Hybrid Integrations
with Oracle Platforms & Services

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Abstract

This paper provides a practical view of the Enterprise Application Integration landscape to evolve and manage the integration delivery across various systems and platforms that have evolved, including Integration Platforms. It provides and sets the direction for Enterprise Integration teams to evolve integrations for cloud-based applications and devices to leverage fully integrated digital ecosystems and drive the best value for customers and enterprises.

Target Audience: Chief Technology Officer, Chief Information Officer, Chief Data Officer, Enterprise Architects, Integration Architects, Data Architects, Solution Architects, Business Capability leads, IT Business Partners, Technology Managers, Integration Developers, Data Engineers.

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Introduction

Hybrid Integration combines different integration methods to connect various applications and data sources such as on-premises, Cloud, and third-party systems. **Hybrid Integration is both a terminology and a technology (Platform).** It is critical to acknowledge that Hybrid Integration and Hybrid Integration Platforms (HIPs) are used distinctly in this article to describe the concepts and capabilities.

Hybrid Integration as terminology provides a point of view and clarity on how the IT Landscape is evolving and is to be adopted within various Integration contexts for a Modern Enterprise. It provides an approach to consider for evolving future Enterprise Integration strategies and encompasses various new and unfolding integration domain models, architectural styles, and archetypes. It also highlights the critical capabilities of abstract technology maps.

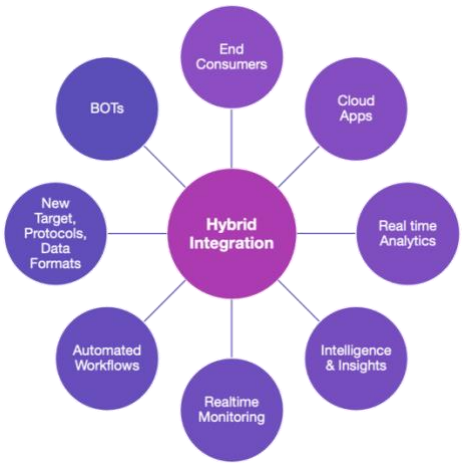
Hybrid Integration Platforms (HIP) can be implemented through various technologies, such as enterprise service buses, messaging systems, file transfer solutions, batch orchestration tools, process integration products, cloud integration platforms, API management tools, etc. This approach allows organizations to take advantage of the benefits of different products and technology while minimizing the potential drawbacks of any one method. It can also allow organizations to be more flexible in using and managing various integration platform technologies.

It is unlikely that one platform alone can satisfy all the needs of hybrid integrations; each of these systems may have unique requirements and capabilities, and a single platform may not fully support them. Additionally, organizations may have different use cases and requirements for their integration needs, such as real-time data replication, batch processing, and API management, which may require different capabilities and technologies. A combination of different platforms and tools will likely be needed to support a comprehensive hybrid integration strategy.

The key concept to be understood from this article is, though we have adopted ubiquitous computing for seamless end-user experiences to access data, information, insights, and intelligence, platforms that enable them are heterogenous, working together in few cases and in parts to create the more considerable sum for seamless user experience as discussed above; this acknowledgment is very critical to engineer the hybrid integrations. The need for hybrid Integration is growing with complexity and should be viewed critically by businesses to invest in the correct set of platforms, tools, and technologies. Toward the end of this article, we will discuss the possible convergence of delivery practices for cost optimization to develop hybrid integrations used to innovate your business.

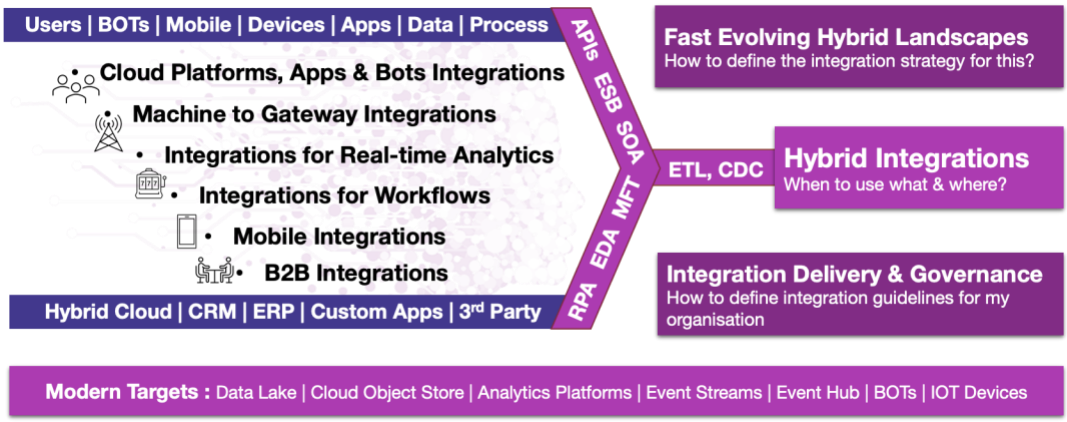
Drivers for Hybrid Integrations

There are critical outcomes that drive Hybrid Integrations that are not limited but focus on improving the business processes, increasing the agility in delivering business services, and reducing the costs but ensuring that security and compliance are maintained by leveraging the power of modern technologies. The critical drives of hybrid integrations are,



- Increase in demand from **End Consumer**s to get access to data, information, insights, and intelligence.
- Increase adoption of **Cloud Platforms and Applications** to host business processes to integrate the data in the Cloud.
- Increase demand for **Real-time Cross-Domain Analytics** to connect to various application events and information.
- Increase in demand for **intelligence and insights** that need contextual representation of data with changes in user preferences, geo-locations, and ecosystem behavior in real-time and offline for users and systems.
- Increase in demand for **Real-time Monitoring** of the physical world in digital twins that requires data to be integrated from machines and devices.
- Increase demands for **Automation and workflows** that require integrations to systems and processes.
- Increase in demand for **Converging Technology Targets, Protocols, and Data formats.**
- Increase in demand for **Bots to integrate with Applications and Data.**

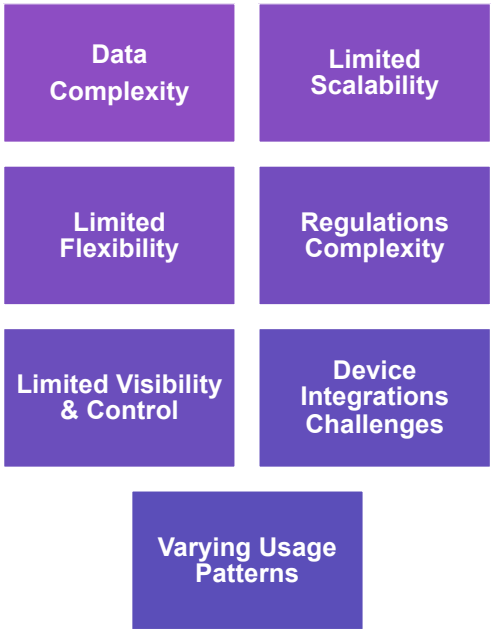
Gartner says, On average, Integration with other systems is about 18% of a business application implementation effort, and this amount can escalate to > 45%



This could leave you with two critical questions listed in the diagram above, which will be addressed in this article.

Benefits of Hybrid Integrations

Hybrid Integration Platforms (HIPs) can address several pain points that organizations typically face when connecting and integrating various systems technologies and provide benefits such as:



- **Pain-point #1: Complexity in data integration:** HIPs can provide capabilities such as data replication, messaging, data transformation, routing, and security, which can help organizations simplify the data pipeline and better manage and integrate their data.

- **Pain-point #2: Limited scalability and flexibility:** HIPs can be easily scaled up or down to meet changing demands and can also provide organizations with the ability to quickly and easily deploy and test new integrations, which can help organizations to leverage their IT investments better and to achieve faster time to value.

- **Pain-point #3: Difficulty complying with regulations and standards**: HIPs can provide capabilities such as data encryption, tokenization, and masking, which can help organizations comply with various regulations and standards, such as GDPR, HIPAA, and PCI-DSS.

- **Pain-point #4: Lack of visibility and control:** HIPs can provide capabilities such as monitoring, management, and troubleshooting, which can help organizations ensure that their integration environment is running smoothly and that any issues are quickly resolved.

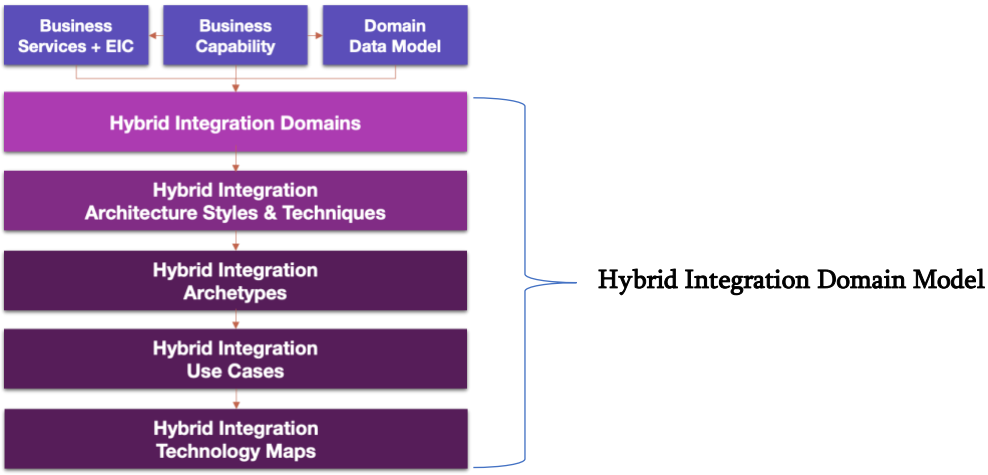
- **Pain-point #5: Difficulty in achieving real-time analytics:** HIPs can provide capabilities such as real-time analytics, data visualization, and reporting, which can help organizations leverage their data and make decisions based on real-time data.

- **Pain-point #6: Difficulty integrating with IoT and Edge computing devices:** HIPs can provide data ingestion, transformation, and routing for IoT devices and sensor data, which can help organizations leverage their data better and make decisions based on real-time data.

- **Pain-point #7: Unpredictable Usage Patterns:** HIPs can be more cost-effective, especially when using cloud-based HIPs, as they typically offer a pay-as-you-go pricing model, which can be more cost-effective for organizations with variable or unpredictable usage patterns.

Strategy for Hybrid Integrations

The domain-driven hybrid integration model is a top-down approach to hybrid Integration that will address the critical challenges and pain points we discussed earlier. It should be clear to readers that domain-driven design (DDD) is a crucial driver to initiate and formalize the capabilities, and it is equally important to differentiate that the domains addressed in hybrid integrations are different from DDD domains, but it works well in tandem with it; hybrid integration domain model can also work without business domains in DDD if you are yet to implement it in your IT delivery practice. This section of the article will provide an overview of layers in the hybrid integration domain model that will be discussed in detail in the following part.



- **Business Capabilities** are an organization's ability to perform a specific business function, process, or activity. It provides a common language and understanding of an organization's capabilities across different functions, departments, and business units (Business Domains), and it supports business strategy, planning, and execution. Business domains should be used as a fundamental means to create Business Services aligned to each integration domain to avoid the integration catalog being crowded with technical integration points. Best Practices in maintaining the integration service catalog should be based on the representation of the Integration as business services, and implementation details should be maintained in an independent unit.

- **Business Services** (APIs/Interfaces) would encapsulate each functional aspect of business domains. If you are following the Domain Driven Design model for enabling business services through an application, this would fit well with integrations; APIs could be defined based on this to represent the business domain services; beyond namespaces and API design tools now support this approach to have clarified view on the domain driven design which will connect back to business capability maps and application designs.

- **Domain Data Model:** The Data Domain is no less critical in the context of Integration, as the need for importance with data is increasing than ever before. Domain-driven Data Model design is critical for maintaining good integration services that can feed into business services delivered from the hybrid Integration.

- **Hybrid Integration Domains** describe typical areas in a hybrid landscape where Integration is needed between Cloud2Cloud, Cloud2Onprem (Cloud2OP), or OP2OP.

It defines the capability and architecture styles to be adopted for integration requirements.

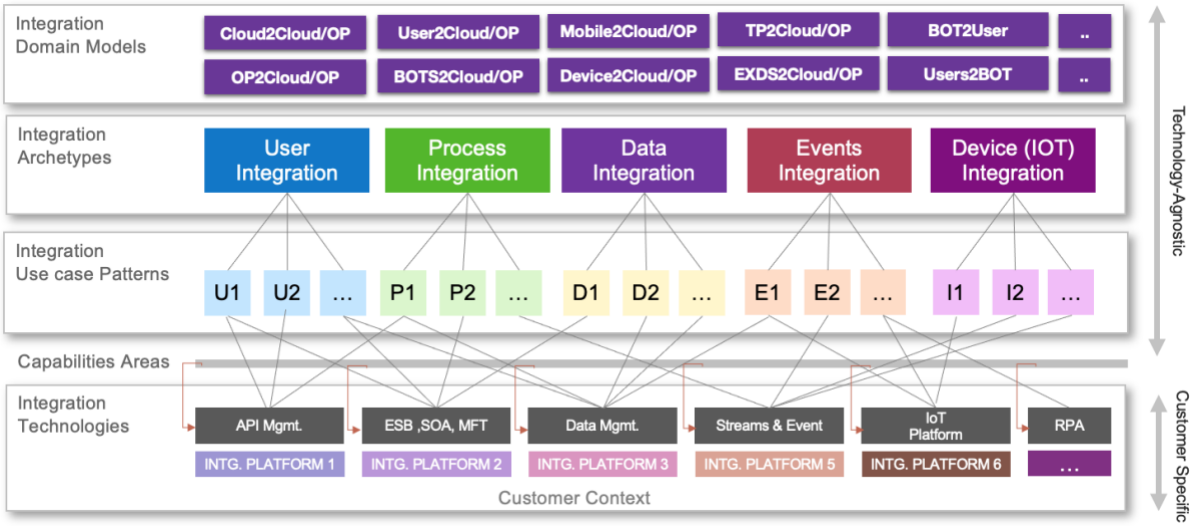
- **Hybrid Integration Architecture Styles, Techniques, and Archetypes** comprise a set of technology-agnostic integration use cases such as SOA, EDA, Stream Processing, Extract-Transform-Load, etc.

- **Hybrid Integration Archetypes** and use cases can be mapped to **Integration Technologies**/services based on a given integration context. Integration Archetypes include User Integration, Process Integration, Data Integration, Event Integration and Device Integration.

- **Hybrid Capability Areas** include several key areas but are not limited to the following.
    - **API Management:** Create, Manage, Deliver, and Integrate with APIs
    - **Process Orchestration:** Integrate Application Business Process
    - **Managed File Transfers:** Configure, Schedule, & Secure File Transfers
    - **Service Bus & Messaging:** Publish & Subscribe Msg. from Topics & Queues and Service Orchestration.
    - **Data Integration & Data Pipelines:** Integrate, Ingest, Synchronize, Replicate or Move Data
    - **Data Lakes & Data Hubs:** Store Large Volumes of Data for Analysis
    - **Batch Orchestration:** Schedule and Orchestrate batch process
    - Events Processing & Hub: **Ingest, Store, Process and Analyze Events**
    - **Streaming Processing:** Analyze and Process Event Stream Data
    - **Edge and IoT Device Integration:** Integrate Devices to digital twins to process data at the client and synchronize to a central hub.
    - **Data Virtualisation:** In-Place Data Integration without movement
    - **B2B Integration:** Integrate Business Transactions through B2B Standards

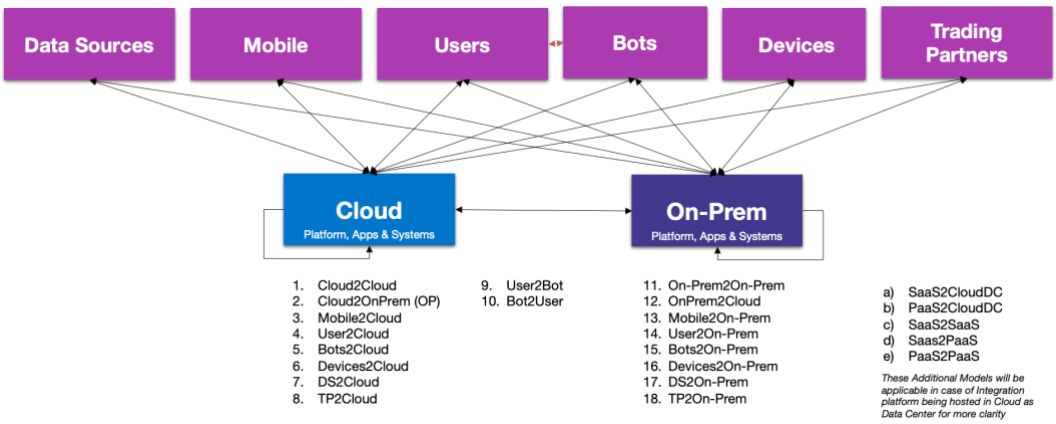
- **Hybrid Integration platforms** are where the Business Services should be implemented and mapped to the correct technology map per the use case. Oracle has 23+ integration platforms and services/products that support a comprehensive list of architectural styles and integration patterns for various integration scenarios.

A summary of the Hybrid Integration Model is shown below; we will discuss each layer in this model in detail in this article following this section.



Hybrid Integration Domains

Hybrid Integration domains refer to the different types of systems and applications organizations need to integrate as part of their hybrid integration strategy. The below diagram shows some of the common integration domains:

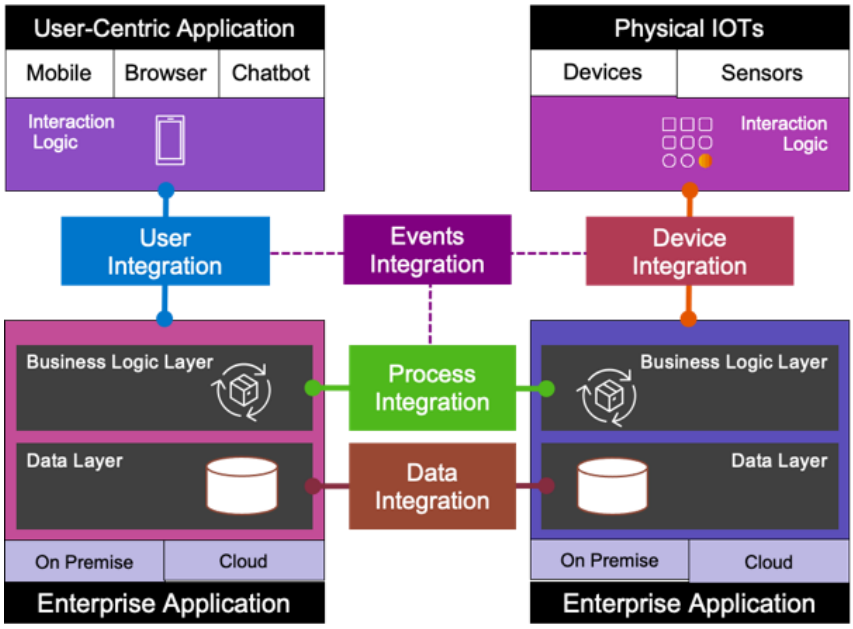


- **Cloud domains:** This domain refers to integrating cloud-based systems and applications, such as SaaS, PaaS, and IaaS, with on-premises systems and applications.
- **On-premises domains:** This domain refers to integrating on-premises systems and applications, such as ERP, CRM, and mainframe systems, with other on-premises systems and applications, as well as with cloud-based systems and applications.
- **Mobile domains**: This domain refers to integrating mobile systems and applications, such as smartphones and tablets, with other systems and applications.
- **Devices Domain:** This domain could be called Edge and IOT Domains. **It** refers to integrating systems and applications running at the network's edge, such as edge gateways, IoT devices, and sensors, with other systems and applications.
- **B2B domains/Trading Partners Domain:** This domain refers to integrating systems and applications between different organizations, such as suppliers, partners, and customers.
- **Data domains (External and Internal):** This domain refers to integrating data-related systems and applications, such as data warehouses, data lakes, and data marts, with other systems and applications.

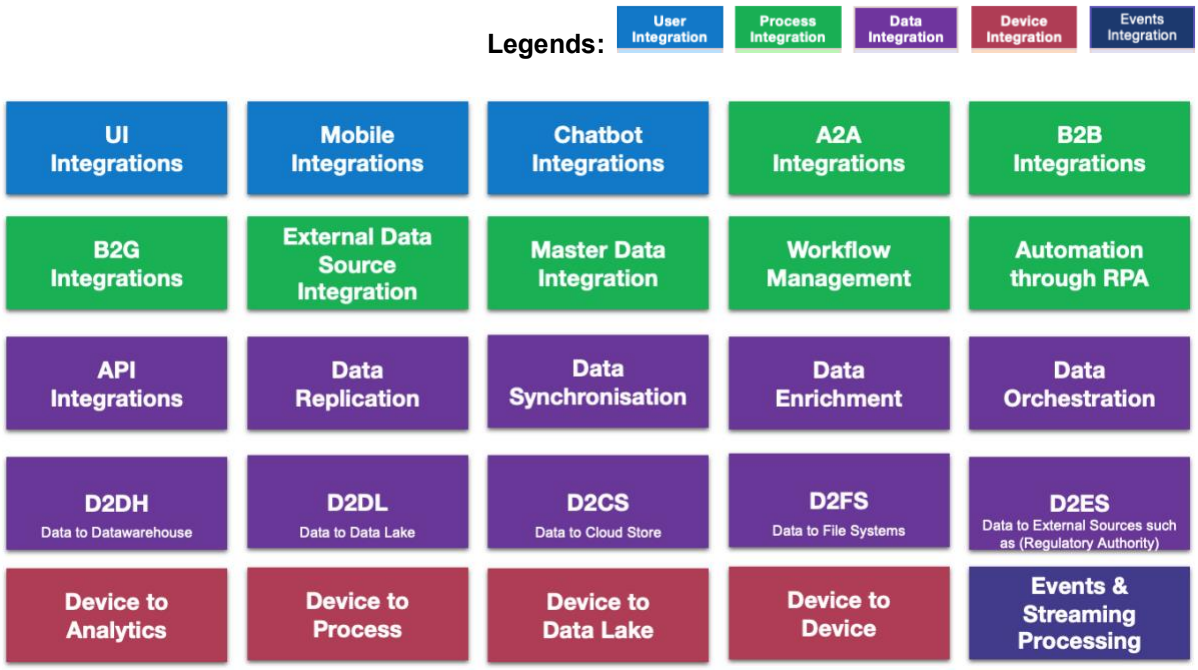
As the integration requirements get complex, domains intervene to create several integration domains, as listed in the picture above, such as Cloud2Cloud, Cloud2OP, OP2OP, etc. This section has provided an overview of the domains, and further sections in the article will show how they all fit together with architectural styles, techniques, and archetypes mapping to decide on the HIP Components of choice based on the required capabilities.

Hybrid Integration Archetypes

Integration archetypes describe categories of Integration that include User, Process, Data, Device, and event Integration. Each integration style has specific characteristics and can be refined by use-case and integration patterns. It is an instrumental paradigm that will enable us to map the right technology component that suits the integration needs or combine them appropriately. This classification also provides better clarity in managing the integrations.



The below map provides a holistic view of various flavors of the archetypes, which we will discuss in detail in the following section.



- **User Integration:** Allows to connect user-centric applications with applications.
    - **UI Integration:** Integration of multiple application UIs into a single point of entry
    - **Mobile Integration:** Consumption of backend application services in a mobile app, leveraging native or hybrid device capabilities, including offline data synchronization
    - **Chatbot Integration** - Integration of chatbots into various communication channels, including Integration with backend applications to trigger a transaction or retrieve further information
- **Process Integration:** Allows for the connection of business processes across applications.
    - **A2A Integrations –** Application to Application Integration**:** Connecting business processes between business applications by the exchange of transactional data
    - **B2B Integrations –** Business to Business Integrations: Connecting business processes between business partners by the exchange of transactional data leveraging B2B protocols doc formats
    - **B2G Integrations** – The Business to Government (B2G) channel is a way to transact with our Online Services from your business systems.
    - **Workflow Mgmt. -** Automation of business processes that spawn across multiple applications with human interventions.
    - **Master Data –** Synchronise, Replicate, or provide access to the master data such as employee, customer, supplier, locations, products, finance data codes, etc., and related changes across business applications
    - **RPA -** Automation of workflows across user interfaces and applications using configured scripts (bots)
- **Data Integration:** Allows access, synchronization, replication, and data integration across applications between various data sources and applications.
    - **API Integration -** Provisioning secure access to business applications and data through well-managed APIs. It is mainly used in a unidirectional context to access the data and rarely to update it in an integration context.
    - **Data Synchronisation -** This could be a bi-directional or unidirectional integration to move the data between systems that exchange data with the master-slave architecture, which can interchange its roles to support various business or technical scenarios.
    - **Data Replication -** Unidirectional interaction method to update data from source to target**.** Data exchange of master data across business applications and File/Table-based Integration of data covering data replication, migration, or analytical use cases based on ETL/ELT
    - **Data Enrichment-** Integrating data from multiple sources for cleansing, matching, or consolidation (central business terms) or enhancing the data from multiple sources to represent the enterprise definition of business objects to serve consuming applications based on the application profiles.

- **Data Orchestration -** Pipeline-driven data integration for disparate data supporting also distributed processing.

- **Data Hubs -** Provisioning large-scale, high-throughput APIs by inserting a high-performance in-memory data store layer between the API service layer and the system of record.

- **D2X:** Data Integration to various critical systems within an enterprise and external enterprise is becoming increasingly important and complex; the list of data movement archetypes below clarifies selecting the right technology maps.

    - **D2DH – Data to Datawarehouse:** Move data from different application sources to data warehouse systems and reporting solutions

    - **D2DL – Data to Data Lake:** Move transactional data from various data sources such as ERPs and custom Applications to Data Lake

    - **D2CS – Data to Cloud Store:** Move data to the cloud store to build analytics and insights through modern algorithms

    - **D2FS – Data to File Systems:** Move data securely to file systems

    - **D2ES – Data to External Systems** such as Regulatory bodies or authorities:

- **Device Integration:** Allows the Integration of real-world objects into systems and applications.

    - **Device to Analytics -** Real-time device or machine data integration for monitoring and analytics.

    - **Device to Process -** Integration of device or machine data for triggering a business process step.

    - **Device to Lake -** Collection of device or machine data to derive future value out of it

    - **Device to Device -** Data exchange between two or more devices, e.g., machine-to-machine (M2M).

- **Events Integration:** Allows immutable events to be processed and integrated

    - **Event-Based Integration -** Decoupling of applications, extensions, or IoT data by messaging principles (pub/sub).

    - **Stream Analytics -** Real-time processing and analytics of event streams, including the reaction to event patterns.

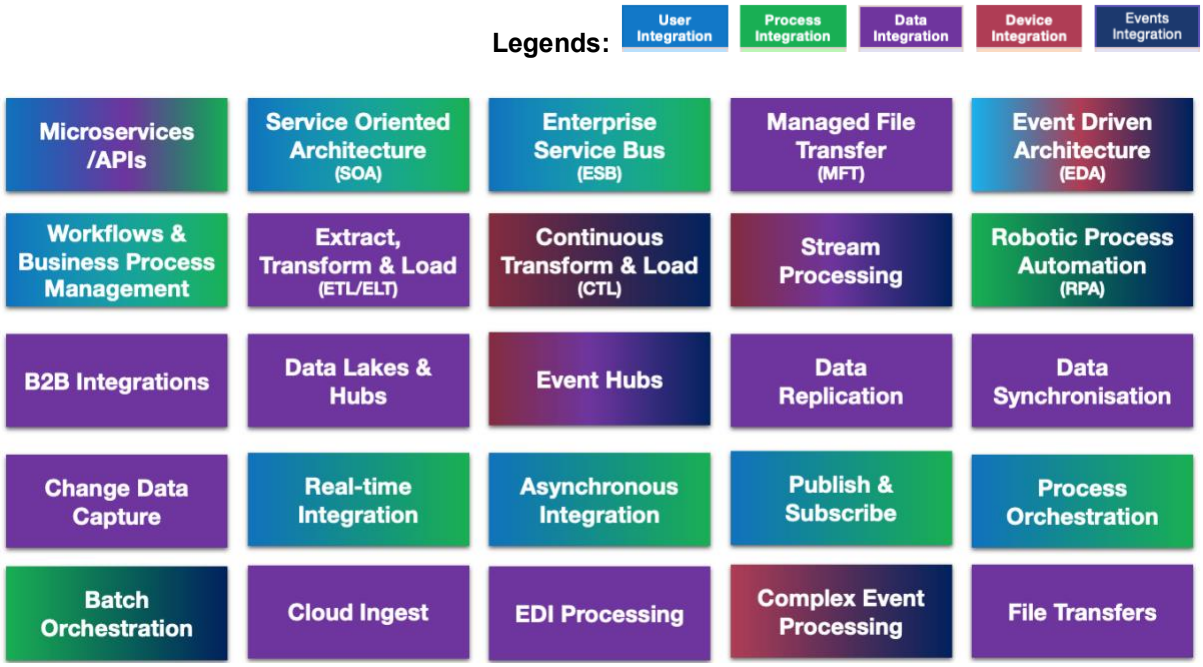
The below map shows Enterprise Hybrid Integration domains mapping to Archetypes.

Enterprise Hybrid Integration: Domain to Archetypes Map

HI Domains	User Integration	Process Integration	Data Integration	Device Integration	Event Integration
Cloud2Cloud	✓	✓	✓	✓	✓
Cloud2OnPrem (OP)	✓	✓	✓	✓	✓
Mobile2Cloud	✓	✓			✓
User2Cloud	✓	✓			✓
Bots2Cloud		✓		✓	✓
Devices2Cloud		✓	✓	✓	✓
DS2Cloud			✓		
TP2Cloud			✓		
User2Bot	✓	✓			
Bot2User	✓	✓			
On-Prem2On-Prem	✓	✓	✓	✓	✓
OnPrem2Cloud	✓	✓	✓	✓	✓
Mobile2On-Prem	✓	✓			
User2On-Prem	✓	✓			
Bots2On-Prem		✓		✓	
Devices2On-Prem				✓	✓
DS2On-Prem			✓		
TP2On-Prem			✓		
SaaS2CloudDC	✓	✓	✓	✓	✓
PaaS2CloudDC	✓	✓	✓	✓	✓
SaaS2SaaS	✓	✓	✓		✓
Saas2PaaS	✓	✓	✓	✓	✓
PaaS2PaaS	✓	✓	✓	✓	✓

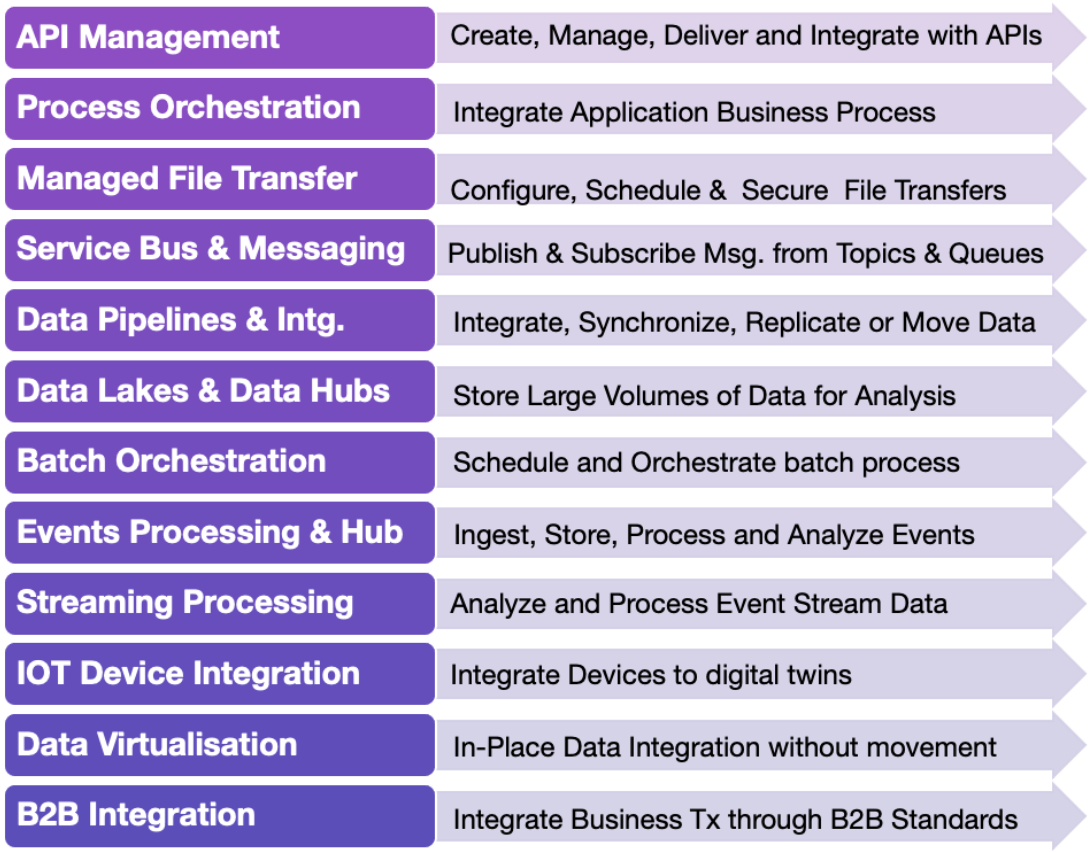
Hybrid Integration Architectural Styles & Techniques

We should remember that hybrid Integration is an evolution from existing enterprise integration methods to accommodate the evolving modern targets and integration domains, so it is expected to encapsulate the existing architecture styles and techniques to add new techniques and converge the capabilities to minimize the overheads. The diagram below shows a snapshot of different architectural styles and techniques that are applicable in hybrid integrations that pass through various architectural styles to create a spectrum of hybrid integrations that gives a view of how they evolve to the capabilities for implementation, as there are popular architectural styles; descriptions for each of this is not provided in this article as some of them are already covered in the previous section of this article; but shown here to display the breadth and depth of hybrid integration requirements that are evolving in the current IT Landscape. It sets the stage for making the right decision in investing and choosing the right components for enterprise requirements.



Hybrid Integration Capabilities

Hybrid Capability Areas include several capabilities that provide required features for Integration to meet requirements from different domain models and archetypes.



- **API Management:** This capability allows organizations to create, manage, and publish APIs to expose their systems' functionalities to external parties. It also allows organizations to secure, govern, and monitor API usage.
- **Process Orchestration:** This capability is closely related to hybrid Integration. It refers to the ability of a system or platform to support the Integration and coordination of business processes, departments, different systems, technologies, and domains.
- **Managed File Transfers:** Configure, Schedule, and Secure File Transfers. This capability allows organizations to transfer files between systems using FTP, SFTP, and FTPS protocols.
- **Batch Orchestration:** This capability allows organizations to automate, schedule, and monitor batch processes, such as data integration, transformation, and replication.
- **Service Bus & Messaging:** This capability allows organizations to coordinate and automate the flow of services within a business process to Publish and subscribe messages from Topics & Queues and forward messages with the required level of transformation for the targets connected to the service bus on specific orders and orchestrate any required business process or data flows

- **Data Integration & Pipelines:** Integrate, Ingest, Synchronize, Replicate or Move Data. This capability allows organizations to integrate, transform, and replicate data between systems. This capability also allows organizations to govern and monitor data quality, consistency, and completeness.

- **Data Lakes & Data Hubs:** Store Large Volumes of Data for Analysis

- **Events Processing & Hub:** This capability allows organizations to ingest, store, process, and respond to events in real-time using techniques such as event messaging, event streaming, and event processing.

- **Streaming Processing:** This capability allows organizations to Analyze and Process Event Stream Data using advanced windowing functions and provides time-series analysis capability on the event data, which is usually unavailable in other techniques.

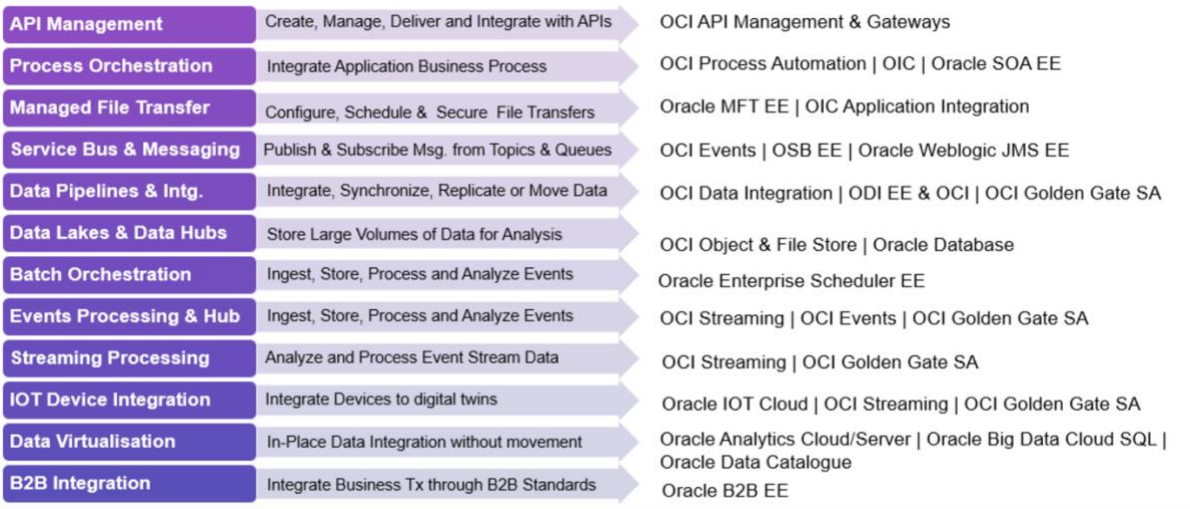
- **Edge & IOT Device Integration:** Integrate devices to digital twins, process data at the client, and synchronize to a central hub.

- **Data Virtualisation:** It is **an** in-place Integration capability without data movement. This capability allows organizations to create a virtual view of their data, regardless of where it is physically located or in what format it is stored. This virtual view can access, integrate, and query data from multiple sources as a single, unified data store.

- **B2B Integration:** This Capability allows the Integrate Business Transactions to secure data transfer, mapping, and transformation, as per B2B Standards. It can help organizations easily connect and integrate their systems with their partners, customers, and suppliers.

Oracle Resume for Hybrid Integrations

Oracle Integration products and services have matured over several decades and provide capabilities and features to address all capability areas of hybrid Integration. Depending on the enterprise application landscape, hybrid integration platforms can evolve to expand or converge to fulfill business integration needs. The Hybrid Integration map below shows Capability Areas and related Oracle Integration Solutions and Services. This article section aims to overview the Oracle services that map to Hybrid Integration Capability Areas.



OCI API Management & Gateways: Oracle API Gateway service enables the publishing of APIs with private endpoints that are accessible from within the network and which can be exposed to public IP addresses if it needs to accept internet traffic. The endpoints support API validation, request and response transformation, CORS, authentication and authorization, and request limiting.

OCI Process Automation: A Low code process integration platform that allows the connection/orchestration of processes across enterprise systems deployed in Oracle SaaS and non-Oracle platforms. Process Automation Service creates well-structured and dynamic processes, enables design forms to collect and interact with data, introduce and intervene in human actions, or automate the decision process through DMN (Decision Model and Notation) or FEEL (Friendly et al.) Standards.

OCI Integration Cloud (OIC): Oracle Integration Cloud allows you to integrate applications through APIs and other protocols to integrate the business process through data available in various enterprise systems.

Oracle SOA Suite (EE): Oracle SOA Suite EE is an On-Prem Integration Suite equivalent to OIC or, in a few cases, superior features to Integrate applications.

Oracle MFT EE: Oracle Managed File Transfer is an On-Prem software that schedules, monitors, and securely transfers files.

OCI Events: OCI Events enables integrations between different OCI Technical Components and Applications where changes to the state of the OCI resources are emitted are introspected by rules to action for sending notifications, streaming event data, and calling OCI Functions to process the event further for integrating to achieve Event-Based Architecture in a stateless manner.

OSB EE: Oracle Service Bus Enterprise Edition is an on-prem integration bus service that integrates disparate systems through service-oriented or event-driven architecture. OSB is a very mature product in the Oracle Integration Service Stack that is reliable and robust to support varied integration patterns

Oracle Weblogic JMS EE: Oracle Weblogic EE is an On-prem software that enables message-driven Integration with various integration components/platforms to send and receive data from different systems.

OCI Data Integrator: OCI Oracle Data Integrator provides the capability to build Data Integrations with Oracle Cloud Resources to perform ETL/ELT functions for bulk data upload between the systems.

ODI EE: Similar to OCI Data Integrator service, ODI provides ELT (Extract et al.) capabilities to extract, load, and transform data at the target in the required format by the target system.

OCI Golden Gate SA: OCI Golden Gate Streaming Analytics Service is an advanced service that integrates data to and from various Enterprises, Cloud Systems, and Technology Targets using Streaming techniques.

OCI Object Store & File Store: Storing Data is no longer an anti-pattern in the Integration context, with modern cloud systems requiring the creation of data hubs to exchange data. Oracle Supports this through Object Store and File Store to exchange the data.

OCI Autonomous Database: Oracle Autonomous Databases have been a traditional target to store the data, and they can play a critical role in data exchange between different systems to contribute to Hybrid Integrations

Oracle Enterprise Scheduler: Oracle Enterprise Scheduler components enable scheduling flows to trigger at appropriate stages either by time-driven or actions-driven through external system calls. It enables the orchestration of the batch flows to maintain the batch dependencies between them.

OCI Streaming: OCI Streaming is a managed service provided by Oracle to stream data between different systems. All features of Kafka are available with this.

Oracle IOT Cloud: Oracle IOT Cloud enables the configuration and exchange of data from IOT devices to a central data hub to enable data streaming.

Data Virtualization: Data Virtualization is achieved through various products and services in OCI to integrate the data without movement. However, data is utilized across various systems through the virtualization layer created using available services.

Oracle B2B EE: Oracle B2B Enterprise Edition is a trading partner integration software integrating EDI-based messages.