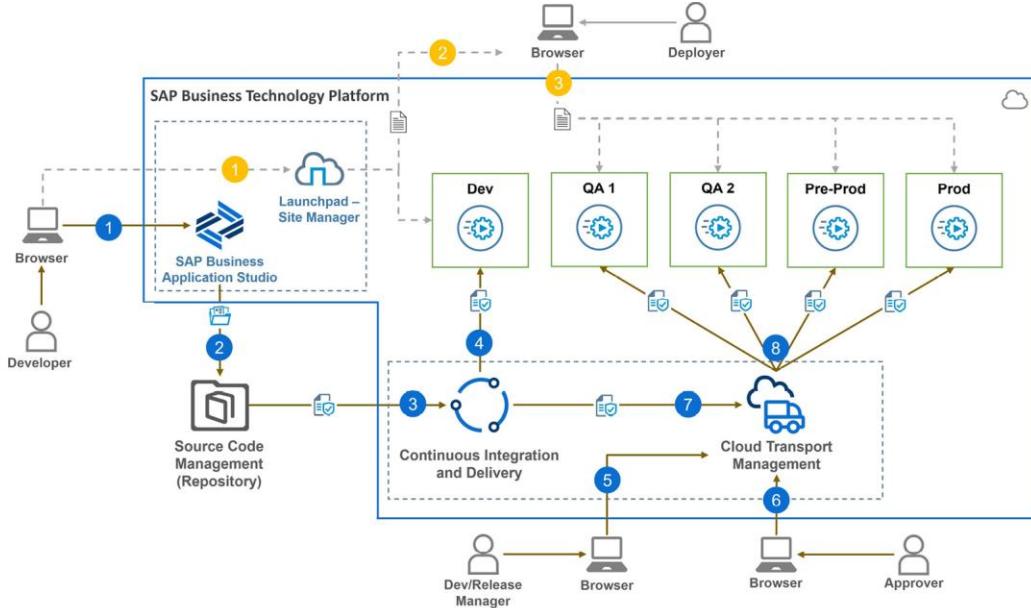


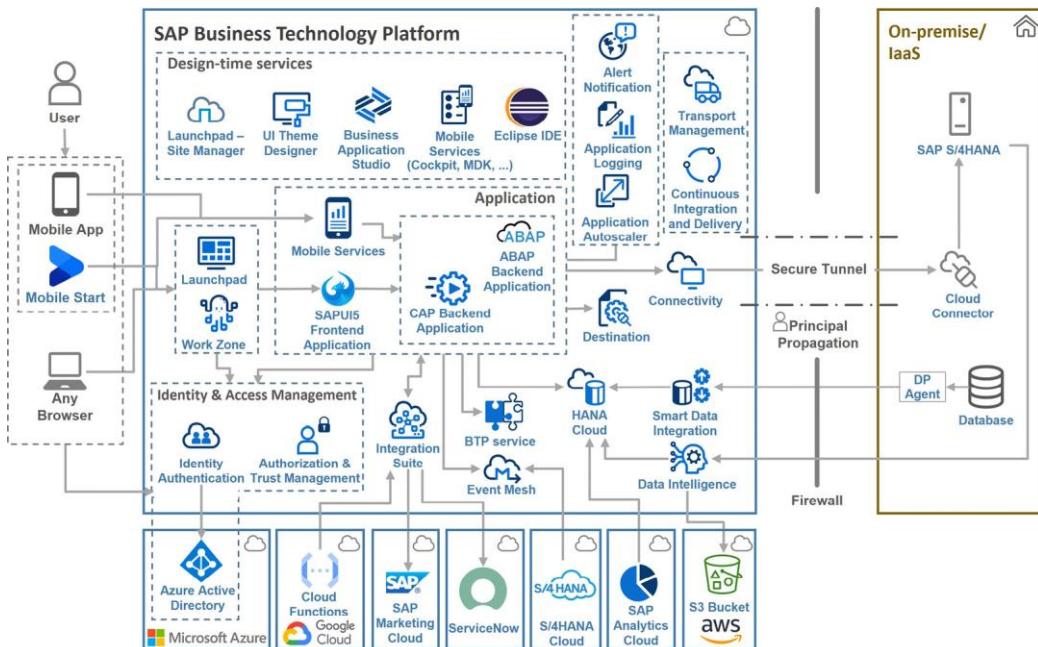
Figure 9.19 – Example architecture design – services added for non-functional requirements



**Figure 9.20 – Example architecture design – integration services added**



**Figure 9.21 – CI and delivery setup with SAP BTP services**



**Figure 9.22 – Example architecture design including several application development-related services**

## Tables

Runtime Environment	Pricing Metric	Description
Cloud Foundry	Memory (GB)	Memory consumed by the deployed applications
Kyma	Capacity units are calculated based on the infrastructure elements.	VM size, number of additional nodes, storage capacity, and throughput
ABAP	Hours of persistent and runtime memory	Number of hours x memory (GB)

**Table 9.1 – Pricing metrics for runtime environments**

# Chapter 10

## Images

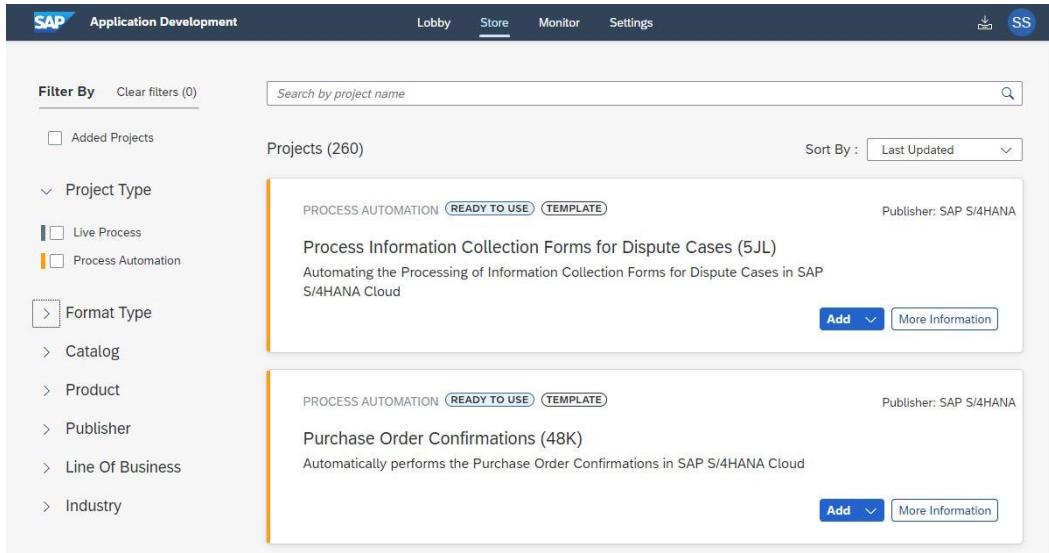
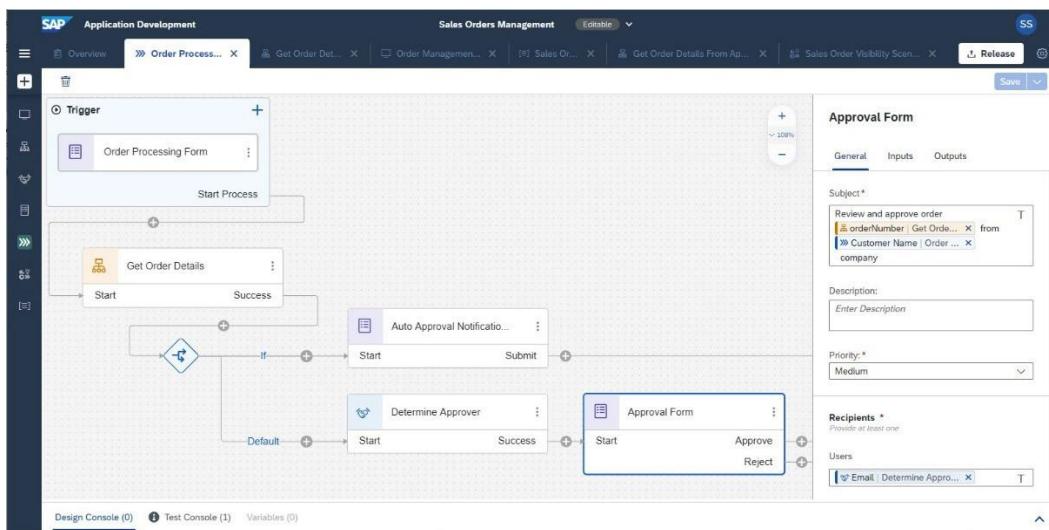
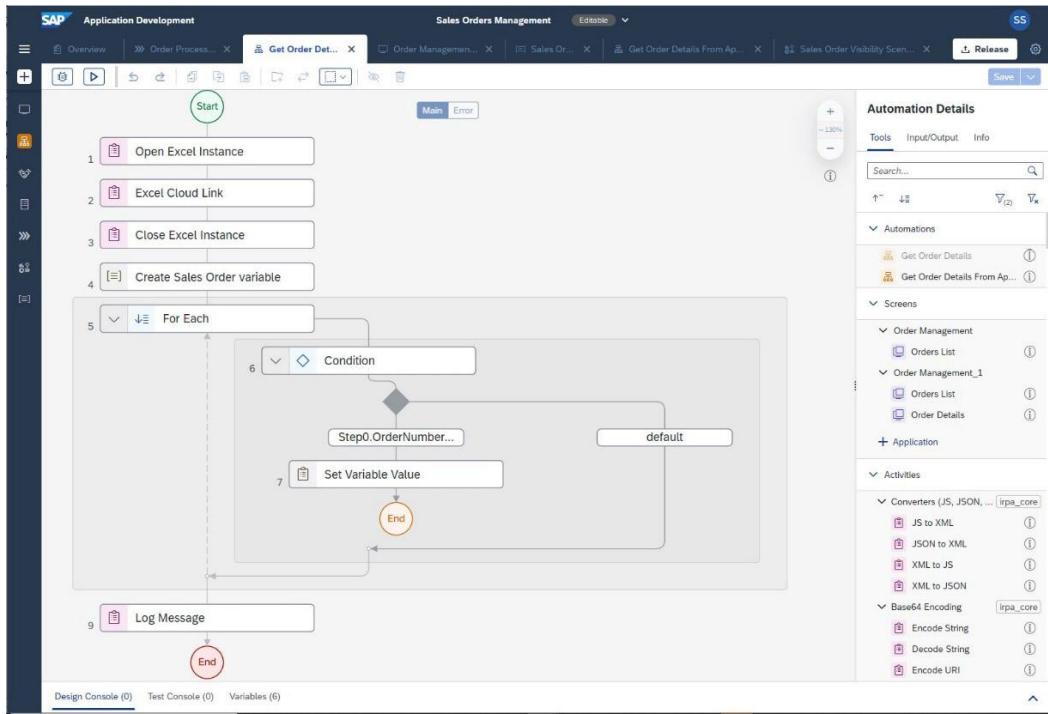


Figure 10.1 – SAP Process Automation Store



**Figure 10.2 – SAP Process Automation – process builder**



**Figure 10.3 – SAP Process Automation – automation builder**

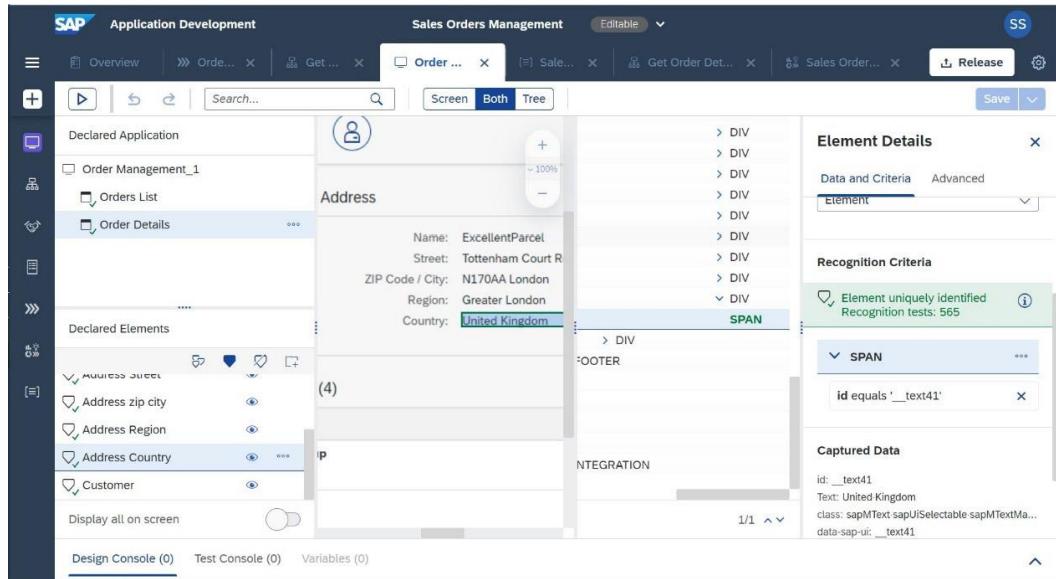


Figure 10.4 – SAP Process Automation – application editor

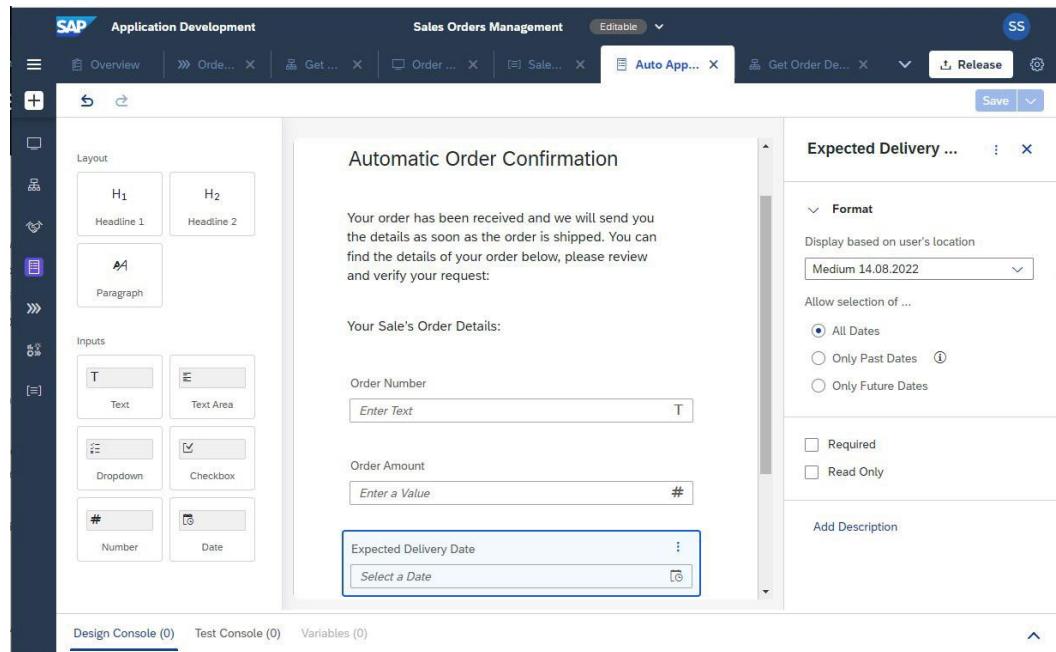


Figure 10.5 – SAP Process Automation – form editor

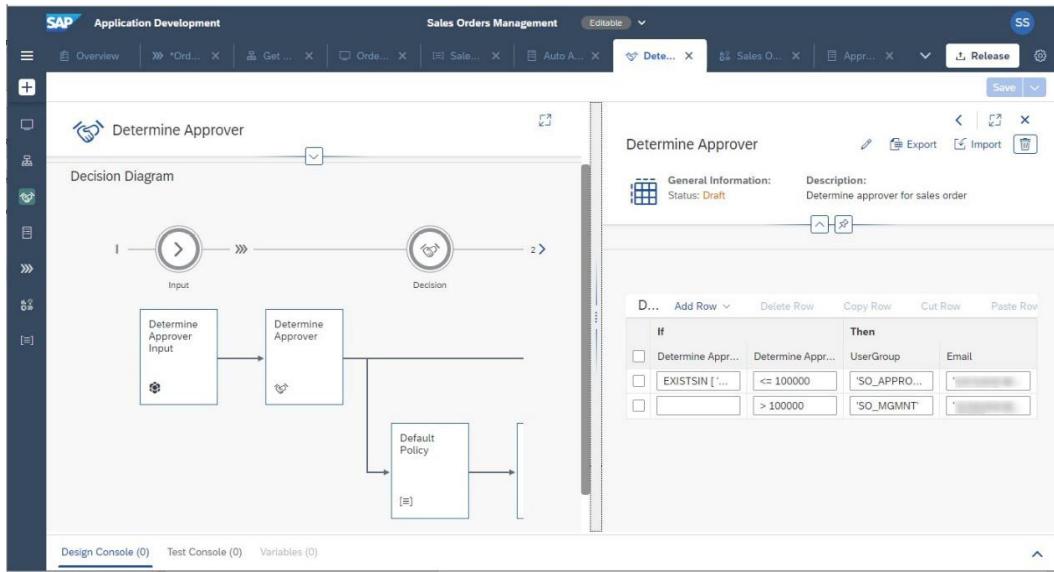


Figure 10.6 – SAP Process Automation – decision builder

Instance

### Order Processing

Started By: [REDACTED] Status

Definition ID: eu10.[REDACTED].salesordersmanagement.orderProcessing Completed

INFORMATION	ERROR MESSAGES	CONTEXT	EXECUTION LOG
<pre> 13 14     "fb1gx6" : "I8E4LR": 150935.13, 15     "fbdyZD" : "/is12kY": "2022-01-27" 16   }, 17   "startEvent": { 18     "fbvSe" : "isYkd2rp": "SAP SE", 19     "fb1CFk" : "JSjsP41": "PO7918" 20   }, 21   "form_approvalForm_1": { 22     "fbKE" : "y11lyA6": true 23   }, 24   "decision_determineApprover_2": { 25     "determineApprover_Output": { 26       "Email": "[REDACTED]", 27       "UserGroup": "SO_MGMT" 28     } 29 } 30 </pre>			

**EXECUTION LOG**

- Instance completed successfully  
8 Aug 2022, 02:17:34
- [User icon] completed the task "Your order PO7918 has been successfully received."  
8 Aug 2022, 02:17:33
- [User icon] Task "Your order PO7918 has been successfully received." available  
8 Aug 2022, 02:17:20  
Instance ID: d9d90cd4-1  
Recipients: 8  
Initiator: [REDACTED]
- [User icon] completed the task "Review and approve order PO7918 from SAP SE company"  
8 Aug 2022, 02:17:20

Show Subflow Instances Show Tasks

Figure 10.7 – SAP Process Automation – monitoring a process instance

Store / More Information

» Automatic Creation of Sales Order from Unstructured Data (5LT)  
By SAP S/4HANA  
Version: 1.0.1 Published At: August, 12 2022 Type: Process Automation

Open ▾

Description Tags Documents (6) Artifacts (24) Version History

**Documents (6)**

Name	Description
Sample Input Template - Automatic Creation of Sales...	A spreadsheet containing data to create Sales Order, in SAP S/4HANA system by the bot.
What's New - SAP Help Portal	
SAP Intelligent RPA 2.0 Content Configuration Guide with SAP...	
Test Script - Automatic Creation of Sales Order from Unstructured...	
Release Strategy - SAP Best Practices for SAP Intelligent RP...	
Disclaimer	

**Artifacts (24)**

Name	Description	Type
aCreateSalesOrders		applications
aLoginPage		applications

**Figure 10.8 – SAP Process Automation – prebuilt process automation in the Store section**

# Chapter 11

## Images

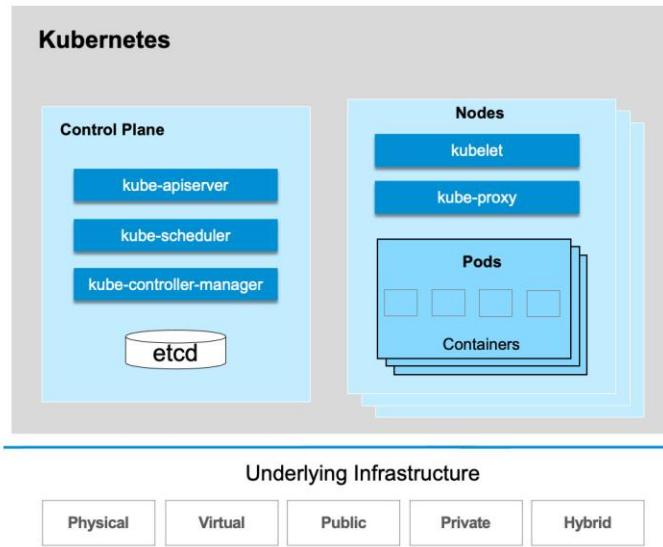


Figure 11.1: The Kubernetes architecture

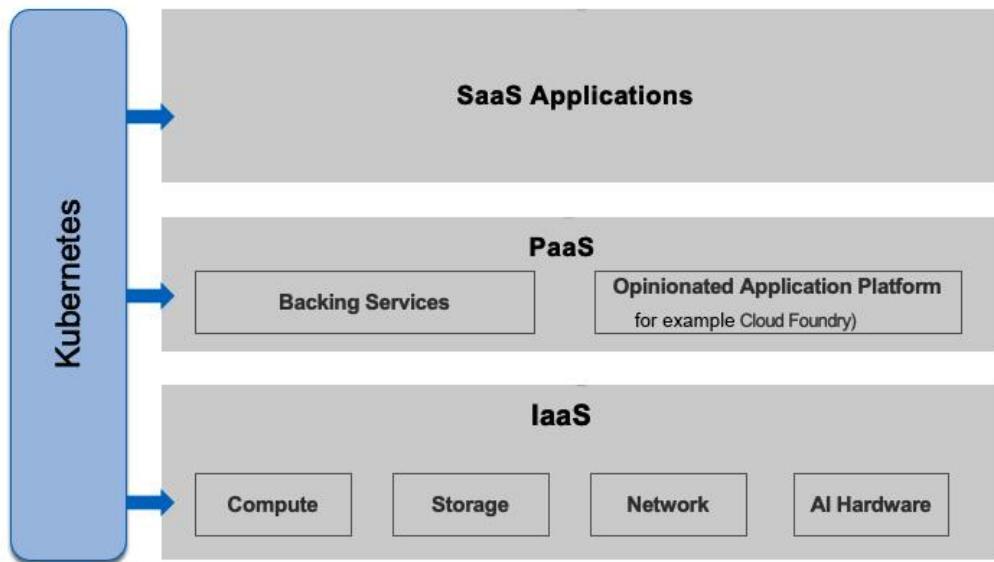


Figure 11.2: Kubernetes connects the layers

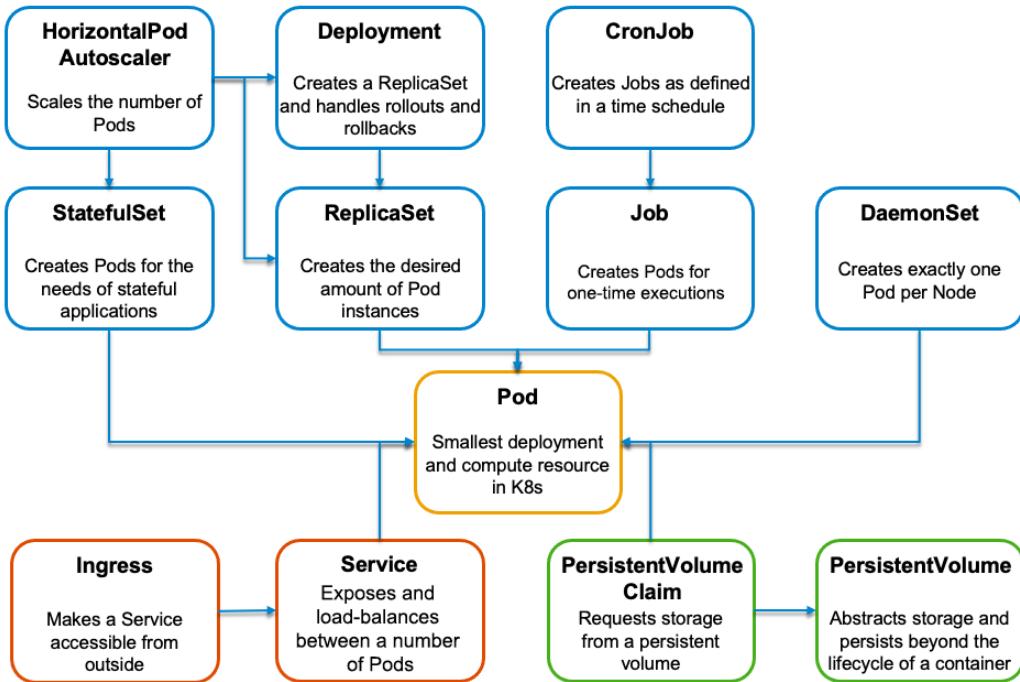


Figure 11.3: Kubernetes core objects

## Gardener – Kubernetes-as-a-service at Scale

- Multi-cloud and multi-OS portability
- Configurable Control Plane
- Homogenous
- Hybrid and private cloud support
- Fleet Management
- Thousands of Clusters
- Minimal TCO
- Control Plane as a Service

Figure 11.4: Overview of Gardener features

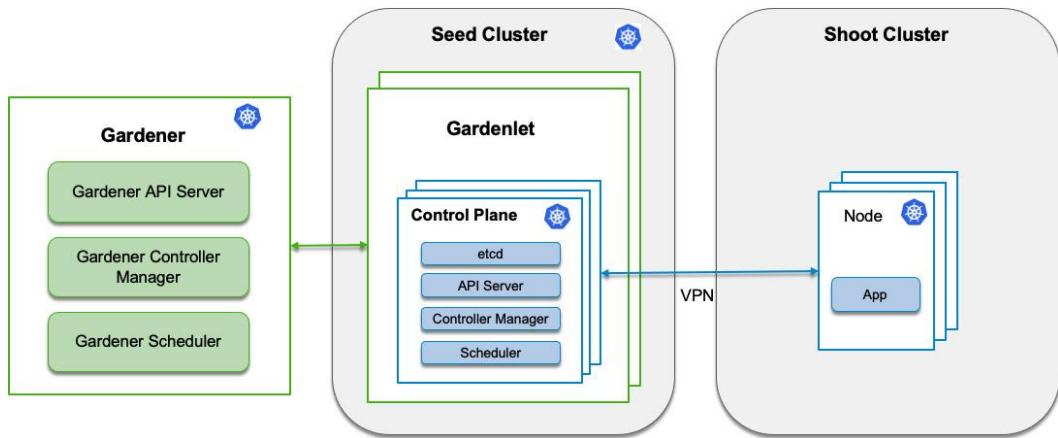
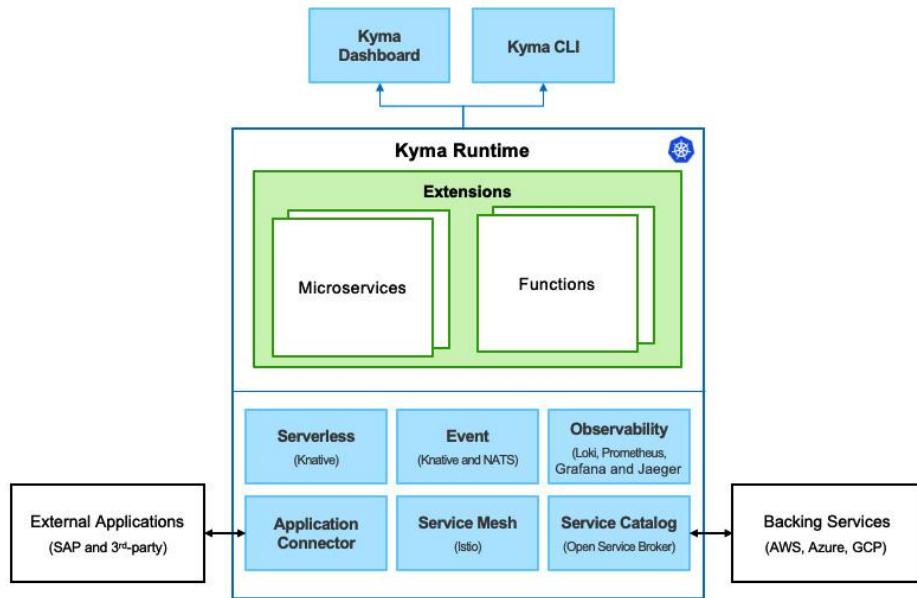


Figure 11.5: Overview of Gardener architecture



**Figure 11.6: Overview of Kyma architecture**

## Tables

Kubernetes	Gardener
Kubernetes API server	Gardener API server
Kubernetes controller manager	Gardener controller manager
Kubernetes scheduler	Gardener Scheduler
Kubelet	Gardenlet
Worker node	Seed cluster
Pod	Shoot cluster

**Table 11.1: Kubernetes versus Gardener**

<b>Decision Criteria</b>	<b>Cloud Foundry</b>	<b>Kubernetes</b>
Team skillset	Citizen developers and application developers need higher-level abstraction.	Cloud-native developers prefer to have low-level access and are comfortable with the level of complexity in exchange for the necessary flexibility.
Use case types	Stateless applications that follow the 12-factor apps methodology	Highly scalable microservices, stateful applications.
Infrastructure and regional coverage	Runs in hyper-scale public clouds only	Needs to support hybrid and private cloud environments as well
New technologies and services	Cloud Foundry-based business services and backing services	Wants to benefit from cloud-native capabilities, such as service mesh, the operator approach, the need for application-specific backing services (through Open Service Broker), or compatibility with special machine types (for example, for AI workloads).

Table 11.2: Decision criteria between Cloud Foundry and Kubernetes

# Chapter 12

## Images

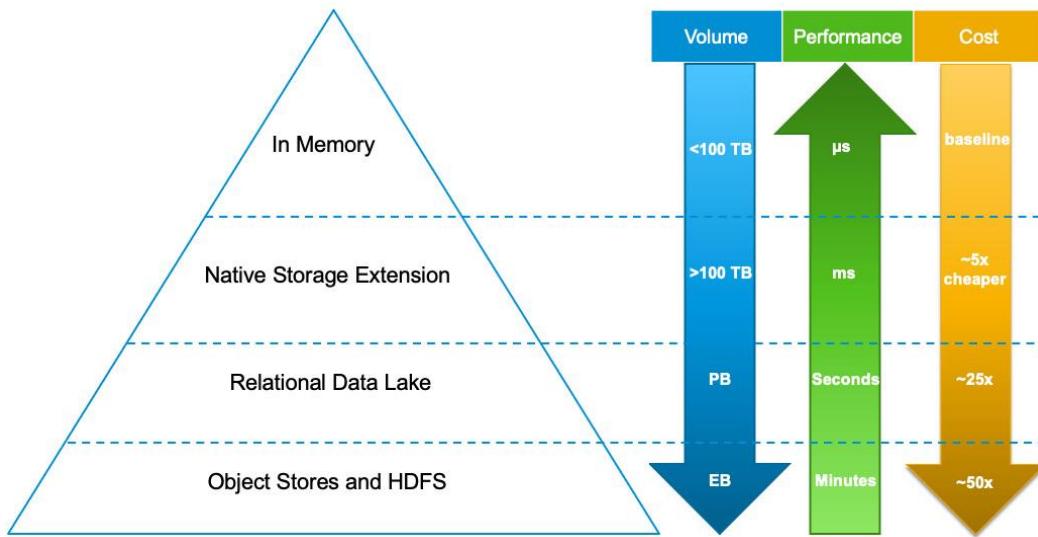
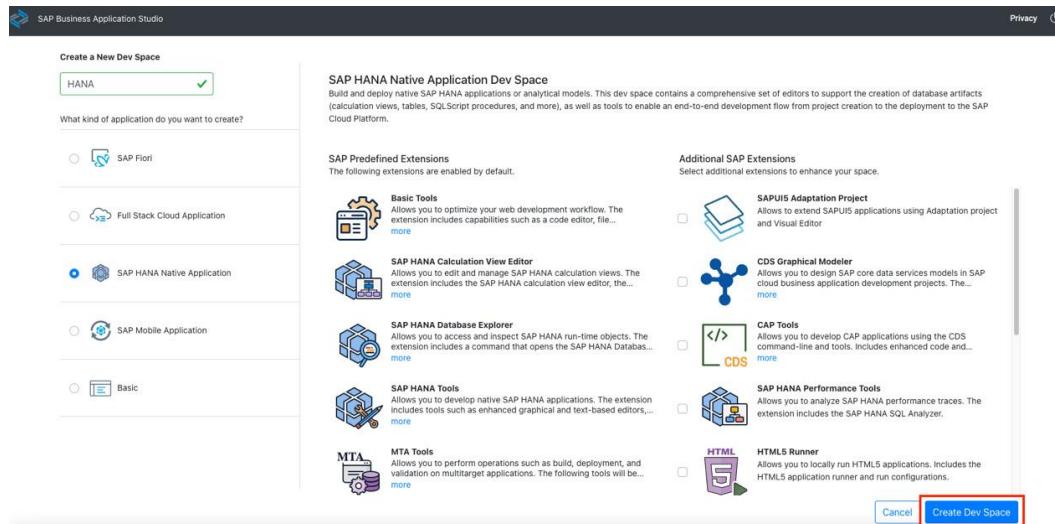
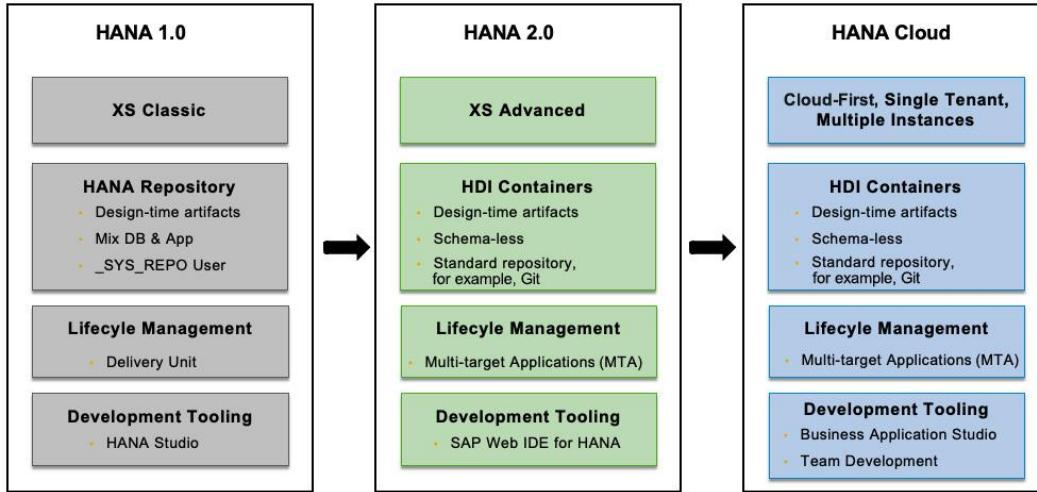


Figure 12.1: Data pyramid of SAP HANA Cloud



**Figure 12.2: Creating a Dev Space for SAP HANA Native Development**



**Figure 12.3: HANA Native Development evolution**

The screenshot shows the "HDI API Procedures in the Container Metadata Schema" interface. It displays two main sections:

- HDI Schemas:** A list of schemas under "myHANA\_hdi\_db\_ws\_Bjjsx (dev)" including MYHANA\_HDI\_DB\_1, MYHANA\_HDI\_DB\_1#DI, MYHANA\_HDI\_DB\_1#OO, MYHANA\_HDI\_DB\_1\_D2F7ID8MV35B2B0DEZIAHKOF9\_DT, MYHANA\_HDI\_DB\_1\_D2F7ID8MV35B2B0DEZIAHKOF9\_RT, MYHANA\_HDI\_DB\_1\_ETNOY5GMQOYURQBO41SWBEFSA\_DT, and MYHANA\_HDI\_DB\_1\_ETNOY5GMQOYURQBO41SWBEFSA\_RT.
- HDI API Procedures:** A list of procedures under "myHANA\_HDI\_DB\_1#DI" including MAKE, MAKE\_ASYNC, READ, READ\_DEPLOYED, REVOKE\_CONTAINER\_API\_PRIVILEGES, REVOKE\_CONTAINER\_SCHEMA\_PRIVILEGES, REVOKE\_CONTAINER\_SCHEMA\_ROLES, STATUS, and WRITE. The "MAKE" procedure is selected, showing its code:

```

CREATE PROCEDURE MAKE
-- Triggers a make with the given set of files/folders.
-- DEPLOY_PATHS
-- UNDEPLOY_PATHS
-- PATH_PARAMETERS
-- PATH_PARAMETER
-- File/folder-level parameters
-- IN DEPLOY_PATHS _SYS_D1_TT_FILESFOLDERS,
-- IN UNDEPLOY_PATHS _SYS_D1_TT_FILESFOLDERS,
-- IN PATH_PARAMETERS _SYS_D1_TT_FILESFOLDERS_PARAMETERS,
-- IN PATH_PARAMETER _SYS_D1_TT_FILESFOLDERS_PARAMETER,
-- OUT RETURN_CODE INT,
-- OUT REQUEST_ID BIGINT,
-- OUT MESSAGES _SYS_D1_TT_MESSAGES
-- SECURITY DEFINER
AS BEGIN
    CALL SYS.D1_MAKE_DEV('MYHANA_HDI_DB_1', :DEPLOY_PATHS, :UNDEPLOY_PATHS, :PAT
END

```

**Figure 12.4: HDI schemas and HDI API procedures**

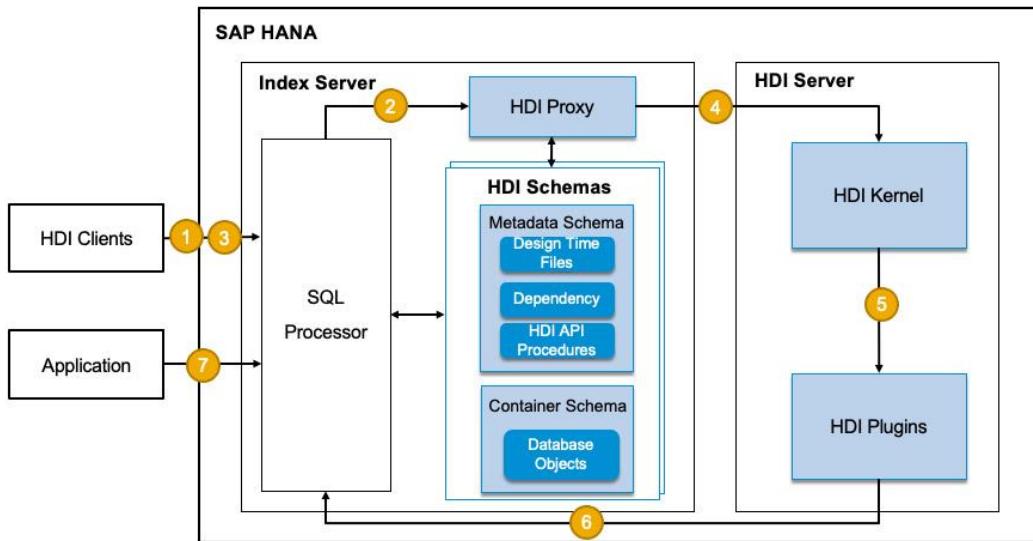


Figure 12.5: HDI deployment steps

The screenshot shows the SAP HANA Service Marketplace interface. On the left, a sidebar lists various services:

- PostgreSQL
- Redis, hyperscaler option
- SAP HANA Cloud
- SAP HANA Schemas & HDI Containers** (selected)
- SAP HANA Schemas & HDI Containers Trial
- Service Manager
- Usage Data Management

The right side displays the details for the selected service plan:

**SAP HANA Schemas & HDI Containers**  
name: hana

Plan	Description	Environments
hdi-shared	HDI container on a HANA database <a href="#">More</a>	Cloud Foundry
sbss	User with permissions to use SBSS <a href="#">More</a>	Cloud Foundry
schema	Schema on a HANA database <a href="#">More</a>	Cloud Foundry
securestore	User with permissions to use secure store <a href="#">More</a>	Cloud Foundry

Figure 12.6: SAP HANA Schemas & HDI Containers' service plans

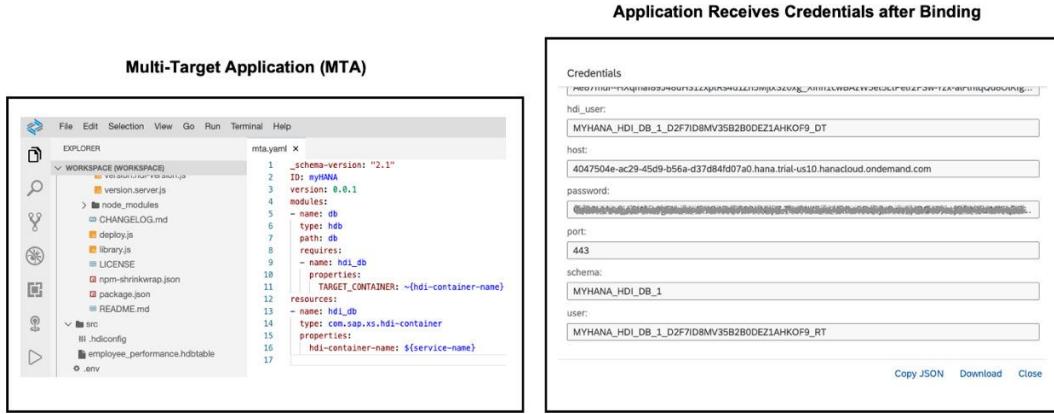


Figure 12.7: Application binding to an HDI container

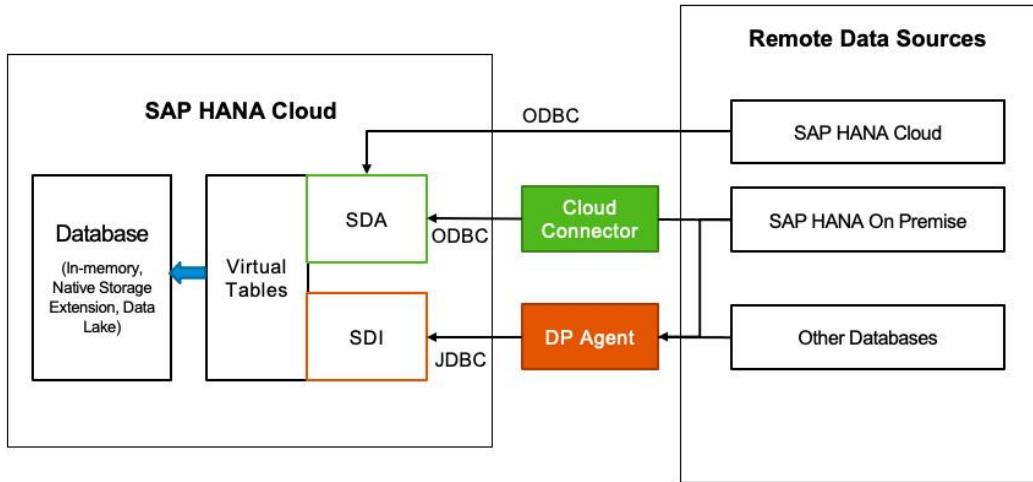


Figure 12.8: SAP HANA Cloud Data integration options

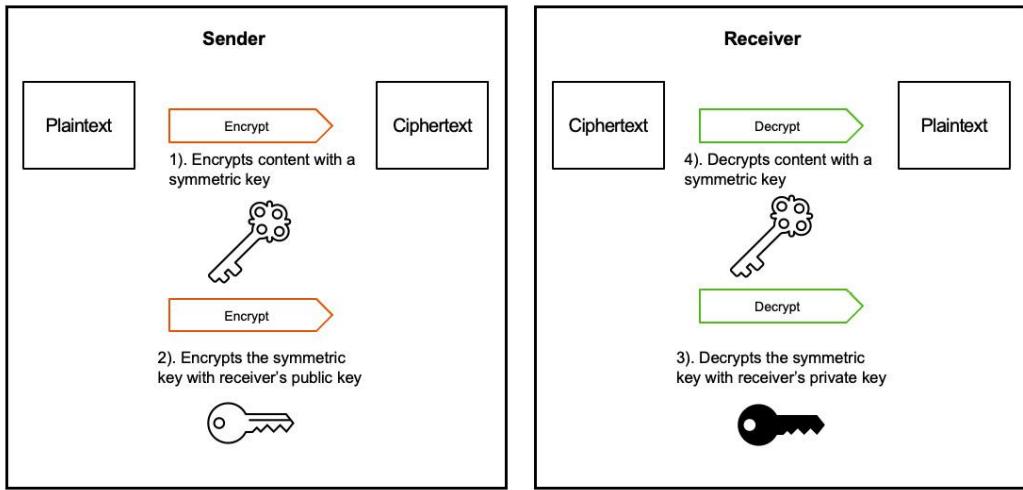


Figure 12.9: Envelop encryption with symmetric and asymmetric keys

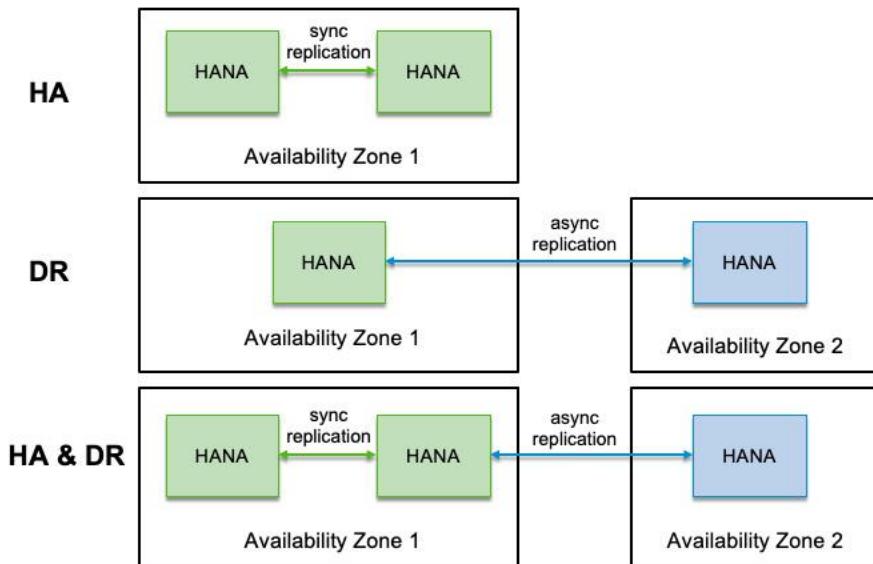


Figure 12.10: SAP HANA Cloud HA/DR options

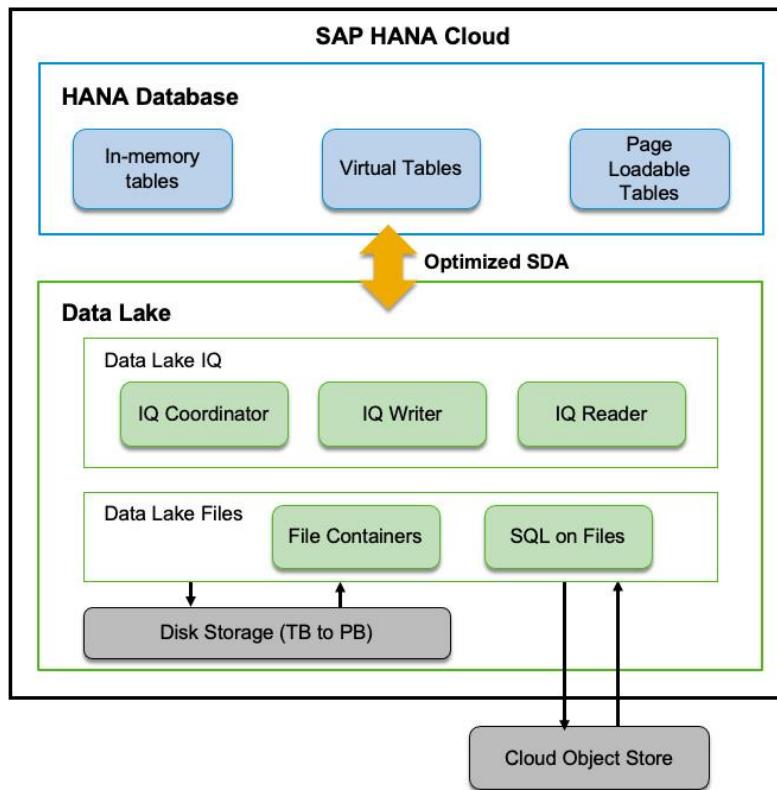


Figure 12.11: HANA Database and HANA Data Lake

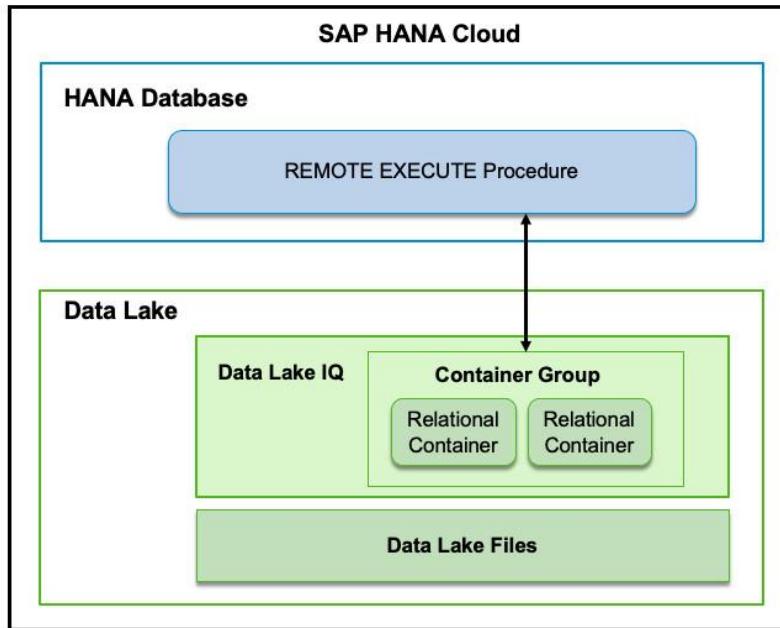


Figure 12.12: SQL execution from HANA Database to Data Lake

## Tables

Areas	Features
System management and operation	Direct access to OS level
	SAP HANA MDC
	SAP host agent
	Various system privileges (USER ADMIN, DATA ADMIN, EXTENDED STORAGE ADMIN, and more)
	Various built-in procedures and functions—graph nodes; anonymization nodes; history table option; column store cache option; import/export options
	Ability to disable logging, LCM, Delta log

	<p>Volume input/output (I/O) statistics; result caching</p> <p>Scale-out and SQL plan stability (planned but not available initially)</p>
Data definition	<p>Data-type creation</p> <p>Full-text indexing, geocode indexes, non-unique inverted hash indexes</p> <p>Time-series tables, flexible tables, history tables, temporary row tables</p> <p>BusinessObjects Explorer (BO Explorer) including SQL extensions</p>
Data processing	<p>Text analysis and text mining</p> <p>SAP HANA dynamic tiering (DT)</p> <p>SAP HANA External Machine Learning (EML) library; TensorFlow integration)</p> <p>SAP HANA Smart Data Quality (SDQ)</p> <p>Hive integration; R integration</p> <p>Capture and replay</p> <p>Live cache</p>
Application development	<p>SAP HANA XS Advanced (XCA) and SAP HANA XS Classic; includes native OData services and a built-in job scheduler</p> <p>SAP HANA Repository</p> <p>SAP HANA CDS</p> <p>Multidimensional Expressions (MDX)</p> <p>Attribute and analytic views</p>
Tooling	<p>SAP HANA Studio</p> <p>Enterprise Architect Designer (EAD)</p>

Security	Client-side encryption
	SYSTEM user access (replaced by DBADMIN)

**Table 12.1: Feature compatibility of HANA Cloud with HANA On-Premise**

## Code and commands

Command 12.1:

```
npm i @sap/hdi-deploy
```

Code 12.1:

```
CALL SYSHDL_CONTAINER1.REMOTE_EXECUTE (
    CREATE VIEW VIEW_T AS SELECT * FROM T
) ;
```

## Using SAP HANA Cloud as the database runtime

Just as with any other database, you can use HANA as the database runtime. In this case, you can use standard SQL statements to create, update, or delete database objects such as schemas, tables, and views, as well as run queries, join tables, filter data, and so on.

SAP HANA Client needs to be installed to provide a connection to the HANA Database using JDBC and ODBC, with the following connection strings respectively:

- **JDBC:** "jdbc:sap://<endpoint>:<port>/?encrypt=true"
- **ODBC:** "driver=libodbcHDB.so;  
serverNode=<endpoint>:<port>;encrypt=Yes"

The SAP HANA client also includes a command-line tool for executing database commands (for example, **Data Definition Language (DDL)**; **Data Manipulation Language (DML)**) in a terminal window—**HDBSQL**. It can also execute commands from a script file for scheduled execution.

Drivers and libraries are supported for all major programming languages. For Node.js, `@sap/hana-client` can be used to connect and run SQL queries. It can be simply installed by running `npm install @sap/hana-client`. Find more details at <https://www.npmjs.com/package/@sap/hana-client>.

Similarly, Python, Go, Ruby, ADO.NET, and more programming languages and OSs are supported. You can check **SAP Note 2648274** for SAP HANA client interfaces at <https://launchpad.support.sap.com/#/notes/2648274>.

# Chapter 13

## Images

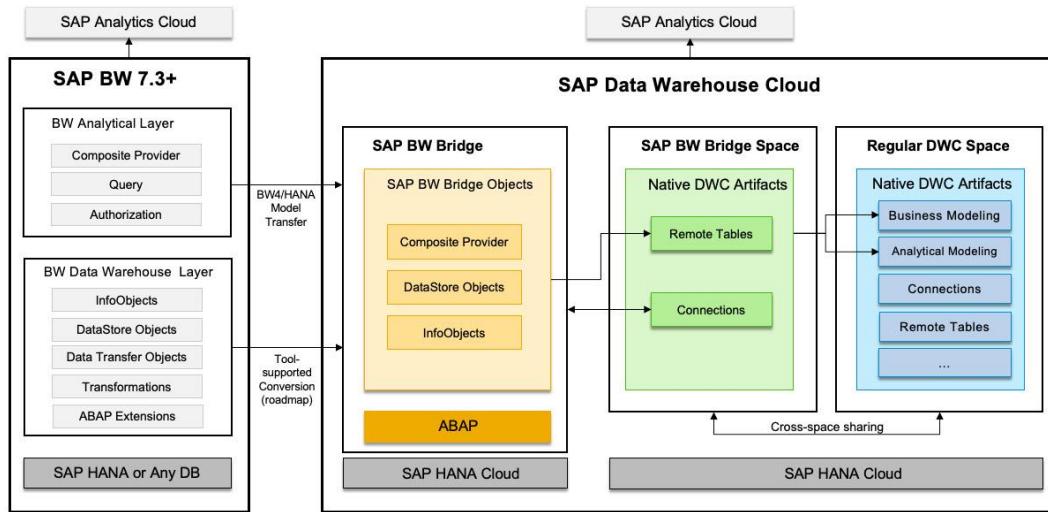
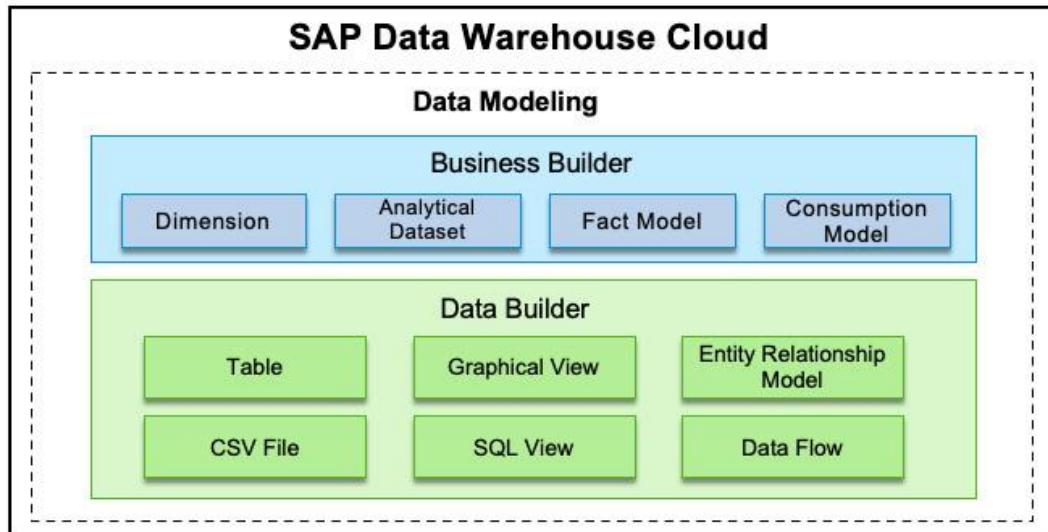
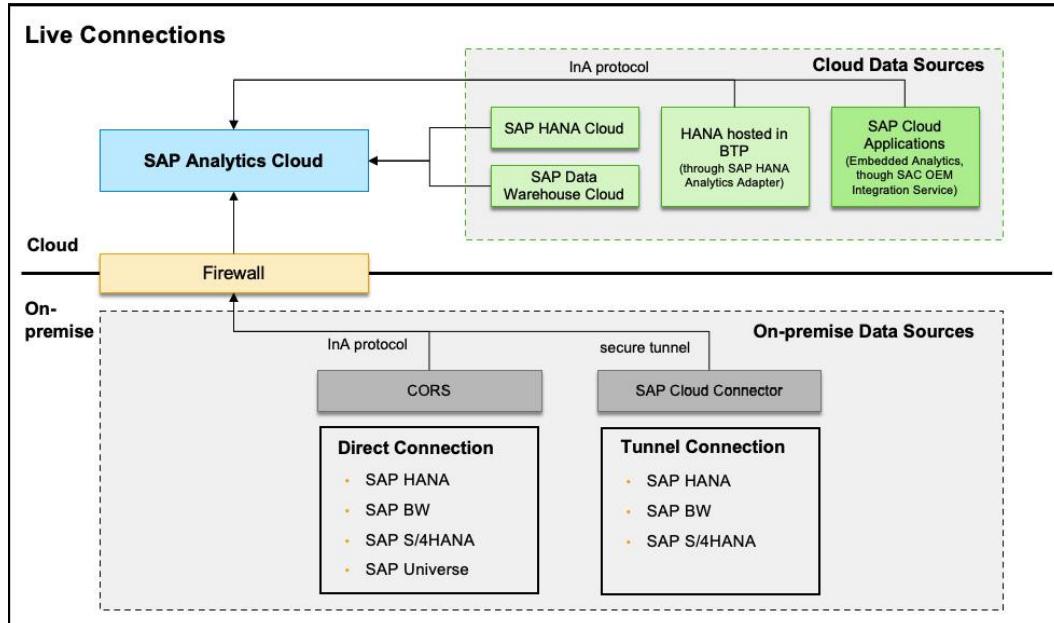


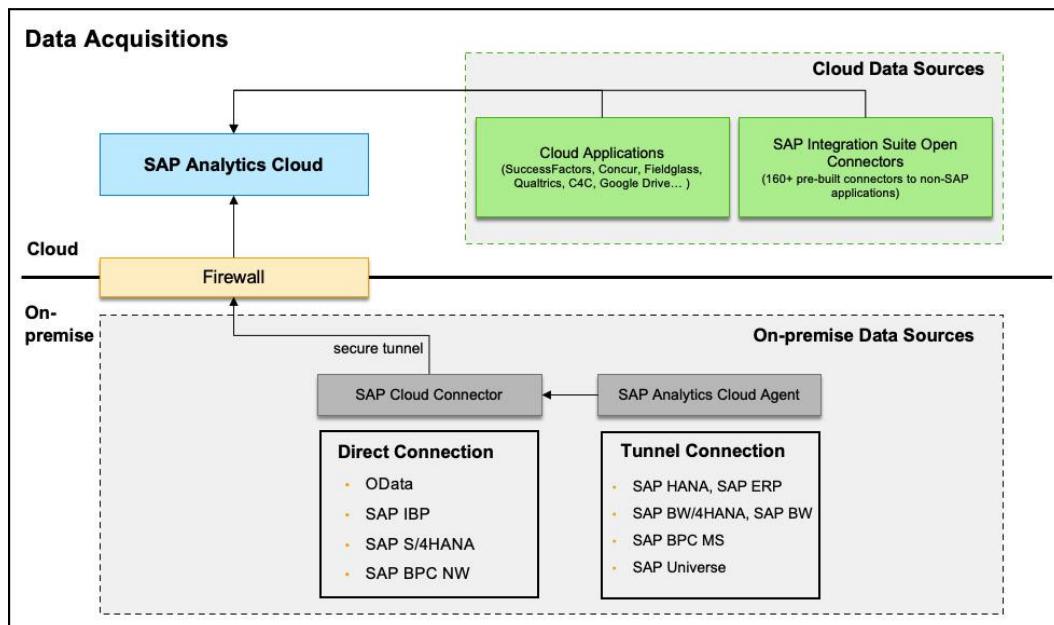
Figure 13.1 – SAP BW Bridge to SAP DWC



**Figure 13.2 – Data Builder and Business Builder in data modeling**



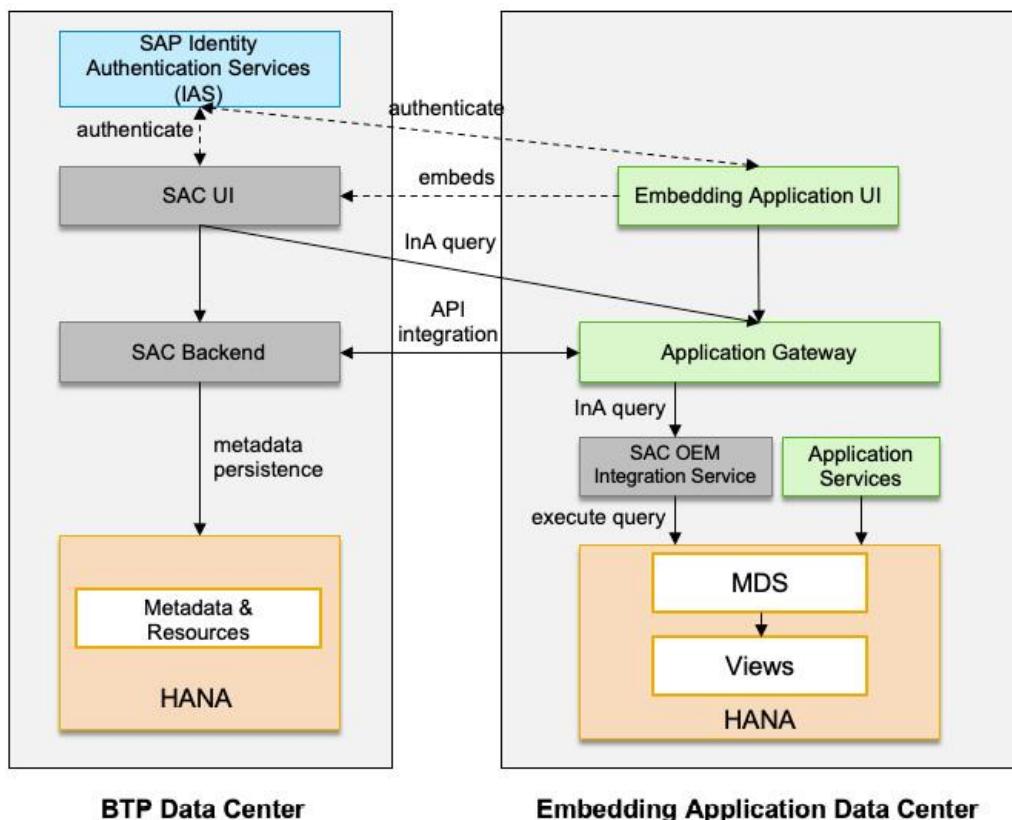
**Figure 13.3 – SAC live connections overview**



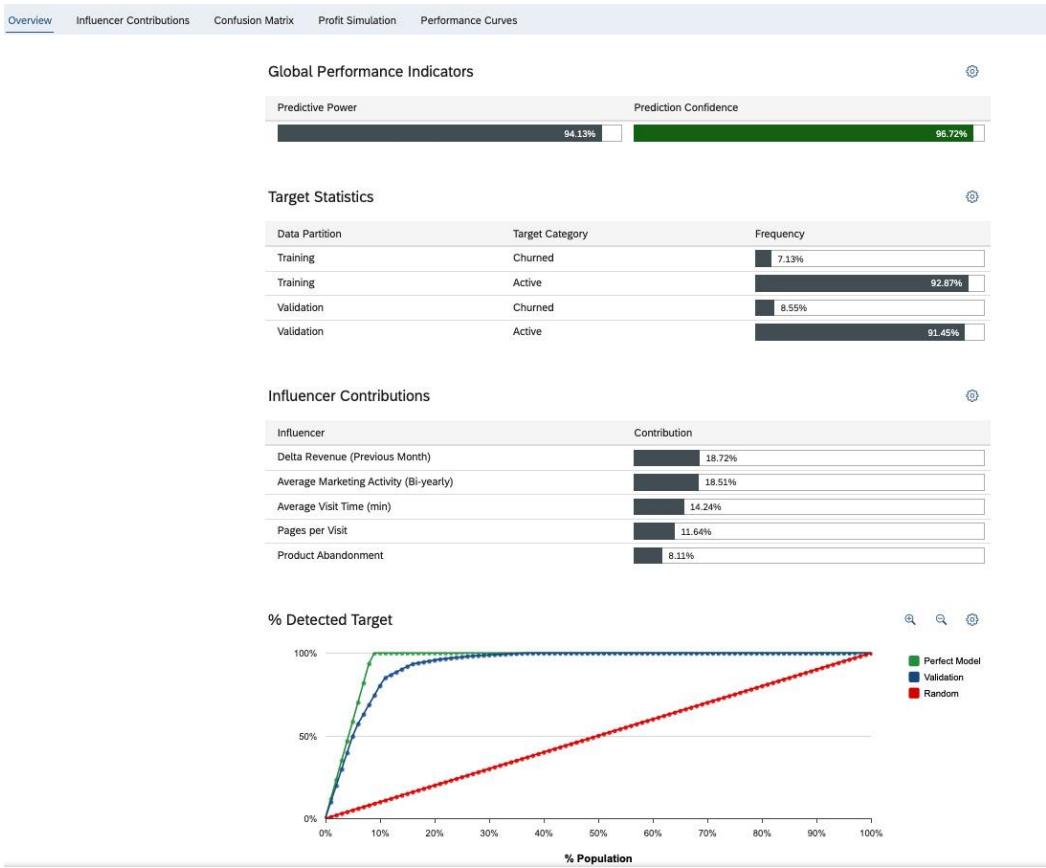
**Figure 13.4 – SAC data acquisition overview**

Classic Account Model: Single measure with multiple accounts				New Model: Multiple measures without account dimension			
Account	Customer ID	Product	SignedData	Customer ID	Product	No. of License	Opportunity Value
No. of License	1	Prod-1	100			100	100,000.00
No. of License	2	Prod-2	200			200	200,000.00
Opportunity Value	1	Prod-1	100,000.00				
Opportunity Value	2	Prod-2	200,000.00				

**Figure 13.5 – Classic account model and the new model**



**Figure 13.6 – Embedded analytics integration architecture**



**Figure 13.7 – Customer churn classification**

## Global Performance Indicators

Root Mean Square Error (RMSE) Prediction Confidence

16,459.11

96.44%

## Target Statistics

Data Partition	Minimum	Maximum	Mean	Standard Deviation
Training	11,000	209,000	64,008.71	45,976.44
Validation	11,000	201,000	64,718.16	46,677.99

## Influencer Contributions

Influencer	Contribution
License	40.53%
Customer_Meeting	15.63%
Customer_Status	14.25%
Customer_Segment	10.42%
Highest_Contract_Level	8.79%

## Predicted vs. Actual

- Perfect Model
- Validation - Actual
- Validation - Error Min
- Validation - Error Max

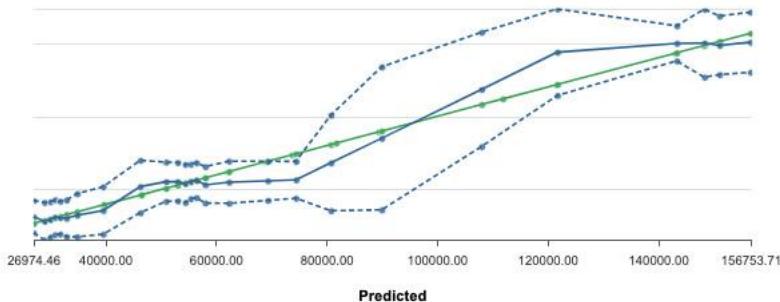


Figure 13.8 – Sales opportunity regression

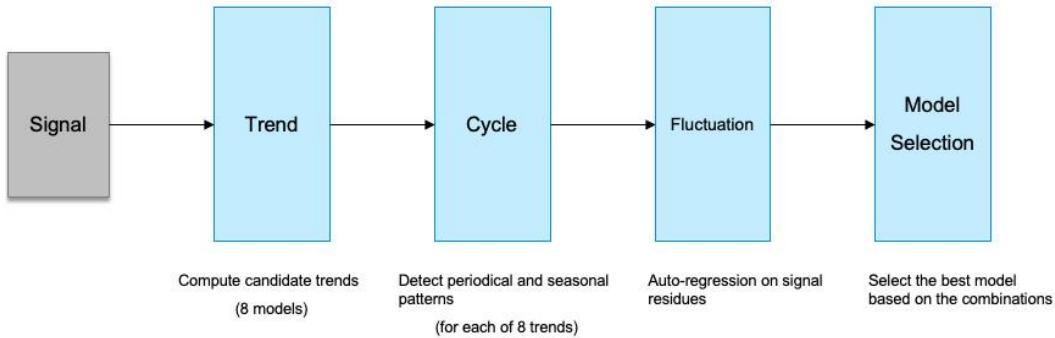


Figure 13.9 – Time series forecasting signal components

The screenshot shows the SAP Analytics Cloud interface with the following sections:

- Apply Predictive Model:** Data Source: Customer\_Churn, Generated Dataset: Customer\_Churn\_Prediction.
- Create Transform:** Fields: Customer ID, Revenue(Current Month), Customer Lifetime (days), Product Category.
- Generated Dataset:** A table with 24 rows of data, including columns for Predicted Category and Prediction Probability.

	AA_Predicted Category	I= Prediction Probability
1	Active	0.02256337957917404
2	Active	0.03889208645895115
3	Churned	0.9096159338951115
4	Churned	0.3887726664543152
5	Churned	0.8913320436598773
6	Churned	0.9605375283395171
7	Churned	0.0320908262843002
8	Churned	0.351918254852295
9	Churned	0.39362610429579614
10	Churned	0.0791357085108757
11	Churned	0.01312462489367199
12	Churned	0.0964135970457217
13	Churned	0.014995326569963
14	Churned	0.0061539424054623
15	Churned	0.01812330868765498
16	Churned	0.180920240074443
17	Churned	0.009353610816177
18	Churned	0.0180774461992264
19	Churned	0.00647815227873548
20	Churned	0.00642614495299249
21	Churned	0.0296013017892837524
22	Churned	0.0148004108161853
23	Churned	0.2499743396241455
24	Churned	0.4387246370515552

Figure 13.10 – Applying a predictive model

2022												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Quarterly Release Cycle (Dev, QA, Prod)			Wave 2022.02				Wave 2022.08				Wave 2022.15	
Test Preview Release Cycle					Wave 2022.02				Wave 2022.08			
Fast Track Release Cycle	2022.02	2022.03	2022.04	2022.05	2022.06	2022.07	2022.08	2022.09	2022.10	2022.11	2022.12	2022.13
	2022.14	2022.15	2022.16	2022.17	2022.18	2022.19	2022.20	2022.21	2022.22	2022.23	2022.24	2022.25

Figure 13.11 – SAC release cycles

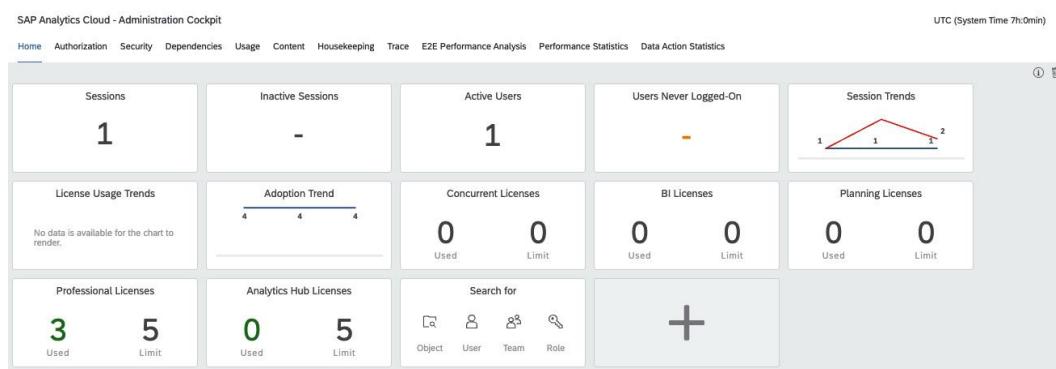


Figure 13.12 – The Administration Cockpit home page

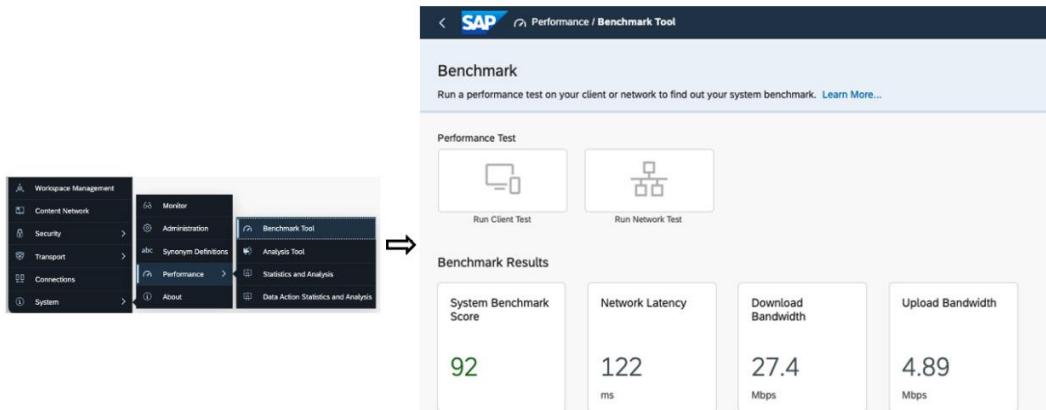


Figure 13.13 – Performance Benchmark

## Tables

Criteria	Live Connection	Data Acquisition
Functional	Performance and product limitations may apply. No planning support on the live connection. Available for HANA, DWC, BW, BOE Universe, and S/4HANA.	Support analytics, planning, and predictive scenarios. Available for SAP cloud applications and third-party data sources.

Data Storage	Data stays in the source system and connects to SAC in real time.	SAC stores the model and data locally in its underlying HANA database.
Data Security and Privacy	Managed on the source system. This is preferred when full control of data is required, and data cannot leave the source system.	Security is added to the models within SAC, and data is fully encrypted and secured.
Data Volume	No theoretical limitations as the data is processed in the backend. However, it needs to apply adequate filtering and aggregation to limit the volume returning to the web browser.	Limitation in file sizes (< 200 MB for Excel files and < 2 GB for CSV files), row and column counts (< 2 B rows, < 100 columns in models, < 1,000 columns in datasets), and cell sizes.

**Table 13.1 – Live connections and data acquisition**

	Dataset	Model
Use Cases	Ad hoc data, agile story building with data wrangling, predictive scenarios with Smart Predict	Governed data and the preferred format for live data, planning, and time series forecast scenarios
Data Management	Stored as a table with separate metadata within a story or as a standalone dataset, limited data management	Stored as a star schema with measures and dimensions, only exists outside a story, fine-grained data management
Data Access	No row-level security and can access the dataset as a whole	Row-level security, supports data access control per the dimension value

**Table 13.2 – Datasets versus models**

	Embedded Analytics	Enterprise Analytics
Data Sources	Restricted to embedding applications through live connections only	Can connect to various SAP and non-SAP data sources through live connections and data acquisitions; supports data blending from multiple data sources
Prebuilt Analytics Content	Prebuilt dashboard for the embedding application; content delivery by the application can only be done through SAC APIs	Comprehensive content packages from SAP and third parties through the Content Network library
Smart Features	None of the smart features or R-Visualization are available	Supports Search to Insight, Smart Insights, Smart Discovery, Smart Predict, and R-Visualization
Planning	Doesn't support planning processes	Supports operational, strategic, and financial planning
Insights to Action	Out-of-the-box integration with the embedding application	No out-of-the-box setup
User and Role	Reuse roles from the embedding application	A separate set of roles and authorizations need to be setup
Add-Ons and Custom App Support	No add-on support	Supports multidimensional analysis via Excel-based add-ons, Digital Boardroom, and custom widget design
License	Doesn't require any separate license	Requires separate SAC licenses

**Table 13.3 – Embedded analytics and enterprise analytics scenarios**

	Smart Insights	Smart Discovery
Features	Identifies the top contributors and various insights for the selected value or variance. They are visualized in the <b>Smart Insights</b> side panel, with different types of charts and dynamic text explanations.	Identifies key influencers for selected dimensions or measures and explores the relationship between different attributes. The results are presented in a generated story that covers key influencers, unexpected values, and simulations.
Use Case	Looks for insights for a particular value, performs deep-dive analysis, and explains surprising elements in data. An example of a use case is as follows:  Understand what contributed most to the revenue for a county	Jump starts data exploration, understands what is relevant to a result and the complex relationships and outliers, and performs what-if-like simulations. An example of a use case is as follows:  Discover how sales or marketing activities influence the revenue
Data Context	Single data point or variance	A data model with multiple dimensions and measures

**Table 13.4 – Smart Insights and Smart Discovery**

## Formulae

Formula 13.1:

$$\text{RMSE} = \sqrt{\frac{\sum_{i=1}^n (P_i - A_i)^2}{n}}$$

Formula 13.2:

Horizon Wide MAPE (forecast, signal, H)

$$= \frac{1}{H} \sum_{h=1}^H \left( \frac{1}{N} \sum_{i=1}^N \left| \frac{(forecast_{i+h}^h - signal_{i+h})}{signal_{i+h}} \right| \right)$$

# Chapter 14

## Images

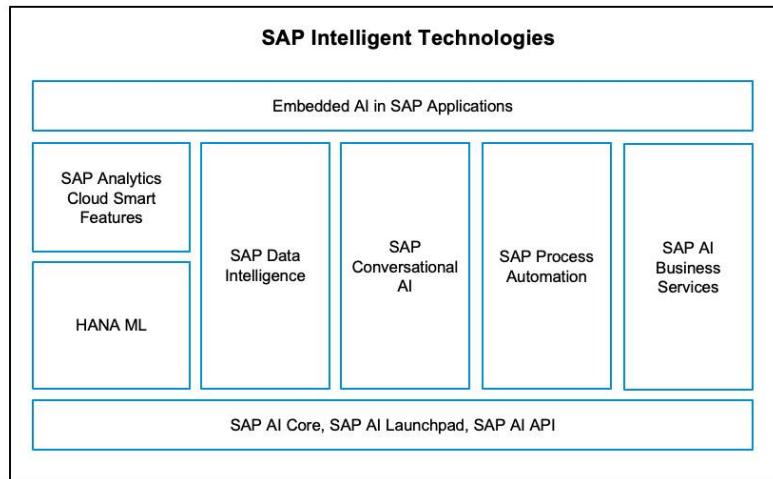


Figure 14.1: Overview of SAP Intelligent Technologies

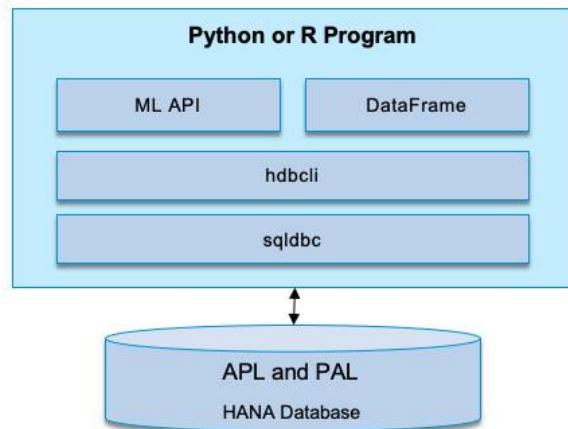


Figure 14.2: SAP HANA ML libraries

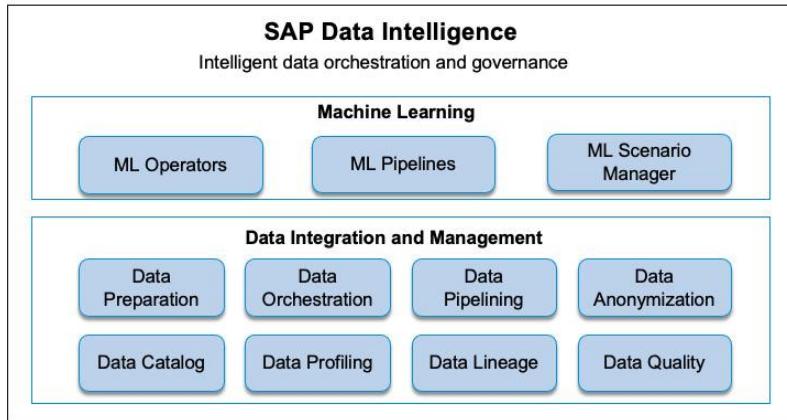


Figure 14.3: ML/AI support in SAP Data Intelligence

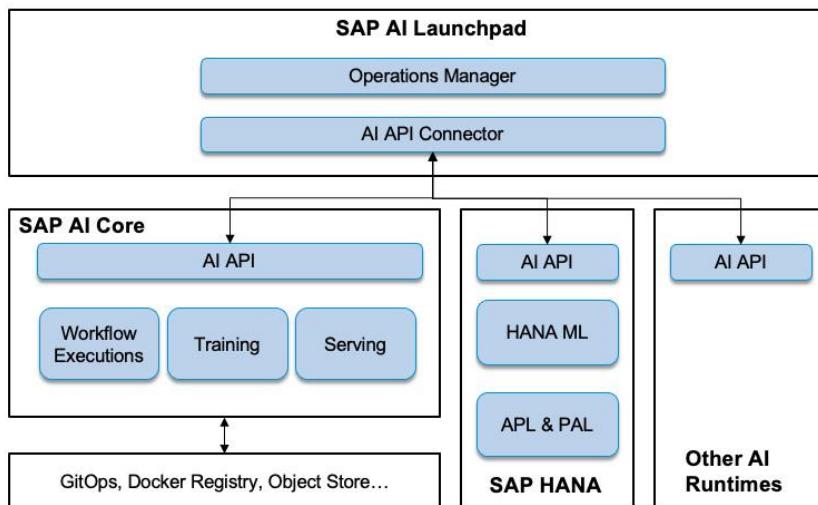


Figure 14.4: SAP AI Core, AI Launchpad, and AI API

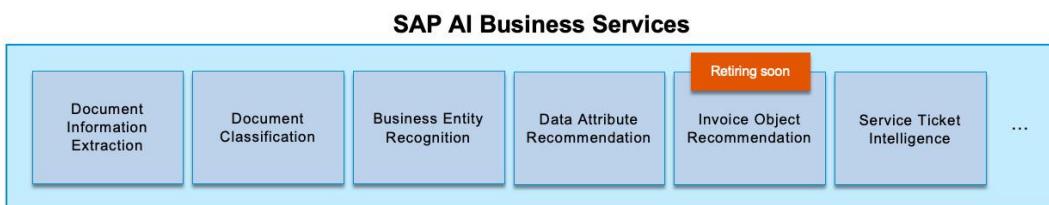
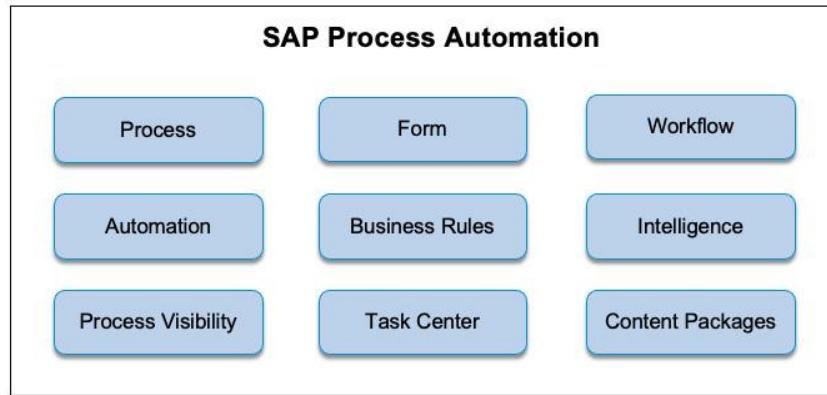
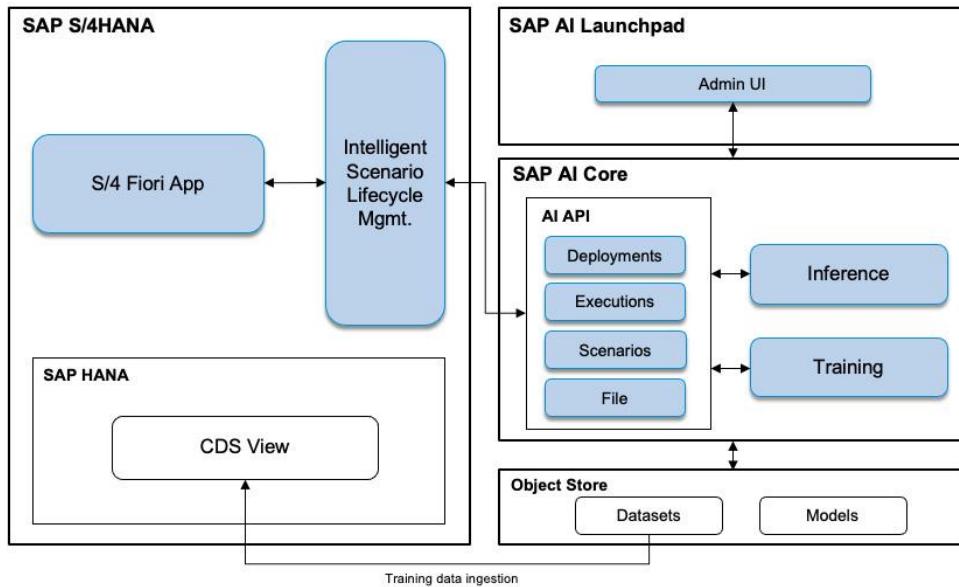


Figure 14.5: SAP AI Business Services



**Figure 14.6: SAP Process Automation capabilities**



**Figure 14.7: A side-by-side intelligent scenario in S/4HANA**

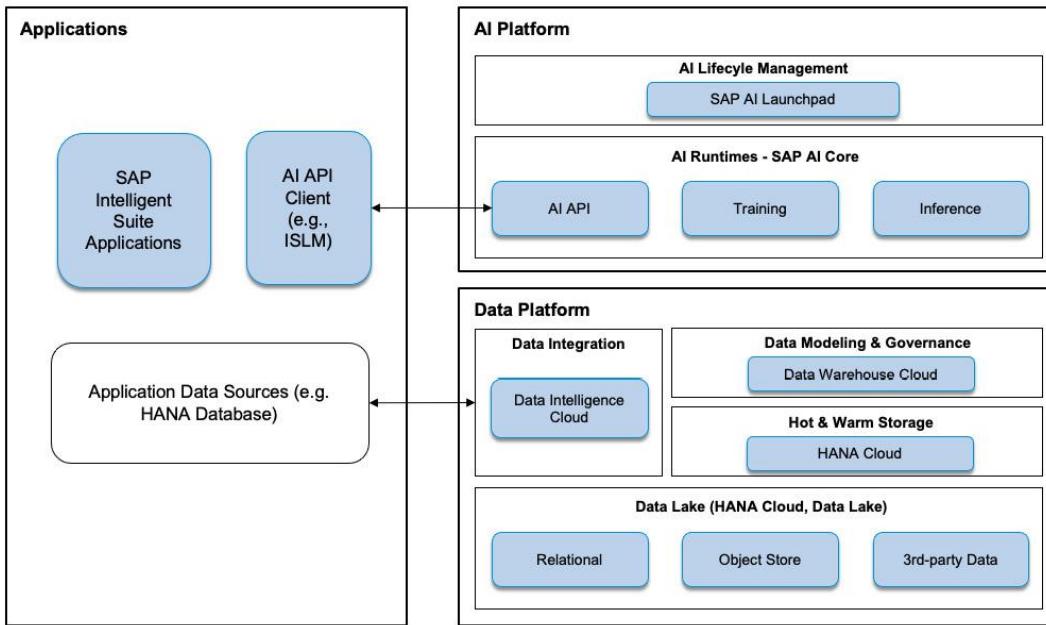


Figure 14.8: Data architecture for AI

## Tables

Predictive Scenario	Accuracy	Robustness
Classification	Predictive Power	Prediction Confidence
Regression	<b>Root Mean Squared Error (RMSE)</b>	Prediction Confidence
Time Series Forecasting	<b>Mean Absolute Percentage Error (MAPE)</b>	

Table 14.1: SAC Predictive Model Metrics

## Commands and Code

Code 14.1:

```
with ConnectionContext('address', port, 'user', 'password')
as c_context:
    dataframe = (c_context.table('TABLE1',
schema='SCHEMA1').select('COL1','COL2','COL2'))
```