

An iPaaS Reference Model

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Introduction

Integration platform-as-a-service (iPaaS), is a sub-section of PaaS, and continues to evolve as an integration alternative capable of meeting a wide range of integration needs, including on-premise, cloud, B2B, and mobile integration. Organizations should consider iPaaS as a means to reduce the complexity of their integration landscape as they continue to focus on managing the complex business needs and budget constraints, and still achieve faster time to integration. This paper will help enterprise/solution/integration architects, integration center of excellence (COE) and line-of-business (LOB) leaders select an iPaaS solution best suited to their specific business requirements.

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Overview

An integration platform as a service - iPaaS provides capabilities to enable data, application, API and process integrations spanning cloud and on-premises solutions. This is achieved by developing, deploying, managing and monitoring integration interfaces i.e. integration solutions bridging multiple endpoints so that they can work together. iPaaS is typically used for cloud integration, application to application integration, business to business integration, mobile application integration, API publishing and Internet of Things integration scenarios.

iPaaS provides various technologies that enables **building robust integration solutions**. iPaaS capabilities can be utilized to build integration flows that connect combination of cloud-based and on-premises applications, including those for business partners. These integration flows are deployed and managed in the cloud, therefore users don't need to procure hardware and integration middleware to run them. Nor do they have to bother with deployment, administration, upgrading and monitoring of the underlying integration platform as it's a managed platform.

Integration Capabilities:

- Application integration based on an enterprise service bus (ESB) or low-latency messaging based on JMS, for example, with latency equal to or lower than 1 millisecond
- B2B integration based on a B2B service or a licensed B2B technology handling major EDI formats.
- Business process management (BPM) or business rules management (BRM). BPM supports dynamic case management, human workflow, and straight-through processing.
- Data integration with the data integration technologies
- Cloud-based integration (CBI), which is defined as a multitenant integration service running in the cloud and providing data mapping and synchronization between cloud and cloud or cloud and on-premises business applications.
- API management
- Integration with the Internet of Things or physical computing. Offers a packaged approach to integrate embedded devices or industrial manufacturing infrastructures like robots.

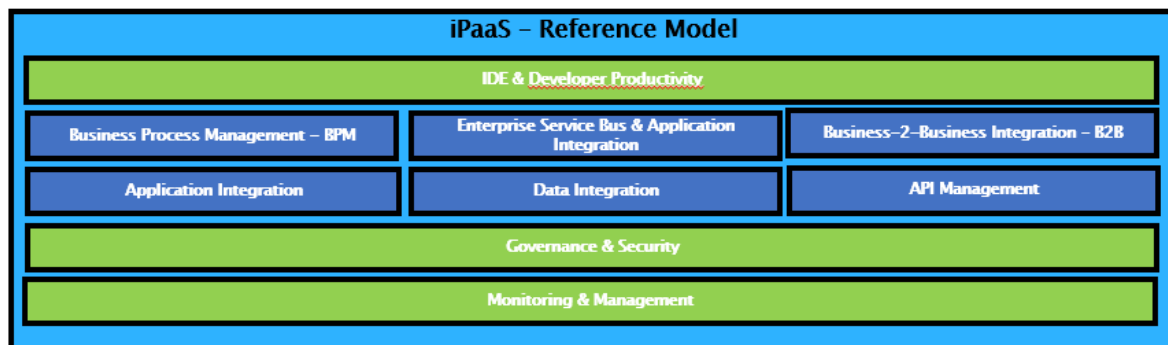
Key Drivers for iPaaS

- Application portfolios are hybrid, with many organizations having to integrate between these diverse endpoints
- Enterprises must continuously adapt to changing business needs. As a result, the interfaces with these applications must also continuously evolve: changing from batch to near-real time, introducing a new attribute in the data schema, or changing from one API to a new version.
- Few organizations are finding that their established on-premises integration practices can be leveraged to integrate with SaaS applications, many more are finding that their existing approaches are just not delivering fast enough to meet these new business challenges.
- For organizations that never established systematic integration practices, the thought of having to start now is daunting. The large costs, long delivery times and complex infrastructure builds associated with traditional on-premises approaches are just not in line with today's lean approaches and timelines.
- Organizations have heavily and strategically invested in ESBs to support their service-oriented architecture (SOA) initiatives. While this investment is valuable for on-premises

systems-of-records integration, it too often doesn't support applications in the cloud, convergence of data and applications, and dynamic integration needs. These large enterprises have the choice of either renewing their strategic ESB investments or complementing their ESB strategic investments with an iPaaS for cloud integration.

- Organizations like to focus on unlocking extra value via API creation, Mobile integration, IoT and big data analytics.

iPaaS Reference Model



iPaaS Reference Model

The iPaaS Reference consists of the following building blocks:

BPM: BPM provides users with integration platform services to execute integration flows. These integration flows can be developed in the IDE via the development and life cycle management platform services.

iPaaS services are provided in a multitenant fashion. That is, the software platform implementing the services is shared across multiple tenants (i.e., organizations using the iPaaS), and tenant isolation is guaranteed. One tenant cannot see or change the integration flow models of other tenants, cannot start or stop integration flows in other tenants' environments and cannot see in-transit data belonging to other tenants, and the execution of one tenant's integration flows cannot interfere with those of other tenants.

- Implements and orchestrates visually designed integration workflows and microservices.
- Workflows are based on the standard Workflow Definition Language. These workflows provide efficient ways to process and manipulate data that can be obtained or pushed via different connectors
- To build integration solutions it provides a growing catalog of ~200 built-in connectors, such as SQL Database, Azure® services, Office 365®, Salesforce® and many more
- One can interact with different protocols, SaaS systems, other services and on-premises systems. Communication protocol connectors (FTP, HTTP, AMQP, MQTT, AS1/2/3/4, etc.)
- Implements cloud-based B2B integrations compliant with AS2 and EDI protocols.
- Custom logic can be implemented in microservices to be orchestrated by BPM.

- Support for "service aggregation" i.e. combining APIs/services associated with different back-end applications for development of composite functionality
- Application connectors/adapters for SaaS and on-premises packaged applications
- Data formats (XML, JSON, ASN.1, etc.) & Data standards (EDIFACT®, HL7®, SWIFT®, etc.)
- Integration flow development and life cycle management tools. Implements and orchestrates visually designed integration workflows and microservices.
- Variety of predefined workflow templates for common connector integration scenarios
- Implements code-based microservices or processing logic.
- Provides pre-defined connectors, workflows & templates

ESB & B2B Integration: ESB facilitates integrating numerous applications together over a bus-like infrastructure. ESB facilitates integrating different applications by enabling a communication bus between them and then enable each application to talk to the bus. This decouples systems from each other, allowing them to communicate without dependency or knowledge of other systems on the bus.

Business-to-Business (B2B) Gateways facilitates integrating data from different back-end systems enabling information exchange across trading partners.

This set of capabilities provides the runtime environment for application and B2B integration, implementing services such as transport of data and messages between endpoints using a variety of formats and protocols, data and message validation, content-based routing, adapters, security and B2B partner community management.

- Supports variety of data and message validations, content-based routing, adapters, security and B2B partner community management
- Supported use cases: SaaS-to-SaaS, on-premise-to-on-premise, B2B, mobile, and social and application integrationSupported transformations:
 - Simple object access protocol (SOAP) or extensible mark-up language (XML) over Java message service (JMS)/HTTP to REST/JSON services/APIs
 - File-based interfaces (used for B2B integration) to REST services/APIs
 - JSON to XML
- Support for real-time and batch-mode integration
- Content-based routing capability
- Decouples upstream systems from downstream systems or different microservices.
- Designed for synchronous and asynchronous messaging flows.
- Allows messages to be reliably routed between systems and applications
- Supports various protocols including REST, AMQP and WS*
- Deployment options: appliance and public cloud, private cloud/On-premise, hybrid deployment (including the scenario when only runtime engine is deployed on-premise)
- Provision for switching (includes reuse of integration processes/configurations) between different deployment model's easy federation with traditional integration platforms (for example, ESB)
- Eliminate point to point integration and thus system dependencies, decoupling services wherever possible
- Securely expose legacy LOB (Line of Business) data sources and services
- Forms the critical core of their updated architecture and allows messages to be reliably routed between systems
- Facilitates message interchange across a Hybrid and/or Multi-Cloud architecture
- Supports Queue and publish/subscribe-based messaging paradigms
- All messages are logically routed through the Service Bus providing a highly available fully managed messaging fabric

- Simplified data migration, making it easy to streamline and automate business processes
- Facilitates message interchange across a Hybrid and/or Multi-Cloud architecture

API Management & Microservices: API management offers a unified approach to the governance of public, private, and partner APIs while fulfilling other key requirements, such as message/protocol transformation, developer enablement and community management, API lifecycle governance, operational and business analytics, API/service/data security, and monetization. It is an increasingly critical capability, providing the requisite governance, performance management, and security framework to help ensure the delivery of positive business outcomes.

- Implement code-based microservices or business logic. This is where the business logic is implemented and triggered or invoked through the API management
- Custom logic is built in microservices and is orchestrated by BPM.
- Provides the API Management features, which includes: securing backend APIs, response caching, request throttling, request routing, request transformation, calls tracing, usage and health analytics.
- Mediation with IoT protocols, such as message queuing telemetry transport (MQTT) and constrained application protocol (CoAP)
- Support for aggregation of data from various sources, such as internal backend APIs and third-party applications
- End-to-end governance across the entire API lifecycle
- Capability to send alerts and notifications to subscribers in the case of an occurrence of an API lifecycle event
- Support for API deprecation and retirement
- Automated fail over for high availability and reliability

Data Integration: Enable the aggregation of data from multiple sources into an integrated view to support consistent access to and delivery of cloud-based and on-premises data. These capabilities involve using bulk/batch data delivery approaches to consolidate data from primary databases and formats, executing queries against multiple data sources to create virtual integrated views of data in memory, encapsulating data in messages that various applications can read, or synchronizing data between a cloud-based data store and other cloud-based or on-premises DBMSs and schemas.

- Extract, transform and load (ETL) capability
- Data quality services (data profiling, de-duplication, enrichment, cleansing, matching, and so on) offered by the iPaaS solution
- Data mapping and transformation
- Data integration solution that supports all the bulk data integration needs.
- High performance data integration platform that's able to scale up and down seamlessly, without disruption to the business. Highly performant and scalable data integration framework
- Transformation components, including prebuilt objects that act on data to satisfy simple and complex data integration requirements
- Extensive enterprise connectivity to support varied data integration requirements
- Create, schedule and manage data pipelines
- Easily design and implement workflows using visual tools

Monitoring & Management: Through the monitoring and management platform, users deploy and administer integration flows, monitor their execution, manage their behaviour (e.g. can change priorities, quality of service [QoS] requirements or security policies) and perform other monitoring and management tasks. This set of services provides the capabilities needed to monitor, manage and administer the runtime execution of users' integration flows.

- Configuration of error/failure alerts and notifications
- Command line interface (CLI) for administration functions
- A web console for
 - Monitoring resource utilization/system health/runtime performance
 - Monitoring production integrations
 - Changing, stopping, and disabling/deleting configurations/integration processes
 - Network monitoring
- Support for monitoring via mobile devices
- Web API for development of client applications for management (creating, changing, stopping or deleting configurations) of integration processes
- Built-in fault-tolerance and recovery mechanisms
- A load balancer or other such suitable provision for management of workloads spread across different runtime engines

Governance & Security: An iPaaS also provides governance platform services to support the governance processes associated with integration/SOA initiatives. These services help users agree on, define and apply policies that enforce the governance decision chains associated with endpoint interfaces (e.g. SOA services or SaaS APIs), oversee compliance with the policies (through metrics) and decide what to do with the exceptions.

- Provide capabilities to manage the life cycle of endpoint interfaces and other reusable artifacts.
- Collect the data necessary to track governance key performance indicators (such as endpoint availability, response time, number of messages emitted/processed by each endpoint, etc.) and other policy-relevant metrics from endpoints, on-premises application infrastructure components and the iPaaS runtime environment.
- Govern SOA and integration initiatives implemented on top of the iPaaS, but also on a different heterogeneous platform
- Enable users to monitor or gather information and data to support governance decisions, and feed it to the related policies or registry/repository entries
- Dedicated security mediator or security gateway for SaaS integration
- Provision for providing granular access privileges to individual resources
- Provision for storing and retrieving access credentials across different environments
- Support for lightweight directory access protocol (LDAP) integration
- Provision for isolation between different tenants
- Support for HTTPS (HTTP over SSL), Secure FTP (FTP over SSH) and FTPS (FTP over SSL), OAuth®, secure database connectivity, and Kerberos®
- Support for logging and resolving security errors (for example, authentication failures)
- Provision for encryption of password/credentials during the development of integration flows
- Support for compliance of regulations, such as SSAE 16®, PCI®, and HIPAA®
- Support for implementation and administration of security and governance policies, including exception handling

IDE & Developer Productivity: These enable users to model, develop, configure, test and deploy integration flows and their associated artifacts. These capabilities are provided through an integrated, graphically oriented modelling environment or the IDE, which makes it possible for developers to model integration flows, orchestrations, business objects, message formats, data, rules and other assets utilizing an intuitive "drag and drop" metaphor. Certain aspects, for example, integration flow configuration and deployment, are assisted by wizard-driven tools. Typically, developers can also incorporate custom-developed code (Java, .NET, JavaScript, PHP and other languages) in their integration flows, if necessary.

- User-friendly configuration wizard/drag-and-drop tool/integration flow development
- Interface/graphical integrated development environment
- Pre-built connectors/integration templates/mappings for:
 - Business application like CRM, ERP, HCM
 - Collaboration applications
 - Financial applications
 - Big data processing frameworks
 - Content management systems
- CDK or template development kit
- Unit testing and regression testing tools
- Provision for modification of existing connectors/integration templates or components
- Availability of sample code, documentation, best practices, and collaboration venue as part of developer support
- Self-service to end users
- Version control for integration processes (for example, rollback to a previous state/version)
- Support for cloning of configurations (for example, running an existing orchestration with a different set of endpoints)
- Automated suggestions for error resolution
- Saves time, boosts productivity, and allows spending of more time focusing on core business needs

iPaaS Versus Integration Middleware

Difference between an iPaaS and a traditional integration platform middleware product is that in an iPaaS:

- Users don't pay upfront for a (often very highly priced) software license, but pay a periodic (usually monthly) service subscription priced on the basis of functionality or parameters such as number of connections, volume of data exchanged or transactions processed by the iPaaS.
- Users are relieved of the burden of deploying, managing, troubleshooting and maintaining the integration platform. Therefore, they can focus only on developing and monitoring the integration flows and business needs.
- Commercial iPaaS offerings provide productivity-oriented, model-driven development tools, and come with a wealth of predefined integration flow templates for the most common and well understood integration issues (for example, data synchronization between salesforce.com® and SAP®). Therefore, iPaaS are often characterized by fast time to integration, at least for the simplest and most well-known use cases.

- True to their cloud nature, iPaaS offerings typically also provide a collaborative environment for users and service providers to exchange integration flow templates. These collaborative environments often assume the form of a true marketplace (or "integration flow store") also supporting forms of "self-service" deployment of pre-packaged integration flows, at times referred to as "cloudstreams".

Key Use Cases for iPaaS

Given their affinity to software-as-a-service (SaaS) applications, iPaaS are used primarily to support cloud-to-cloud and cloud-to-on premise integration. iPaaS-based approaches are also very common for e-commerce B2B integration, dating back to the initial adoption of electronic data interchange (EDI)/value-added-network (VAN) services. However, as offerings mature and adoption expands, iPaaS are used to address a broader set of requirements, including certain internal SOA and A2A use cases. Integration-platform-as-a-service specializes for dynamic integration. iPaaS is a simplified version of hybrid integration targeting two key use cases:

- allowing enterprises that have not invested in SOA infrastructure and that are moving to the cloud to adopt integration solutions rather than coded interfaces
- allowing larger enterprises to complement their existing ESB on-premises investments with integration solutions for SaaS, delivering dynamic integration and making integration easier and faster to deploy.

Sample Key Vendors

iPaaS vendor compared in this section comprises of specialized integration vendors. These iPaaS vendors have expanded the capabilities of their solutions beyond core competency to providing a cloud-based application and data integration platform. This includes delivery of API management and data quality and management services on top of iPaaS. In fact, the top vendors in this paper account for over 50% of the global iPaaS market size.



	MS Azure	Dell Boomi	Informatica	Mulesoft
Modern API architecture	++	+	+	++
Pricing	++	+	+-	++
Single integration platform. Technologies agreed on group level	++	+	+	+
Ease of developing and implementing Enterprise integration solutions	++	+	+-	+
Migration from current Synchrony tool to new ESB solution	++	+	+-	+-
Governance, Management & Monitoring	+	+	+	+
Common integration architecture & Security	+	+	+	+
Support	+	+	+-	+-

Legend: -- Very low (1), - Low (2), ± Neutral (3), + Good (4), and ++ Very good (5)

iPaaS Platform - Key Vendor Comparison

Benefits of iPaaS Platform

- **Low risk** solution as iPaaS provides out-of-the-box capabilities
- Solution components are **highly Scalable and Configurable**
- **Cost efficient** for developing, managing and running software solution as it's a pay as you go model
- iPaaS can help you on your journey to **reducing risks** and achieving compliance with the **GDPR** through tools and processes.
- **Agile and responsive** to meet business demands, with accelerated application deployment and continuous agility by design
- Compliant with the **common security protocols**
- **Enables and leverages integration architecture**, governance and management framework, best practices and standards.
- **Governance framework** that will help drive future business development and business decision making
- Leveraging Cloud & On-premise solutions facilitating **Hybrid integration**
- **Visually build workflows with easy-to-use tools**
- **Get started faster with iPaaS platform templates, workflows and out of box connectors**
- **Connect disparate systems across heterogeneous environments**
- **Provides Excellent support for enterprise integration and B2B scenarios**
- **Write once, reuse often** which means built-in re-usability and extensibility in the platform

Conclusion

iPaaS provides model-driven development tools, prepackaged integration flows and templates, self-service provisioning and subscription-based pricing that are particularly attractive for small to midsize businesses or departments and business units of large enterprises looking for fast time-to-integration approaches. With businesses moving toward digitization, **iPaaS helps connect legacy systems, modern, and cutting-edge systems** more easily and quickly by providing pre-built APIs as connectors.

iPaaS platform are fully managed by the ISV, which frees enterprises from the worries of building, hosting, scaling, managing, monitoring, and maintaining the solutions. With the capability to create **serverless applications and solutions**, enterprises can focus on the core business logic rather than spending effort and time on lesser priority tasks. You pay only for what you use, based on a **pay-as-you-go pricing model**.

iPaaS continues to expand beyond cloud service integration, and is increasingly being used for hybrid integration scenarios involving a mix of on-premise, SaaS, B2B, and/or mobile application integration. With the increasing need to “do more with less”, Integration Competency Centre - ICC/integration COEs are embracing agile approaches to integration. LOB-led iPaaS adoption is quite common. The role of iPaaS in enterprise integration continues to expand, as evidenced by the increase in average subscription/deal size for relatively mature iPaaS solutions. The competition in the iPaaS vendor landscape continues to increase, with several major middleware vendors introducing/announcing their iPaaS solutions. Major iPaaS vendors have enhanced the overall value proposition of their solutions by offering low-latency processing, data management, and API management capabilities on top of iPaaS.

Author Bio



Sameer Paradkar is an Enterprise Architect with 15+ years of extensive experience in the ICT industry which spans across Consulting, Product Development and Systems Integration. He is an Open Group TOGAF, Oracle Master Java EA, TMForum NGOSS, IBM SOA Solutions, IBM Cloud Solutions, IBM MobileFirst, ITIL Foundation V3 and COBIT 5 certified enterprise architect. He serves as an advisory architect on Enterprise Architecture programs and continues to work as a Subject Matter Expert. He has worked on multiple architecture transformation and modernization engagements in the USA, UK, Europe, Asia Pacific and Middle East Regions that presented a phased roadmap to transformation that maximized the business value, while minimizing costs and risks.

Sameer is part of IT Strategy & Transformation Practice in AtoS. Prior to AtoS he has worked in organizations like EY - IT Advisory, IBM GBS, Wipro Consulting Services, TechMahindra and Infosys Technologies and specializes in IT Strategies and Enterprise transformation engagements.