This Hype Cycle helps application leaders interested in cloud-based solutions understand the pace and viability of maturing and emerging PaaS markets. Long-standing PaaS flavors are approaching the Plateau of Productivity, while a new wave of PaaS innovation crowds the Peak of Inflated Expectations.

**Strategic Planning Assumptions**

By 2023, over a quarter of cloud platform offerings will be a part of either the technically oriented “IaaS+PaaS” continuum or the business-oriented PaaS as SaaS extension offerings.

By 2023, over 90% of the top 20 low-code application platform services (aPaaS) will include some integration, composition and orchestration capabilities.

By 2024, at least eight of the top 10 integration platform services (iPaaS) will offer business-user-oriented application development capabilities.
**Analysis**

**What You Need to Know**

Platform as a service (PaaS) provides cloud application infrastructure services, fitting between the computer and storage infrastructure cloud service (IaaS) market and software solution (SaaS) markets. PaaS covers most types of services for custom applications and solutions, where the cloud attributes of scale and internet availability encourage innovation and high performance.

Organizations that embrace cloud computing seek cloud-native digital experiences. PaaS offerings deliver the next-generation computing environment, featuring greater scalability, availability, agility, productivity and consistency of operations. The breadth of PaaS services, from application development to integration, data management and analytics, makes for a powerful platform for business innovation, and is now mature and broadly embedded in mainstream computing.

The five-year compound annual growth rate (CAGR) 2020 through 2025 of PaaS spend is more than double that of on-premises spend across equivalent software markets (AD, AIM, business intelligence and DBMS). This trend leads to faster growth opportunities in markets such as integration, databases and application platforms. In fact, through 2025, the PaaS market is projected to almost triple in size from $46.3 billion to about $134.0 billion (see *Forecast: Public Cloud Services, Worldwide, 2019-2025, 2Q21 Update*).

More than 20 cloud platform capabilities are delivered as specialized PaaS offerings. Organizations use the database, AD, integration, analytics, IoT, event, API management and other platform services to digitize their businesses. Some PaaS offerings are fully managed (that is, opaque, serverless); others leave some infrastructure controls open to the customer for fine-tuning.

As vendors move to a cloud-first or cloud-only delivery model, several PaaS technologies are advancing rapidly and have become pervasive. Yet, even in cloud-only scenarios, the potential for multicloud providers raises an even more complex set of requirements. Technologies and capabilities like APIs, in-memory data and multitenancy have become more pervasive throughout PaaS. Because these are really more delivery platforms than technologies, they can move rapidly to and off the plateau.
Furthermore, both IaaS (Amazon Web Services [AWS], Google, Microsoft) and SaaS (Oracle, Salesforce, ServiceNow) megavendors are increasingly putting forth PaaS efforts. Customers turn to strategic cloud platforms for more business initiatives, and we are seeing continual progression of PaaS-related technologies toward the Plateau of Productivity on this year’s Hype Cycle.

Many PaaS vendors and platforms are proven in enterprise IT. Some PaaS vendors are specialists to one particular flavor of PaaS, but many support multiple service capabilities (albeit often with limited integration or API standardization). Application leaders developing cloud computing strategies must expect continued diversity across all PaaS types and cloud providers, which means also embracing a suitable composition strategy to mitigate this challenge — what technology will you use to consume these PaaS types?

For more information about how peer infrastructure and operations (I&O) leaders view the technologies aligned with this Hype Cycle, see 2021-2023 Emerging Technology Roadmap for Large Enterprises.

The Hype Cycle

This Hype Cycle is designed to help organizations understand the hype in the PaaS market and judge to what degree the stated benefits of various cloud platform innovations match the realities of user experience and vendor capabilities. Application leaders and cloud strategy planners are required to deliver cloud-based applications and services that meet the demands of modernization and digital business. However, some PaaS services still display overhyped capabilities, leading to overblown, unrealistic expectations. Therefore, this Hype Cycle introduces the most recent innovations in the cloud platform space and indicates which technologies have become a safe mainstream choice. It also indicates those that are still immature and, as a result, offer earlier opportunities for business differentiation.

Some PaaS capabilities are offered as specialist services, such as cloud robotic process automation (RPA) PaaS; others are assembled into multifunctional platforms, such as integration platform as a service (iPaaS); and yet others are offered as comprehensive cloud infrastructure and platform services (CIPS) megasuites.
Gartner tracks over 20 types of PaaS (xPaaS), including application PaaS (aPaaS), integration PaaS (iPaaS), API management and event brokering services, serverless function PaaS, business analytics PaaS (baPaaS), Internet of Things (IoT) PaaS and database PaaS (dbPaaS). PaaS capability can be delivered multicloud, multitenant or dedicated. These specialized PaaS capabilities (xPaaS) are offered as special-purpose platform services and include application, integration, database, IoT and event processing.

With the breadth of available options in PaaS, naturally the spectrum of maturity varies greatly. Early innovations like serverless and blockchain and in-memory data grids have been adopted enough to be in a transition between hype and production. Some categories are reaching the Peak of Inflated Expectations (such as knowledge graphs and cloud data ecosystems), while others are approaching full mainstream maturity (notably, PaaS as a whole). Everything on the right of the Trough of Disillusionment is becoming real: In particular, blockchain and serverless are being adopted and gaining momentum on the way to the next maturity stage. Event stream processing will become mainstream in the next few years. Newer technologies such as SaaS as a platform (SSP) and distributed cloud are still near the Innovation Trigger, but the cloud delivery of platform technology is slowly becoming the default in technology selections.

In 2021, the number of innovation profiles at the Innovation Trigger stage to the left of the Peak is still a noticeable nine, while several sizable, in terms of revenue generated, PaaS segments (e.g., database platform as a service) have already reached maturity and mainstream status and are therefore off the Hype Cycle.
The Priority Matrix

PaaS is a powerful enabler of the maturity of cloud as a platform, which translates to greater mastery of technology across the enterprise. This trend is shifting central IT toward the role of a service to business organizations — competing and cooperating with cloud service providers to deliver the greatest cumulative service to their business. Many cloud platform offerings are low-code — that is, they can be used with minimal or no programming, instead of relying on modeling and other nonprocedural expressions of business logic. This brings to the cloud platform new types of software engineers and business technologists, making PaaS an integral part of the business-IT collaboration.

Some notable observations emerge from the 2021 Priority Matrix for PaaS innovations:

- Cloud has become the de facto delivery model for some types of platforms, and “cloud-first” or “cloud-only” has become the norm.
- The majority of PaaS-related innovations will reach or approach maturity during the next five years.
One of the core trends in PaaS is an increasing emphasis on high productivity. This means that the increasing maturity of PaaS will be less skill-constrained, as well as translating to increasing IT in lines of business (LOBs). To manage this change, central IT in leading organizations will need to adopt an IT brokerage posture toward the business and develop its technology strategy in collaboration with the business. As a result, LOBs will attain a new level of self-service, while IT will remain engaged to preserve the overall integrity, efficiency and compliance of the organization's information processing and systems of record.

During the next five years, as more PaaS components reach maturity, the application business will increasingly experience the transformational impact of PaaS. This maturity will increase the pressure to maximize PaaS and transform related processes, technologies, skills and organizational strategies.

- Intelligence and automation are peaking.
- Individual xPaaS and other PaaS-related innovations can have only moderate to high industry impact ratings when viewed on their own.
- Some xPaaS types have high levels of benefit due to the increased availability and serviceability of the technology through cloud delivery.
- Combinations of xPaaS can be transformational in application capability and delivery speed, enabling new digital business models.
Table 1: Priority Matrix for Platform as a Service, 2021
(Enlarged table in Appendix)

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<th>Benefit</th>
<th>Years to Mainstream Adoption</th>
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<td>Less Than 2 Years</td>
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<td>Transformational</td>
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<td>Low</td>
<td>Serverless iPaaS</td>
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Source: Gartner (August 2021)
On the Rise

SaaS as a Platform

Analysis By: Paul Vincent, Fabrizio Biscotti, Yefim Natis

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Emerging

Definition

SaaS as a platform (SSP) provides an integrated comprehensive business platform comprising a unified stack of SaaS-based packaged business capabilities, exposed as building blocks through APIs and/or event channels, and a low-code composition platform to facilitate new capabilities and experiences.

Why This Is Important

SaaS megavendors consume increasing proportions of IT budgets while providing both out-of-the-box business capabilities, and increasing extensibility for new and custom use cases for their customers. The combination of scalable SaaS business capabilities, information access via APIs, and low-code workflow and user interface tooling is increasingly popular among enterprises.

Business Impact

The SSP offerings are already disrupting the IT business: Salesforce attaining revenue of $13 billion faster than any other software company demonstrated the value of SSP. These SaaS offerings are already considered by many as a strategic platform. SSPs and their ecosystem partners are providing more packaged business and composition capabilities every year, displacing smaller specialized vendors across SaaS, PaaS and application development markets. This adoption curve is likely to grow.

Drivers
SSP provides a unified business platform equating to a combination of SaaS+PaaS, including notably a composition capability through low-code application platform (LCAP) and integration PaaS (iPaaS) tooling. SaaS megavendors provide sets of business services or packaged business capabilities, along with a default user experience, API and/or event channel access to their services, and PaaS capabilities around application, data and user interface. The prime example is Salesforce, which has achieved No. 1 market status in customer relationship management as well as No. 2 status in application infrastructure and middleware services, and is therefore easily No. 1 in SSP.

SSP vendors overlap, albeit incompletely, and are in increasing competition across their SaaS services. They may participate in specific markets through their ecosystem of partners rather than directly. Their approach to their PaaS services, like data, integration and user multiexperience, varies from customizable prebuilt services to complete frameworks and toolkits competing in those markets as separate offerings. The competitive nature of their SaaS drives the innovation and capabilities of their low-code development tooling, enabling enterprise users to consume new technologies as they are delivered by their SaaS providers through APIs.

The wide-scale adoption of these SaaS solutions by business IT teams, together with the desire for differentiation on top of their commodity services, is driving the growth of the SSP model. Business leaders are less concerned with cloud infrastructure details/benefits of pro-code development, and more about application productivity and availability, making SSP a popular choice to extend SaaS investments into digital business initiatives. Customers are recognizing the value of a specific application ecosystem sharing data and services. Hype is low but increasing around SSPs as their adoption evolves from departmental to strategic and enterprise.

**Obstacles**

The strategic SSP concept, providing customers with an integrated (typically one vendor) solution for standard business capabilities (SaaS) and new differentiating service applications (enabled by developer tools like LCAP, business process automation, integration and design systems), provides a customer dilemma:

- Strategic SaaS vendor investment versus best-of-breed solution selection and integration.
The platform components of SaaS vendors are often incomplete, such as around compositability, component catalogs, real-time events and decision management.

SaaS vendors themselves often have an incomplete portfolio, requiring multiple vendors across CRM, ITSM, ERP, financials, HR, etc., with associated higher costs.

Hype is low but increasing around SSPs as their adoption moves from departmental to strategic and enterprise; there is still little recognition from CIOs as to their commitment to the SSP model.

**User Recommendations**

CIOs and IT leaders investigating the strategic selection of composable SaaS+PaaS platforms will likely already be a customer of some of them.

- Understand the implications of a single platform versus best-of-breed approach for applications and platforms. For many, the selection of a SSP will be to increase automation capabilities, yet multiple integration standards across SaaS will add problems.

- Ensure the SSP vendor being considered can demonstrate the desired characteristics of a unified SaaS+PaaS platform. Its SaaS services must be readily extendable to create new and custom applications via APIs, and its integration capabilities must be either strategic in scope or replaceable with a strategic integration solution.

- Beware of legacy vendors that provide SaaS on multiple underlying platforms and architectures with disparate API styles, which increase operational management costs and complexity of reuse.

- Be wary of high costs associated with menu-driven pricing for these platforms, and mitigate that through contract best practices.

**Sample Vendors**

Creatio; IngageApp; Microsoft; Oracle; Pegasystems; Salesforce; SAP; ServiceNow; Zoho

**Gartner Recommended Reading**

*Emerging Technologies and Trends Impact Radar: 2021*

*Identify and Evaluate Your Next Low-Code Development Technologies*
Solution Path for a SaaS Adoption Framework

Emerging Technology Horizon for Enterprise Software

Distributed Cloud

Analysis By: David Smith, Daryl Plummer, Milind Govekar

Benefit Rating: High

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

“Distributed cloud” refers to the distribution of public cloud services to different physical locations, while operation, governance, updates and evolution of the services are the responsibility of the originating public cloud provider.

Why This Is Important

Distributed cloud enables organizations to use cloud computing wherever needed with consistency while the cloud service provider retains the burden and responsibility of managing the technology, implementation and evolution of the capabilities. It gives organizations the flexibility to support use cases that will benefit from the power of cloud services. Organizations can use distributed cloud to reimagine use cases where cloud computing is not currently feasible at the location desired.

Business Impact

A major notion of the distributed cloud concept is that the provider is responsible for all aspects of delivery. This restores cloud value propositions that are broken when customers are responsible for a part of the delivery, as is true in some hybrid cloud scenarios. The cloud provider must take responsibility for how the system is managed and maintained. Otherwise, the value proposition of distributed cloud is compromised.
Drivers

Distributed cloud computing is a style of cloud computing where the location of the cloud services is a critical component of the model. Historically, location has not been relevant to cloud computing definitions. In fact, the variations on cloud (e.g., public, private, hybrid) exist because location can vary. While many people may claim that private cloud or hybrid cloud requires on-premises computing, this is a misconception. Private and hybrid cloud do not require that the private components are in any specific location. With the advent of distributed cloud, location formally enters the definition of a style of cloud services.

Drivers include:

- In hyperscale public cloud implementations, the public cloud is the center of the universe. There has been distribution of cloud services through worldwide regions in public cloud practically since its inception. The major hyperscale cloud providers have different geographic regions around the world, and all are centrally controlled and managed, and provided by the public cloud provider.

- Distributed cloud supports tethered and untethered operation of like-for-like cloud services from the public cloud “distributed” out to specific and varied physical locations. This enables an important characteristic of distributed cloud operation — low-latency compute where the compute operations for the cloud services are closer to those that need the capabilities. This can deliver major improvements in performance as well as reduce the risk of global network-related outages.

- Data sovereignty and other regulatory issues.

- Perceived and real security and privacy concerns with off-premises applications and infrastructure.

- Latency needs of IoT/edge applications.

- Disconnected operations.

Obstacles

Customers can’t abandon existing technologies in favor of complete and immediate migration to the public cloud. Sunk costs, latency requirements, regulatory and data residency requirements, and even the need for integration with noncloud, on-premises systems hold them back. Some obstacles include:
Different approaches to distributed cloud have different value propositions (portability approach, software approach, appliance approach).

Distributed services are a relatively small subset of the providers centralized services today and will take time to expand. They will never reach 100% parity.

Distributed cloud running in your data center will inherently have limits to scale and elasticity that do not exist with the centralized public cloud.

More-advanced approaches like distributed cloud embedded in networking or telecom equipment or delivered as metro area services are very immature.

User Recommendations

- Adopt distributed cloud by overcoming the fear of a single franchise controlling the public cloud and on-premises cloud estates.
- Use the distributed cloud model to prepare for the next generation of cloud computing by targeting location-dependent use cases (such as low latency, tethered scale and data residency) that are enhanced by using a distributed cloud model.
- Identify scenarios where distributed cloud use-case requirements can be met by evolution of a hybrid cloud model and where the requirements are substantially different.

Sample Vendors

Amazon Web Services; Google; IBM; Microsoft

Gartner Recommended Reading

Top Strategic Technology Trends for 2021: Distributed Cloud

‘Distributed Cloud’ Fixes What ‘Hybrid Cloud’ Breaks

The Cloud Strategy Cookbook, 2021

Decision Management PaaS

Analysis By: Paul Vincent, W. Roy Schulte

Benefit Rating: Moderate
Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition
Decision management platform as a service (dmPaaS) refers to a cloud platform that manages the design, maintenance, governance and deployment of structured executable decisions. Structured decisions are explicit decision models representing the decision-making process, including data or event inputs, decision logic and results.

Why This Is Important
Business performance is dependent on good decision making, and for repeatable operational decisions this decision-making performance is increasingly critical for competitive and compliance reasons. The growth of artificial intelligence (AI) and machine learning (ML) services supports the need for managed and governed operational decisions, with increasing exploitation of cloud services ensuring dmPaaS is growing in importance.

Business Impact
dmPaaS in the cloud can:

- Improve business performance for automated or assisted decision making while exploiting cloud benefits of scale and cost predictability.
- Assist with management decision making against operational decisions, as some decision management solutions now include business simulation environments.
- Provide frameworks for supporting and quantifying the benefits of AI/ML initiatives to improve specific operational decisions.

Drivers
Decision management in the cloud (dmPaaS):

- Supports enterprises’ need for better-organized, optimized and auditable approaches for decision automation, as they increase straight-through processing of business systems with an increasing amount of legislation and business competitiveness.
Aligns decision automation with increasingly cloud-based AI and ML services. These focus on providing better decisions but, in turn, benefit from a structured approach to their exploitation by managing the executable decisions to which they apply: exploiting predictive models, analytics, ML-driven score models, optimization mechanisms and other advanced decision capabilities.

Extends business rule management to support decisions, and decision engineering, as first class artefacts and practices that are closer to the needs of business and IT leaders. The potential of portable models of rulesets, decision tables and decision trees is being recognised by some IT leaders, while decision management in the cloud is enabling governance of decisions and their embedding across different technology stacks.

Features in the portfolios of major decision automation and business rule management system (BRMS) vendors that now support the cloud for development and/or delivery. The use of portable Decision Model and Notification (DMN) models has enabled a separation between decision analysis (business decision modelling using tools like Signavio and Trisotech) and decision execution (such as Camunda, Flowable and Red Hat).

Obstacles

Decision management in the cloud:

- Remains an underexplored area between business governance and software engineering, with the concept of decision engineering unknown to many IT and business leaders outside of the financial sector.

- Continues to have low levels of support for decision modelling standards such as DMN. Neither major AI cloud providers, like AWS and Google, nor major decision management vendors, support industry standardization.

- Continues to be sidelined by legacy practices such as manually coded business logic for decision-rich services, despite the risks and costs of decision errors in digital businesses. This is due to both poor understanding on the benefits of decision management, and perceived lack of value, particularly due to the historical high cost of proprietary decision management solutions.

User Recommendations

CIOs, CTOs and software engineering leaders should:
Choose dmPaaS when they need the ease of consumption of a cloud service to either deliver better:

- Decision visibility
- Decision complexity
- Rigor and structure to AI and ML initiatives
- Transparent governance and risk management for automated decisions

Evaluate dmPaaS as a plug-in API-enabled upgrade to the native business-rule capabilities embedded in platforms, such as for business process automation or low-code application platforms, when needing better decision management capabilities.

Examine, for operational decision improvements, their wider decision strategy and how dmPaaS can support business DigitalOps and hyperautomation, while exploiting cloud or hybrid decision service solutions.

Beware of vendor lock-in. Mainstream vendors have limited or incomplete support for decision model standards (e.g., DMN and Predictive Model Markup Language [PMML]). Portability of decision logic across mainstream vendors remains uncommon.

Sample Vendors
ACTICO; Camunda; Experian; FICO; IBM; InRule; Progress; Sapiens International Corporation; Signavio; Sparkling Logic

Gartner Recommended Reading

Toolkit: Decision Management Suite Vendor Profiles
How to Choose Your Best-Fit Decision Management Suite Vendor
Should Your Project Use a Decision Management Suite?
Identify and Evaluate Your Next Low-Code Development Technologies

API-Centric SaaS

Analysis By: Yefim Natis, Mark O’Neill, Anne Thomas

Benefit Rating: High

Market Penetration: 1% to 5% of target audience
Maturity: Emerging

Definition
API-centric ("headless") SaaS is a cloud application service that is offered primarily or entirely for programmatic access via APIs or event subscriptions. Some user experience may be provided, but the strategic intent for API-centric SaaS is to be used as a business capability, programmatically packaged for application composition, development and integration.

Why This Is Important
Increasingly, businesses seek a greater role in defining their digital experiences. API-centric SaaS enables customers to define their differentiated application experiences instead of being bound to the user experience packaged by the vendor. API-centric SaaS allows capabilities such as payments or mapping to be used within larger applications. Although as an application (SaaS), the API-centric SaaS is packaged for use in development platforms (PaaS), blurring the boundaries of SaaS and PaaS.

Business Impact
Business organizations that are equipped to capitalize on API-centric SaaS can create new application experiences for their employees and customers through composition of those prepackaged business capabilities, giving them an opportunity for faster, safer and more efficient business innovation. API-centric SaaS is also a base for fast-paced innovation by startups and other software vendors, contributing to the increasing pace of digital business change.
Drivers

- The patterns of software innovation have embraced integration and composition to a degree that application vendors that want to be included must offer their services, at least optionally, as libraries of API-enabled functional capabilities.

- The technology and skills for integration, including management of APIs and event streams, are widespread, allowing some leading businesses to package their business capabilities behind APIs for customers’ and partners’ customized use. API products serve that purpose.

- The demands for the depth of customization of applications in business organizations have evolved to the point that SaaS vendors must allow rearrangement of their business functionality by the customers. API SaaS serves that purpose.

- Increasing use of digital twin architecture in IoT application design serves as the early experience of utilizing API-packaged business capabilities, preparing organizations’ skills and technologies for the use of the similarly designed and encapsulated API-centric SaaS.

- Many older applications are used as if “headless” by businesses accessing them via API and foregoing the vendor-defined user experiences. This prepares organizations’ skills and technologies to include the API-centric SaaS capabilities into their application development experience.

- Business application design has become significantly partitioned into the back-end functionality with its APIs and the front-end multiexperience user interface, each side created using different tools and design expertise. Some business-oriented application vendors find it convenient to concentrate on the back-end data and business logic and leave the finalized user experience to separate teams, including the customer’s own developers.
Obstacles

- API-centric SaaS is a relatively new phenomenon, when compared to the conventional SaaS offerings. There are not enough dedicated development tools or trained software engineering teams to assure the right balance of cost and value of adopting it.

- API-centric SaaS offers business capabilities, typically delivered as a collection of multiple APIs, but most leading marketplace technologies are designed to manage only the individual APIs, making the discovery and governance of such packaged business capabilities more difficult.

- Minimal or fully absent user interfaces packaged with an API-centric SaaS assume and require that the customer implement their own differentiated application and user experience. What is a welcome opportunity for innovation for some can be a burden to others, inhibiting the wide-spread adoption and API-centric SaaS.

User Recommendations

- Give preference to SaaS offerings that expose more of their business capabilities as API and/or event streams.

- Plan for gradual shift of development to composition and integration of API-centric packaged business capabilities.

- Ensure clean separation of the back-end business logic and the front-end user experience in all applications, to maximize future benefits of the composable application experiences.

- Avoid vendor applications that lock your organization into their user experience technology.

- Give preference to low-code and pro-code PaaS offerings that are well-equipped for access to external API and event marketplaces.

- Practice use of API marketplaces in preparation to greater adoption of API-centric SaaS and API products.

- Watch for opportunities to experiment by offering some of your business capabilities as priced API products.

Sample Vendors

Algolia; Alloy; Clearbit; Cloudinary; Lob; MessageBird; Plaid; Strapi; Stripe; Twilio
Gartner Recommended Reading

Create API Portals That Drive API Adoption Among Internal and External Developer Communities

Kick-Start Your Composable Business Journey With 2 Key Strategies

Gartner’s API Strategy Maturity Model

Top Trends in Cross-Industry Open APIs for Product Leaders at Banking TSPs for 2021

Choose the Right API Monetization and Pricing Model
At the Peak

Cloud-Native

Analysis By: David Smith

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

Cloud-native refers to something created to enable or leverage cloud characteristics. Those cloud characteristics are part of the original definition of cloud computing and include capabilities delivered as a service that are scalable and elastic, metered by use, service-based, ubiquitous by means of internet technologies, and shared.

Why This Is Important

Cloud-native is a very popular term. Depending on what its meaning is, it can be described taking full advantage of cloud capabilities of a cloud provider, or using approaches pioneered in the cloud to deliver benefits wherever needed via specific technologies such as containers.

Business Impact

Cloud-native is a popular and hyped concept today because many organizations using cloud have not fully realized the benefits they expected from cloud. For example, if a traditional, noncloud application is migrated to cloud using a lift-and-shift approach, the application is unlikely to leverage cloud characteristics and deliver the full benefits of cloud. If an application is rewritten to take advantage of cloud capabilities, then it is more likely to deliver the expected cloud outcomes.

Drivers

- The primary driver for cloud-native is a desire to “get the most out of cloud.” As cloud itself means different things to different constituencies, it is not surprising that this can mean different things. What drives people to one or another of these approaches varies.
Cloud-native, to deliver cloud characteristics, has potential to enable maximum 
leverage of the cloud technologies and benefits. Note that the two most common 
meanings in use are quite contradictory. One (CSP-native) is all about using native 
features and, therefore, locking yourself into the provider. The other (container-
native) is all about containers, which don't guarantee portability but are directionally 
consistent with the goal. There is also another usage — cloud-native architecture — 
which refers to principles such as LIFESPAR and 12-Factor Apps.

Cloud-native is a concept that is not binary. Rather, it can be expressed in degrees. 
The more something aligns with core cloud characteristics, the more we consider it 
to be cloud-native and the more cloud-native outcomes the thing will produce.

Cloud-native can be viewed on a continuum. It's not a question of whether 
something is cloud-native or not, it's the degree to which it is so. The more it aligns 
with relevant principles (aka cloud principles), the more cloud-native it is.

Organizations should make informed decisions regarding the extent to which they 
invest in cloud-native for traditional workloads and processes. The investment 
required to move existing applications to become “cloud-native” may not be worth 
the expense in some cases.

Obstacles

Cloud-native is particularly challenging with respect to hype because confusion 
amplifies hype. The biggest obstacle is getting beyond the confusion to focus on 
desired outcomes.

It is essential to be realistic about what portability can actually be achieved, and at 
what cost. Otherwise it couldn't be ensured that these features are used “with your 
eyes open,” and that you are aware that you are doing so.

In cloud strategy efforts, principles are the most important component. Cloud-native 
and multicloud are often stated as principles in a cloud strategy. These principles 
can contradict each other and further explanation is required in that case.

When using the term cloud-native, it is, therefore, imperative that there is clarification 
of which meaning is being used. Sorting out the definitions and being clear about 
goals are key to leveraging cloud-native.

User Recommendations
Focus on the outcomes you want from using cloud rather than focusing purely on the definition of cloud-native. The more your use cases align with the core cloud attributes, the more likely you are to recognize the full benefits of using cloud.

Assess vendor claims about their cloud-native capabilities with skepticism. Vendors use the term “cloud-native” to promote their offerings regardless of how cloud-native their offerings may be.

Ensure that the supporting tools, processes and operations support the cloud characteristics when building or acquiring cloud-native applications or services. The value of cloud-native applications can be subverted when supporting elements are not cloud-native in their approach.

Embrace services design to bring you closer to cloud-native outcomes. This can include the use of containers, microservices architecture, serverless design, functions and many PaaS services. Use of these technologies should, however, be a means, not a goal.

Gartner Recommended Reading

The Cloud Strategy Cookbook, 2021

Define and Understand New Cloud Terms to Succeed in the New Cloud Era

Event Broker PaaS

Analysis By: Yefim Natis, Keith Guttridge

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

Event broker platform as a service (ebPaaS) plays the role of the intermediary in event-driven architecture (EDA), configuring the event topics, registering event publishers and subscribers, facilitating capture and distribution of event notifications. Event brokers are built on message-oriented middleware (MOM, also known as message brokers) that delivers the essential publish-subscribe capability, then extended with additional EDA-oriented mediation and governance capabilities.
Why This Is Important

Most of the outcomes of digital business transformation depend, in part, on an organization's continuous awareness of relevant business events and its ability to respond in business real time. Event broker services facilitate detection and distribution of event notifications to application services for automated response, dashboards for human action or data stores for further analysis. The alternative to the use of a broker is custom design, which is less effective, more expensive and a higher risk.

Business Impact

Organizations that are aware of their relevant business ecosystem events are better prepared to manage unexpected interruptions and capitalize on opportunities in business moments. They are equipped for broadcasting notable events for simultaneous, multitargeted response. Event broker services enable organizations’ versatility in monitoring multiple sources of events and communicating to many responders in parallel, with strong scalability, integrity and resilience.
Drivers

- Increased demand for real-time insights drives organizations to manage event streaming and stream analytics, leading in turn to event brokers for governance and coordination of event traffic.

- Increased adoption of Apache Kafka, by both businesses and leading technology vendors, promotes organizational awareness of the benefits and opportunities that event-driven application design brings.

- The migration of business applications to the cloud demands new platforms and communication infrastructure, driving many organizations to evaluate and adopt event broker services, paired with integration and API management offerings.

- The availability of multiple vendors’ ebPaaS, based on open-source standards such as Pulsar, Kafka, NATS, MQTT and AMQP, provides competitive and differentiated options in event broker services for better-tuned fit to customers’ use cases.

- Increased maturity of ebPaaS offerings supports more advanced capabilities in performance, data and process management, and optimization of event-driven applications.

- Most leading SaaS offerings support some event processing, increasing awareness of benefits and opportunities of event-driven application design in a large number of mainstream business and government organizations.

- Open-source event brokers are easier to operate and scale, reducing the cost of early experimentation with event-driven architecture and attracting more start-ups and other advanced software engineering teams.

- The increasing popularity of digital integration hubs and other data consolidation approaches gets the near-real-time data accuracy when consuming event streams, instead of database lookups.
Obstacles

- Desire to keep control of all aspects of infrastructure deployment leads some organizations to manual implementation of event-driven communications.
- ebPaaS offerings become too expensive as more proprietary features are added to help differentiate from the competition.
- Event broker functionality, embedded in some platform and application services, fragments control of event streaming across the organization, while delaying a systematic investment in event brokering.
- Some software engineering teams use webhooks and websockets tools to set up event notifications, delaying the full many-to-many experience of EDA that's implemented via an event broker technology.
- Lack of universally supported standards for protocols or APIs for EDA implementation increases costs and complexity of managing a large event-driven application infrastructure.

User Recommendations

- Apply the complementary strengths of service-oriented architecture (SOA) and EDA, and encourage every new project to consider the combined use of both, as appropriate in advanced mesh app and service architecture (MASA).
- Pilot experimental projects using event brokers to gain insight and skills for the upcoming more advanced projects. Even a basic pub/sub middleware service is sufficient as a precursor for a full-featured event broker.
- Give preference to ebPaaS vendors demonstrating the understanding of the full life cycle of event brokers’ functionality and responsibility.
- Plan for coordinated use of an event broker and a stream analytics platform. The technologies are different and are used in combination in most advanced event broker use cases.

Sample Vendors

Amazon Web Services (AWS); Confluent; Google; IBM; Microsoft; Solace; TIBCO Software; Vantiq
Gartner Recommended Reading

Innovation Insight for Event Thinking
Innovation Insight for Event Brokers
The 5 Steps Toward Pervasive Event-Driven Architecture
The Impact of Event-Driven IT on API Management
Applying Event-Driven Architecture to Modern Application Delivery Use Cases

Choosing Event Brokers: The Foundation of Your Event-Driven Architecture

**PaaS in HCM**

**Analysis By:** Chris Pang

**Benefit Rating:** Moderate

**Market Penetration:** 5% to 20% of target audience

**Maturity:** Adolescent

**Definition**

Platform as a service (PaaS) allows a cloud human capital management (HCM) vendor to selectively expose APIs and native development tools for application extensibility. This allows for easier integration between HCM applications and complementary solutions. It also allows for the creation of “last mile” or custom application functionality which inherits the native properties of the HCM SaaS application (security model, user experience, workflow, reporting and so on).

**Why This Is Important**

Despite the breadth of functionality in modern cloud HCM suites, most customers need to augment delivered capabilities with bidirectional integration to third-party or in-house built systems. Customers also tend to have some very specific functional/process needs that can’t be easily configured in the standard application. While HCM vendors have wide ranging functional roadmaps, it is neither possible nor desirable for them to create and support every requirement needed by every customer.

**Business Impact**

PaaS in HCM helps end customers get a more “complete” solution which integrates with other applications and/or delivers extended functionality which acts and appears as a native component of the HCM suite. For closing simpler functionality gaps, PaaS can be more economical than buying and integrating a third-party application.
Drivers

- The desire of end-user organizations for functionality, not addressed by HCM vendor product roadmaps.
- The need for customers to create integrations and custom-made functionality that are “upgrade safe.”
- HCM PaaS capabilities continue to evolve, and these tools are becoming more sophisticated in what they allow skilled administrators to do.
- Professional services providers are increasingly utilizing HCM PaaS to develop their own packaged intellectual property (IP) and services for customers.
- Large HCM suite providers are maturing and adding to their PaaS capabilities, thus resulting in more marketing and “starting” points for PaaS situations.
- Established and curated marketplaces with numerous prebuilt PaaS extensions are available.

Obstacles

- HCM PaaS is not intended to allow complete freedom of customization. So there will be limitations as to what is possible.
- Limited end customer awareness and understanding of HCM PaaS capabilities.
- Limited availability of skilled implementation/consulting resources in HCM PaaS.
- Customers that decide they can “do without” until their HCM vendor adds their desired functionality into core functionality.
User Recommendations

- Use PaaS to support processes that are not possible through configuring the underlying SaaS application and/or when using a third-party point solution is not ideal — due to cost, integration complexity or functional fit.

- Ensure resources involved in HCM PaaS (internal IT, business analyst or external resource) are trained/certified in the use of PaaS tools, and maintain their certifications as these tools evolve over time.

- Determine if the use of HCM PaaS will be temporary (one to three years) or more permanent (over three years) by comparing your needs with the vendor's roadmap. Allocate effort and set internal expectations accordingly.

- Budget for additional training and support resources because PaaS extensions will require ongoing integration, maintenance and potential evolution work.

- Review new functionality made available for general use annually, to ascertain if existing PaaS extensions can be streamlined or removed, and/or if new opportunities for PaaS scenarios arise.

Sample Vendors
Ceridian; Oracle; SAP; UKG; Workday

Gartner Recommended Reading

What You Need to Know About HCM Platform as a Service

Top 10 Trends in PaaS and Platform Innovation, 2020

Hype Cycle for Platform as a Service, 2020

Top 10 Trends in PaaS and Platform Innovation, 2020

Platform as a Service: Definition, Taxonomy and Vendor Landscape, 2019

Cloud Data Ecosystems

Analysis By: Adam Ronthal

Benefit Rating: High

Market Penetration: 1% to 5% of target audience
Maturity: Emerging

Definition
Cloud data ecosystems provide a cohesive data management environment that ably supports the whole range of data workloads, from exploratory data science to production data warehousing. They have a common governance and metadata management framework, unified access management, and integrate augmented data management capabilities with a set of services accessible by the business user. Operational data sources also participate in data ecosystems.

Why This Is Important
Data and analytics leaders report that the cloud experience today requires a significant integration effort to ensure that components work well together. Cloud service providers (CSPs) and independent software vendors (ISVs) are responding with more refined cloud data ecosystems as the market moves from “some assembly required” to a packaged platform experience. They provide streamlined delivery and comprehensive functionality that is straightforward to deploy, optimize and maintain.

Business Impact
The integration of augmented data management capabilities to streamline the delivery of data and analytics to the business in a unified offering is an attractive proposition. These offerings promise to unify the exploratory world of data science with the production delivery of data warehouses. They promise to unify operational and analytics systems with a holistic management framework. They address key data management disciplines such as data integration, data sharing, governance and metadata.
Drivers

- Data and analytics architectures are under significant stress on two fronts: hybrid and multicloud deployment environments, and the diversity of data persistence models required to meet the increasing demands of data and analytics.

- Data and analytics leaders are seeking to resolve data silos, which now span multiple deployment environments and frequently require different and potentially conflicting operating models.

- At the same time, enterprises are looking to unify the way they engage with different data models, platforms and use cases.

- Data ecosystems serve as a unifying approach to resolving these pressure points. Built on a common foundation of governance and metadata, they enable new practices like DataOps, and new architectures like the emerging data fabric. Infused with AI and ML capabilities, they will become self-optimizing and self-tuning, and support financial governance efforts through cost optimization.

Obstacles

- While cloud data ecosystems have a vision of unifying data and analytics environments (exploratory analytics and production delivery, operational systems, and analytics systems) with common governance, security and metadata, there is still significant work needed to make this a reality. Gaps exist in data integration, data quality, metadata and governance. These will need to be addressed either through native CSP offerings or partnerships with ISVs to fully realize the vision of the cloud data ecosystem.

- When combining native CSP offerings with third-party ISV offerings, data and analytics leaders may find additional effort is required to integrate these components. This undermines the core concept of a unified, holistic data ecosystem. While CSPs are working with third-party ISVs to provide open ecosystems, their initial focus remains on ensuring that their own components are working well together, and a more polished experience for both ISV and CSP offerings may be delayed.

User Recommendations

Data and analytics leaders will need to assess the maturity of these offerings, and the degree to which they deliver on the promise of a unified environment. End users report that cloud data ecosystems are still early in their maturity, with new features and capabilities emerging on a regular basis. Early adopters should be sure to:
Assess points of integration between various components to determine how cohesive the resulting ecosystem is. A less cohesive ecosystem will require significantly more integration time and effort.

Ensure that your cloud data ecosystem has a well-articulated path to production for the full data life cycle (from discovery to production-optimized delivery).

Define what you expect CSPs to deliver as part of the solution, and what capabilities you expect to obtain from third-party ISVs; expect to spend more time on integration efforts when combining CSP and ISV offerings.

**Sample Vendors**
Amazon Web Services; Cloudera; Databricks; Google Cloud Platform; IBM; Microsoft; Oracle; SAP

**Gartner Recommended Reading**

*Cloud Data Ecosystems Emerge as the New Data and Analytics Battleground*

**Knowledge Graphs**

*Analysis By: Afraz Jaffri*

**Benefit Rating:** High

**Market Penetration:** 5% to 20% of target audience

**Maturity:** Adolescent

**Definition**

Knowledge graphs are data structures, representing knowledge of the real world including entities (people, companies, digital assets, etc.) and their relationships, which adheres to a graph data model — a network of nodes (vertices) and links (edges/arcs). The knowledge within the graph can be explicitly stated or implicitly inferred using rules that are defined in an ontology for classes of entities and relationships. Further knowledge can be derived using graph analytics and machine learning.
Why This Is Important

Knowledge graphs capture information about the world in an intuitive way that is often easier to understand, manipulate and use than other types of data models. Google, Facebook, Amazon and other tech companies use graphs as the backbone of a number of products and services due to their ability to encode and interrelate disparate data at source. They support collaboration and sharing, search and discovery, and the extraction of insights through analysis.

Business Impact

Knowledge graphs can drive business impact in a variety of different settings including:

- Digital workplace (e.g., collaboration, sharing and insight).
- Automation (e.g., ingestion of data from content to RPA).
- Machine learning (e.g., augmenting training data).
- Investigative analysis (e.g., law enforcement, cybersecurity or financial transactions).
- Digital commerce (e.g., product information management and recommendations).
- Data management (e.g., metadata management, data cataloging and data fabric).
Drivers

- Ongoing digitization and globalization initiatives lead to growing levels of complexity and dynamics, creating a need for more adaptive and integral approaches, as offered by knowledge graphs, replacing more static and siloed approaches.

- Increasing awareness of the use of knowledge graphs in consumer products and services such as smart devices and voice assistants, chatbots, search engines, recommendation engines and route planning.

- Improvements in graph DBMS technology that can handle the storage and manipulation of graph data structures at scale. This includes PaaS offerings that take away the complexity of provisioning and optimizing hardware and infrastructure.

- Knowledge graph platform providers are entering the market that provide a suite of tools for creating, managing and using knowledge graphs. Low/no-code tools are developing and expanding the use of knowledge graphs to business and nontechnical users.

- The desire to make better use of unstructured data held in documents, images and videos using standardized metadata that can be related and managed.

- The need to manage the increasing number of data silos where data is often duplicated and usage and consumption cannot be controlled.

- The increasing use of graph algorithms and machine learning to identify influencers, customer segments, suspicious activity and critical bottlenecks in complex networks.

- Service providers are specializing in knowledge graph implementation and building offerings based on the technology.
Obstacles

- Awareness of knowledge graph use cases are increasing but business value is difficult to capture in the early stages of implementation making them low priority initiatives.

- Moving knowledge graph models from prototypes to production requires engineering and system integration expertise. Methods to maintain knowledge graphs as their size increases to ensure reliable performance and handle duplication and data quality remain immature.

- Fragmentation of the graph DBMS market across the types of knowledge graph data models (RDF or property), implementation architectures (native or multimodal) and differences in optimal workloads (operational or analytical) continue to cause confusion and hesitancy among adopters.

- Key to the long-term success of knowledge graphs is enabling data within organizations to be interoperable with external knowledge graphs to enable the ingestion, validation and sharing of ontologies and data relating to entities e.g., geography, people, events, etc.

User Recommendations

- Identify use cases where there is a need for custom-made knowledge graphs through the use of a pilot project that delivers tangible value for the business, but also learning and development for data and analytics staff.

- Take an agile approach to knowledge graph development to decrease time to value. Assess the data that is needed to feed a knowledge graph, both structured and unstructured, creating a minimum viable subset that can be used to capture the information of a business domain.

- Utilize vendor and service provider expertise to validate use cases, educate stakeholders and provide an initial knowledge graph implementation.

- Include knowledge graphs within the scope of data and analytics governance and management. To ward against perpetuating data silos, investigate and establish ways for multiple knowledge graphs to interoperate. This is likely to extend to third party data knowledge graphs.

Sample Vendors

Cambridge Semantics; Diffbot; eccenca; Ontotext; Semantic Web Company; TopQuadrant
Private Cloud dbPaaS

Analysis By: Adam Ronthal

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition
Private cloud database platform as a service (dbPaaS) offerings bring the self-service and scalability of public cloud dbPaaS to a private cloud infrastructure, without external exposure. Private cloud dbPaaS offerings should provide similar benefits to their public cloud counterparts — a database management system or a data store engineered as a scalable, elastic, multitenant service, ideally with subscription of chargeback pricing models.

Why This Is Important
Private cloud database platform as a service (dbPaaS) offerings continue to emerge in the marketplace, with a number of offerings from both database management system (DBMS) and infrastructure vendors. These offerings may leverage the existing container-based infrastructure common to many private cloud offerings, either as a private IaaS or as PaaS frameworks. They may also be self-contained products in an appliance form factor or extensions of existing cloud service provider offerings.
Business Impact

Private cloud dbPaaS offerings promise a marketplace-like experience for a range of DBMS offerings: commercial and open source, relational and nonrelational. Many are still maturing to offer services that go beyond self-provisioned developer environments to true production-class environments. These offer high availability, elastic scalability and solid performance. A number of offerings from established vendors like IBM (Cloud Pak for Data System) and Oracle (Cloud@Customer) are available.

Drivers

- Private cloud dbPaaS will primarily appeal to enterprises that are not yet ready or are unable to embrace public cloud alternatives. Public cloud inhibitors (and private cloud dbPaaS drivers) may include: (1) regulatory, governance or security requirements, or the need to operate in an “air-gapped” environment; (2) significant on-premises centers of gravity that are not yet able to move to public cloud; (3) concerns with network connectivity, latency or performance issues in a hybrid cloud environment; (4) data sovereignty requirements that cannot be met by public cloud data centers; (5) compatibility concerns with on-premises environments associated with native public cloud offerings.

- Many of these public cloud inhibitors are transient in nature and may be addressed as organizational culture adapts to the cloud, comfort levels and regulatory best practices associated with operating in the cloud improve. Cloud service provider presence will also expand to additional regions and availability zones. As such, private cloud dbPaaS will be a transitional stage — albeit a potentially long-term one — for many adopters.

- While the initial offerings in the space have been associated with more traditional vendors with strong on-premises presence, the cloud service providers are now engaging with private cloud dbPaaS offerings as well, almost always based on a container strategy that reaches into on-premises data centers.
Obstacles

- “Cloud first” strategies are being broadly adopted by both vendors and end-users alike, which may inhibit choice and breadth of offerings as vendors increasingly focus on public cloud approaches.
- These cloud-first strategies will eventually become “cloud only,” further limiting options for those looking to deploy dbPaaS in on-premises environments.
- Any new implementations are likely to skip private cloud dbPaaS in favor of a straight to public cloud strategy.
- Adoption will be limited to established enterprises with existing on-premises data center footprints.

User Recommendations

Focus on the following capabilities when evaluating private cloud dbPaaS offerings:

- **Breadth of DBMS services offered** — Not all offerings support a full range of database types.
- **Storage model** — For container-based services, a scalable, persistent data storage tier will be required to effectively use these offerings.
- **Pricing model** — Flexibility of pricing models is beneficial to accommodate both capex and opex approaches.
- **Production capabilities** — Evaluate the high availability and disaster recovery capabilities to ensure they can meet your requirements.
- **Disconnected operations** — Many of these offerings have a cloud-based control plane that is part of the management stack. If connectivity to the cloud is unreliable, ensure that the selected offering meets any requirements for disconnected operations.
- **Path to the public cloud** — Private cloud dbPass is often a transitional technology. These offerings should be evaluated for continuity from on-premises operations into the public cloud.

Sample Vendors

Alibaba Cloud; Amazon Web Services (AWS); Google Cloud Platform (GCP); IBM; Microsoft; Oracle; Robin; VMware
Data Fabric

Analysis By: Ehtisham Zaidi, Robert Thanaraj, Mark Beyer

Benefit Rating: Transformational

Market Penetration: 1% to 5% of target audience

Maturity: Emerging

Definition

A data fabric is an emerging data management design for attaining flexible and reusable data integration pipelines, services and semantics. A data fabric supports various operational and analytics use cases delivered across multiple deployment and orchestration platforms. Data fabrics support a combination of different data integration styles and leverage active metadata, knowledge graphs, semantics and ML to automate and enhance data integration design and delivery.

Why This Is Important

A data fabric leverages both traditional and emerging technologies in enterprise architectural design and evolution. It is composable and supports flexibility, scalability and extensibility in an infrastructure used by humans or machines across multiple data and analytics use cases. It abstracts data management infrastructure to disintermediate any incumbent platforms, and enables data integration and delivery regardless of the number of on-premises or CSP-based data assets in use.

Business Impact

Organizations benefit as data fabric:
- Provides insights to data engineers and ultimately automates repeatable tasks in data integration, quality, data delivery, access enablement and more.

- Adds semantic knowledge for context and meaning, and provides enriched data models.

- Evolves into a self-learning model that recognizes similar data content regardless of form and structure, enabling broader connectivity to new assets.

- Monitors data assets on allocated resources for optimization and cost control.

**Drivers**

- A data fabric enables tracking, auditing, monitoring, reporting and evaluating data use and utilization, and data analysis for content, values, veracity of data assets in a business unit, department or organization. This results in a trusted asset capability.

- Demand for rapid comprehension and adaptation of new data assets has risen sharply and continues to accelerate — regardless of the deployed structure and format. The data fabric provides an operational model that permits use cases, users and developers to identify when data experience varies from the data expectations depicted in system designs.

- A shortage of data management professionals is increasing the demand for accurate and actively utilized metadata to make system design, data availability and data trust decisions.

- Catalogs alone are insufficient in assisting with data self-service. Data fabrics capitalize on machine learning to resolve what has been a primarily human labor effort using metadata to provide recommendations for integration design and delivery.

- Business delivery and management professionals find it difficult to identify adjacent, parallel and complementary data assets to expand their analytical models. Data fabrics have the capability to assist with graph data modeling capabilities (which is useful to preserve the context of the data along with its complex relationships), and allow the business to enrich the models with agreed upon semantics.

- Significant growth in demand and utilization of knowledge graphs of linked data as well as ML algorithms to provide actionable recommendations and insights to developers and consumers of data can be supported in a data fabric.
Obstacles

Data fabrics are just past the Peak of Inflated Expectations. The main challenges surrounding broad adoption are:

- Diversity of skills and platforms to build a data fabric present both technical and cultural barriers. It requires a shift from data management based upon analysis, requirements and design to one of discovery, response and recommendation.

- Intentional market hype by providers and services organizations purporting a data fabric delivery is adding to market cynicism.

- Misunderstanding and lack of knowledge in how to reconcile and manage a data fabric and a legacy data and analytics governance program that assumes all data is equal will lead to failure.

- Proprietary metadata restrictions will hamper the data fabric, which is wholly dependent upon acquiring metadata from a wide variety of data management platforms. Without metadata, the fabric requires analytic and machine learning capabilities to infer missing metadata, and while possible, will be error prone.

User Recommendations

Data and analytics leaders looking to modernize their data management with a data fabric should:

- Invest in an augmented data catalog that assists with creating a flexible data model. Enrich the model through semantics and ontologies for the business to understand and contribute to the catalog.

- Invest in data fabrics that can utilize knowledge graph constructs.

- Ensure subject matter expert support by selecting enabling technologies that allow them to enrich knowledge graphs with business semantics.

- Combine different data integration styles into your strategy (bulk/batch, message, virtualization, event, stream, replication and synchronization).
Evaluate existing tools to determine the availability of three classes of metadata: design/run, administration/deployment and optimization/algorithmic metadata. Rate existing and candidate platforms and favor those that share the most metadata.

Focus on a similar transparency and availability of metadata between PaaS and SaaS solutions.

**Sample Vendors**
Cambridge Semantics; Cinchy; CluedIn; Denodo; IBM; Informatica; Semantic Web Company; Stardog; Talend

**Gartner Recommended Reading**
Top Trends in Data and Analytics for 2021: Data Fabric Is the Foundation

What Is Data Fabric Design?

Top Trends in Data and Analytics for 2021: Data Fabric Is the Foundation

Emerging Technologies: Data Fabric Is the Future of Data Management

**Multicloud**
Analysis By: David Smith

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

**Definition**
Multicloud refers to the deliberate use of cloud services from multiple public cloud providers for the same general class of IT solutions or workloads. It is much more common in infrastructure as a service (IaaS) and converged IaaS/platform as a service (PaaS) scenarios than SaaS. While multi-SaaS environments are possible, these would typically be stovepiped situations.
Why This Is Important

Multicloud has the potential to lower the risk of cloud provider lock-in, can provide best-of-breed capabilities for specific use cases and can provide service resilience and migration opportunities, in addition to the core cloud benefits of agility, scalability and elasticity.

Business Impact

Multicloud provides agility and potential of cost optimization. It can also provide a basis to lower cloud provider lock-in and increase workload migration opportunities.

Drivers

- Enterprises typically start with one provider but, over time, they become concerned about lock-in. So, the first use of multicloud is often procurement-based to encourage competition.

- As multiple cloud providers are in use, the need to manage and govern those services becomes important.

- Eventually, some enterprises get to multicloud architectures. These rely on architectural principles and portability solutions, and can potentially enable even cloudbursting and other dynamic placement efforts. Most deliberate multicloud strategies are designed to take advantage of differentiated capabilities from multiple cloud providers while applications run in a single cloud provider. Some applications may have a multicloud architecture themselves.

- The hype around multicloud (at the Peak of Inflated Expectations) is driving adoption as providers often use this industry buzz term to justify why their offering should be considered when another cloud service already exists.
Obstacles

- Multicloud is often confused with hybrid cloud. The reality is that multicloud and hybrid cloud often coexist in a multi-hybrid cloud environment that spans multiple public cloud providers as well as between public and private implementations.

- Multicloud is sometimes thought of as providing a solution to business continuity and disaster recovery scenarios. It is often discussed as part of an exit strategy and planning, as well as regulatory requirements involving managing risk concentration. While there is a connection, multicloud does not by itself solve any of these issues. Rather, an overall architectural approach (which may use multicloud) is key to solutions in these domains. In fact, in some ways, multicloud complicates and makes these solutions more challenging.

- More time, effort and cost are often required to secure and manage multiple providers.

- The scope of leveraging more advanced services from each provider is reduced.

User Recommendations

- Establish security, management, governance guidelines and standards to manage cloud service sprawl and increasing cost, and develop decision criteria to decide placement of services.

- Focus on coordination and strategy across the enterprise to identify the types of services needed to deliver the benefits of a cloud environment.

- Be prepared to incur additional expenses on training and skilled engineers.

- Do not just shift vendor lock-in to a cloud management platform (CMP) and/or a cloud service brokerage (CSB), even though they may enable governance and optimizations in a multicloud environment.

Gartner Recommended Reading

The Cloud Strategy Cookbook, 2021

Technology Insight for Multicloud Networking

Comparing Cloud Workload Placement Strategies

A Guidance Framework for Managing Vendor Lock-In Risks in Cloud IaaS
A Multicloud Strategy Is Complex and Costly, but Improves Flexibility

RPA PaaS

Analysis By: Arthur Villa, Cathy Tornbohm, Fabrizio Biscotti, Saikat Ray

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition

RPA PaaS is a set of public cloud-hosted services to create and execute RPA scripts against customer applications. The service consists of web-based RPA development environments, orchestrators and a performance dashboard. The orchestrator interacts with lightweight agents installed in the client environment that execute “bots.” Unlike RPA SaaS options that offer a ready-to-use business capability service, RPA PaaS is intended for developers to create a new business function/service.

Why This Is Important

Currently, the majority of RPA implementations have been delivered on-premises, but RPA PaaS adoption will increase significantly over the next few years. This trend will enable greater citizen development, scalability and AI integration.

Business Impact

Like many software markets that begin with an on-premises focus and shift to the cloud, RPA PaaS will reduce barriers to RPA adoption, improve scalability and enable tighter integration with native cloud services. RPA PaaS allows organizations to realize the value of on-premises RPA with improved process automation and the reduction of manual, repetitive tasks; however, it further distributes development access, improves governance and enables customers to quickly access new features and capabilities.
Drivers

- The adoption of RPA PaaS is increasing as the majority of leading RPA providers offer some form of cloud-delivered access to their development environments and orchestration tools. One of the main factors driving the adoption of RPA PaaS is demand from business buyers. Through RPA PaaS, business buyers can quickly realize value from RPA without the need to ask busy IT departments to provision servers for RPA orchestration and analytics features. Demand for RPA is typically driven by business buyers and RPA PaaS eliminates a major barrier to business buyer adoption.

- Organizations interested in the benefits of hyperautomation often require integrating RPA with process automation tech, like intelligent document processing, business process management and low-code application platforms (LCAPs). RPA PaaS improves integration with complementary process automation technology by centralizing the development platform in the cloud instead of requiring the installation of add-ons and version control challenges of managing multiple development environments distributed across an organization’s developer workstations.

- Another factor driving adoption is decreasing buyer concerns about the security risks created by RPA PaaS. Early RPA buyers had concerns about new security risk vectors since RPA tools often had privileged access to an organization’s core applications. The RPA vendors mitigated those risks by developing strong security features including data encryption, credential vault integration and robust role-based access control (RBAC) capabilities.

Obstacles

- Heavily regulated industries may be unable to adopt RPA PaaS due to regulatory and compliance challenges. For example, banking and insurance industries are the greatest adopters of RPA, but many customers may be unable to use RPA PaaS due to data privacy regulations like the GDPR or CCPA.

- Buyers frequently express concerns about RPA tool access to personal information and the transfer of confidential data outside of an organization’s firewalls. Years of RPA adoption with limited security events have mitigated buyers’ security concerns; however, a highly publicized breach enabled by RPA would affect buyers’ willingness to place orchestration and development in the cloud.
The increasing centralization of RPA development and management responsibilities within corporate IT teams might limit RPA PaaS. While business buyers drive demand for new RPA adoption, organizations typically scale RPA usage through the creation of automation centers of excellence that frequently centralize key RPA responsibilities.

User Recommendations

- Consider cloud in the form of RPA PaaS to overcome the hurdle of how to implement, maintain and update on-premises orchestrators to manage the bots, as RPA demand will continue to grow as organizations seek to rapidly digitize and automate legacy processes. RPA PaaS can reduce the total cost of ownership (TCO) of RPA by reducing the maintenance burden of upgrades, patches and so on.

- Start small by piloting a simple use case with a clearly defined ROI achievable within four to eight weeks. Focus on key business outcomes, such as productivity gain, higher accuracy and client satisfaction. When evaluating an RPA PaaS offering, be prepared to define and operationalize your cloud governance model jointly with business and IT to identify applicable processes, acknowledge technical debt and evaluate the performance of the application portfolio.

Sample Vendors

Automation Anywhere; Blue Prism; Infosys (Edgeverve Systems); Microsoft; NICE; Pegasystems; UiPath; WorkFusion

Gartner Recommended Reading

Move Beyond RPA to Deliver Hyperautomation

Magic Quadrant for Robotic Process Automation

Emerging Technologies: RPA Software Advancements

Market Trends: RPA Morphing Into Hyperautomation

Top Strategic Technology Trends for 2021: Hyperautomation

Cloud MDM

Analysis By: Sally Parker, Simon Walker

Benefit Rating: Moderate
Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition
Cloud master data management (MDM) solutions are available in the cloud across a spectrum of resource delivery models, ranging from single-tenant share nothing (IaaS) to multitenant share something (PaaS) to multitenant share everything (SaaS).

Why This Is Important
Trusted master data is a foundational requirement of digital business. Organizations that have invested in establishing an enterprisewide trusted view of their master data (e.g., customers, products, suppliers) benefit from greater levels of business agility. As organizations’ applications have moved to the cloud and the data they seek to master has moved to the cloud the center of gravity has shifted in favor of cloud based MDM solutions.

Business Impact
Cloud-based MDM solutions lower the barrier to entry from a technology solutions perspective, providing access to new licensing models, deployment flexibility and improved time to value.

Leading organizations draw the causal link between trusted master data and the business outcomes it supports, including:

- Business agility
- Process optimization
- Improved customer experience
- Reduced time to market
- Operational efficiency
- Governance, risk and compliance requirements

Drivers
In 2019, Gartner saw the MDM adoption trend favor cloud-based MDM deployments over on-premises, a trend that has continued through 2020, driven by five key themes:
Broader acceptance of, and trust in, cloud for master data: Much of the software solutions market shifted to cloud deployment models some time ago, the MDM market has been slow to follow as vendors delayed offering cloud-based solutions until end-user organizations were ready to embrace cloud for their most critical data — their master data.

Gravitational pull of the organizations’ application and data ecosystems: MDM is about creating a single source of truth (or common trusted foundation) for master data across the enterprise’s heterogeneous applications. As the center of gravity for these applications has shifted to cloud the MDM market is now finally following.

Lower barrier to entry cloud affords MDM solutions: Today new initiatives favor cloud-based MDM solutions with adoption expected to accelerate over the next two to five years as interest in MDM expands to a previously untapped and broader client base favoring the lower barrier to entry cloud affords. Cloud-based offerings and, in particular, SaaS also help organizations where MDM skills required to deploy and maintain on-premises MDM solutions are lacking.

Increased availability of cloud-based offerings: MDM vendors have progressed well in transitioning their solutions from perpetual to subscription-based licenses and from on-premises to cloud-based solutions. The latter will ultimately pull the market to the cloud as vendors favor new feature rollout and support for cloud-based platforms to streamline their own product management cycles.

Scalability: To handle compute intensive requirements such as ML/Al for matching.
Obstacles

- **Vendor comparisons:** SaaS solutions are attractive where MDM skills are lacking. PaaS/IaaS options exist for greater configuration flexibility. Various licensing approaches and bring your own cloud (lower initial purchase price) further add to the complexity. Some vendors offer rapid self-provisioning in cloud vendor marketplaces, others go further with MDM spend counting toward clients’ annual committed cloud provider spend. Without appropriate capacity planning and cost modeling, cloud services may prove more expensive on a TCO basis.

- **Governance:** As master data is heavily shared, a need for real-time integration into associated data sources and processes arises. Organizations in transition to cloud must optimize the business processes and more complex governance of a hybrid ecosystem.

- **Migration:** Some MDM vendors have taken the opportunity to rearchitect their solutions for cloud, requiring a migration from on-premises to cloud that often requires external support.

User Recommendations

Although cloud-based MDM solutions are attractive, organizations should:

- Evaluate any gaps in capability between candidate vendors’ cloud-based and on-premises MDM solutions to determine when and whether a migration between the cloud and on-premises environments is viable.

- Cost should not be the driver for cloud MDM and due diligence is required around capacity planning and TCO modeling.

- Conduct a thorough review of current governance practices as a precursor to cloud readiness. Governance complexity increases in a hybrid ecosystem.

- Map and actively track the center of data gravity within your organization for each master data domain, to identify and plan for prospective transition points for cloud.

- Review and document integration complexity to provide a manageable integration scenario that does not negate any benefits of cloud-based MDM.

Sample Vendors

Ataccama; IBM; Informatica; Profisee; Reltio; Riversand; SAP; Semarchy; Stibo Systems; TIBCO Software
Gartner Recommended Reading

Magic Quadrant for Master Data Management Solutions

Critical Capabilities for Master Data Management Solutions

Three Essentials for Starting and Supporting Master Data Management

Create a Master Data Roadmap With Gartner’s MDM Maturity Model

AI Cloud Services

Analysis By: Van Baker, Bern Elliot

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition

Artificial intelligence cloud services provide AI model building tools, APIs and associated middleware that enable the building/training, deployment and consumption of machine learning models running on prebuilt infrastructure as cloud services. These services include automated machine learning, vision and language services.

Why This Is Important

The use and sophistication of AI cloud services continues to increase, with vendors competing to become the platform of choice for developers and citizen data scientists. Applications will increasingly use AI cloud services in language, vision and machine learning to help automate and accelerate achievement of business objectives. However, developers struggle with these offerings as current offerings are limited, but improvements in the service portfolios will drive continued adoption.

Business Impact

The impact of AI will extend to the applications that enable business, allowing developers and data scientists to enhance the functionality of these applications. With the incorporation of forecasts, next best actions and other capabilities, including automation of many workflows that are currently handled manually, these AI cloud services will enable advanced applications that improve business performance.
Drivers

- The explosion of data from both internal and third-party sources enable insight that has previously been unavailable to the business.
- Increasing need for human to machine interactions that are based on conversational capabilities.
- A mandate for businesses to automate processes to improve accuracy, improve responsiveness and reduce costs.
- Improving performance of both AI and machine learning models.
- Reduced need for large quantities of data to train models.
- Ease of accessibility for developers and citizen data scientists to AI and machine learning services due to the availability of API callable cloud hosted services will expand the use of AI.
- Multiple use cases spanning language, vision and automated machine learning services.
- Use of automated machine learning to tailor the off-the-shelf services to more precisely address the specific needs of the business.
- A wide range of AI cloud services from both hyperscaler cloud providers as well as specialized providers in the market.
- Business transformation efforts driving the development of applications with enhanced capabilities to improve business operations and workforce productivity.
- Increasing deployments of sensor networks in IoT-based solutions that facilitate data use to drive model development and facilitate proactive response to changes in the data rather than reactive response.
- The emerging AI model marketplaces should help developers adopt those techniques through AI cloud services.
Obstacles

- Lack of understanding by developers and citizen data sciences about these services and how they can be applied to specific business use cases.
- Pricing models for AI cloud services that make it challenging for businesses to determine the costs associated with use of these services.
- Lack of guidance for solutions that utilize multiple services to address specific use cases for developers and citizen data scientists.
- Lack of understanding about how to use automated machine learning to supplement and enhance the standard language and vision services.
- Minimal marketplaces for pre-built machine learning models that could be used by developers and citizen data scientists.
- Serious lack of ModelOps capabilities that contribute to challenges in integration of AI into applications.

User Recommendations

- Choose AI cloud services over building custom models to address a broader range of use cases and for quicker deployment and built in scalability.
- Improve the chances of success of your AI strategy by experimenting with different AI techniques and AI cloud services providers, using the exact same dataset and then selecting one that best addresses your requirements. Consider using an A/B testing approach.
- Use AI cloud services to build less complex models, giving the enterprise the benefit of more productive AI while freeing up your data science assets for higher priority projects.
- Use features like automated algorithm selection, data set cleansing and preparation, and feature engineering for project elements and leverage existing expertise on operating cloud services. This will assist technical professional teams with little to no data science expertise.

Sample Vendors

Amazon Web Services (AWS); Google; IBM; Microsoft
Gartner Recommended Reading

Critical Capabilities for Cloud AI Developer Services

Magic Quadrant for Cloud AI Developer Services
Sliding into the Trough

Communications Platform as a Service (CPaaS)

Analysis By: Daniel O'Connell

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition

Communications platform as a service (CPaaS) is a cloud-based middleware on which organizations can develop, run and distribute communication software. The platform offers APIs that simplify the integration of communication modules — including SMS, voice, messaging apps, social and video — into applications, services and business processes, complemented with development tools and documentation. A CPaaS vendor may also offer off-the-shelf modules as programmable components and complete solutions.

Why This Is Important

CPaaS is important because it provides a simple way for organizations to integrate communications into workflows via developer-friendly software APIs. Even organizations with modest IT skills now have developers that can deploy SMS, voice and 2FA for basic workflows like notifications and appointment reminders. Digital natives and larger enterprises with robust developer teams can build more complex business workflows with features such as email, video, payments, webchat and WhatsApp.

Business Impact

CPaaS will have an increasingly stronger impact on the enterprise IT landscape through 2025. The impact may not appear to be as pronounced as it actually is because CPaaS is about a new, agile way of delivering software through a DIY developer-based ecosystem of APIs, SDKs and documentation. CPaaS will not focus on any particular part of the business, but instead it will be embedded across the organization, spanning multiple products and business units. Hence its "bite" will exceed its "bark."

Drivers
■ CPaaS is highly correlated with the emerging API economy. Organizations now hire developers to leverage today’s API-enabled software. Software companies open up their software to expand their total addressable market. At the same time, CPaaS provides a developer-friendly ecosystem of APIs, SDKs, IDEs and documentation to an increasingly broader mix of communications modules.

■ The value proposition of CPaaS centers on its simplicity, diversity and tech runway. Basic SMS CPaaS can now be consumed by digital laggards. And as their proficiency improves, they can explore a more diverse and powerful set of communications modules like email, video, WhatsApp, Apple Business Chat (ABC), Google Rich Business Messaging (RBM), and payments. The tech runway includes the ability to build custom-made workflows like an application for a sporting event, an educational tutoring package or an insurance approval tool. Gartner projects API-enabled 5G to be available in two to three years.

■ COVID-19 kick-started organizations to become more digital and operationally efficient. Low-tech organizations have a developer workforce that can connect their CRM system with CPaaS SMS for simple payment reminders, order refills, emergency alerts and the like. Many CPaaS providers now offer “visual builders” to allow non-coders to graphically build CPaaS workflows. Alternatively, new CPaaS users can hire boutique consultants to train their team on the usage of CPaaS.

■ COVID-19 also accelerated CPaaS video for such verticals as healthcare, education, telejustice and consumer dating. While parallel video offerings from Cisco, Microsoft and Zoom are good to start with, the market demands an even better user experience with the video integrated into an app. With CPaaS video, a physician will also gain access to a patient’s prescriptions, insurance and treatment plans within a single app. In-app video also has greater reliability, improved performance and fewer technical hurdles to connect with the patient.

Obstacles

■ The greatest obstacle to CPaaS is executives understanding the importance of API software. As CPaaS is a middleware solution, it is an abstract concept that takes time for nontechnical executives to comprehend. Its complexity is furthered because it can solve such a wide range of unrelated use cases — spanning simple patient reminders, to embedded video for telehealth, to complex IoT cardiac monitoring. So it is incumbent for IT leaders to educate their C-suite on the benefits that can be derived because the C-suite controls budgets.
A second obstacle to CPaaS deployment is developer talent. The developer workforce tends to be younger so organizations that have not been in a hiring mode recently may lack the appropriate skill sets. Some companies in this situation will hire boutique consulting teams to co-build CPaaS solutions for six months — with the goal of the existing staff picking up the CPaaS skill sets in the process.

User Recommendations

- Start the CPaaS process at the basic level and expand from there. The first implementations should focus on SMS, A2P and 2FA. Once this is mastered, it is time to leverage other communications modules. The specific modules will depend on the organization’s use case. But in 2021, Gartner is starting to see greater adoption of email, video, voice calls and WhatsApp. After this group, some customers are engaging with Apple Business Chat (ABC), Google RBM, billing and omnichannel.

- Explore the benefits of CPaaS across the entire business. Often CPaaS is implemented by a single business unit, and stays there. But in most cases if the customer service BU succeeds with CPaaS, other BUs such as HR, operations, supply chain and logistics can benefit from CPaaS.

Gartner Recommended Reading

Market Guide for Communications Platform as a Service

Quick Answer: What Are the Implications of Twilio’s Investment in Syniverse?

Impact Appraisal: Cisco’s Acquisition of IMImobile

CSPs Should Pivot Forward With CPaaS Video API for Increased Customer Engagement

Container Management

Analysis By: Dennis Smith

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream
Definition

To manage containers at scale, container management provides capabilities such as container runtimes, container orchestration and scheduling, and resource management. Container management software brokers the communication between the continuous integration/continuous deployment (CI/CD) pipeline and the infrastructure via APIs, and aids in the life cycle management of containers.

Why This Is Important

Container runtimes simplify use of container functionality and enable integration with DevOps tooling and workflows. Productivity and/or agility benefits of containers include accelerating and simplifying the application life cycle, enabling workload portability between different environments and improving resource utilization efficiency. Container management makes it easier to achieve scalability and production readiness. It also optimizes the environment to meet business SLAs.

Business Impact

Gartner surveys and client interactions show that the demand for containers continues to rise. This is due to application developers’ and DevOps teams’ preference for container runtimes, which have introduced container packaging formats. Developers have quickly progressed from leveraging containers on their desktops to needing environments that can run and operate containers at scale, introducing the need for container management.
Drivers

- Container runtimes, frameworks and other management software provide capabilities such as packaging, placement and deployment, and fault tolerance (for example, clusters of nodes running the application).

- The emergence of de facto standards (for example, Kubernetes) and offerings from the public cloud providers have simplified deploying containers at scale. Many vendors enable management capabilities across hybrid cloud or multicloud environments by providing an abstraction layer across on-premises and public clouds. Container management software can run on-premises, in public infrastructure as a service (IaaS) or simultaneously in both.

- Container-related edge computing use cases have increased in industries that need to get compute and data closer to the activity (for example, telcos, manufacturing plants, etc.).

- Data analytics use cases have emerged over the past few years, as have operational control planes that enable the management of container nodes and clusters.

- All major public cloud service providers now offer on-premises container solutions. Independent software vendors (ISVs) are starting to package their software for container management systems.

- Some enterprises have scaled sophisticated deployments, and many more have recently commenced container deployments or are planning to. This is expected to increase as enterprises restart application modernization projects postpandemic.
Obstacles

- Third-party container management software faces huge competition in the container offerings from the public cloud providers, both with public cloud deployments and the extension of their software to on-premises environments. These offerings are also challenged by ISVs that choose to craft open-source components with their software during the distribution process.

- More abstracted, serverless offerings may enable enterprises to forgo container management. Among these services are Knative, AWS Lambda and Fargate, Azure Functions, and Google's Cloud Run. These services embed container management in a manner that is transparent to the user.

- Organizations that perform relatively little app development or make limited use of DevOps principles are served by SaaS, ISV and/or traditional application development packaging methods.

User Recommendations

- Determine if your organization is a good candidate for container management software adoption by weighing organizational goals of increased software velocity and immutable infrastructure, and its hybrid cloud requirements, against the effort required to operate third-party container management software.

- Leverage container management capabilities integrated into cloud IaaS and PaaS providers’ service offerings by experimenting with process and workflow changes that accommodate the incorporation of containers.

- Avoid open-source deployments unless the organization has ample in-house expertise to support.

Sample Vendors

Amazon Web Services (AWS); Google; IBM; Microsoft; Mirantis; SUSE (Rancher Labs); Red Hat; VMware

Gartner Recommended Reading

Market Guide for Container Management

Data Hub iPaaS

Analysis By: Keith Guttridge, Eric Thoo
Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition
Data hub integration platform as a service (iPaaS) supports integration between applications and system endpoints via a centralized intermediary store that persists the (often-normalized) data before delivery to the destination. This is different to the pass-through architecture that most established iPaaS offerings utilize today and provides additional information management and analytics capabilities as well as API access to the data store.

Why This Is Important
The data landscape for most organizations is fragmenting across on-premises applications and datastores and an ever increasing number of SaaS applications and cloud data stores. This is causing increasingly complex integration and governance challenges. iPaaS vendors are converging application and data integration technologies, including data stores, to increase the appeal of their offerings as a one-stop shop for all integration needs.

Business Impact
Data Hub iPaaS provides the following benefits:

- Simplification of integrating applications and data sources.
- Improved data management and data governance.
- Improved resilience of the production environment with record/replay capabilities for integration errors and system availability.
- Simplified access to the centralized data model via APIs instead of connecting direct to application APIs.
- Analytics of the data in real time to gain business insight and potentially enable business moments.
Drivers

- Organizations looking to improve data management across on-premises and cloud based applications and data sources.
- Organizations looking to build a customer engagement hub.
- Organizations looking to build a digital integration hub.
- Organizations looking to create a hybrid transactional analytics platform.
- Organizations looking to reduce the number of vendors providing integration and data management technologies.
- iPaaS vendors converging various integration technologies.

Obstacles

- Regional compliance policies for data stores.
- Industry compliance policies for data stores.
- Organizations compliance policies for data stores.
- Preference for best-of-breed integration and data management technology.
- Organizational structure impeding unified approach to integration and data management.
- Vendor landscape is mostly small startups with only a handful of large vendors providing this service.
User Recommendations

- Recognize that this is currently still a relatively new market. The few vendors that do provide this capability often do so for relatively niche use cases. It may take several years before data hub iPaaS becomes general-purpose enough for most clients. Given that the data is stored within the data hub iPaaS, this brings with it extra challenges such as security, resilience and compliance that regular iPaaS vendors do not have to worry about.

- Combine offerings from several technology categories and vendors (such as iPaaS + data store + analytics) if the current offerings in the data hub iPaaS market are not suitable for your needs. Once established though, the combination of iPaaS, data management, real-time analytics and machine learning has the potential to significantly disrupt how organizations integrate their application and data portfolios as well as their B2B partners.

Sample Vendors

Cinchy; Domo; ForePaaS; IBM, Informatica; SAP; Sesam

Gartner Recommended Reading

Magic Quadrant for Enterprise Integration Platform as a Service

Magic Quadrant for Data Integration Tools

Service Mesh

Analysis By: Anne Thomas

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Adolescent

Definition

A service mesh is a distributed computing middleware that optimizes communications between application services within managed container systems. It provides lightweight mediation for service-to-service communications, and supports functions such as authentication, authorization, encryption, service discovery, request routing, load balancing, self-healing recovery and service instrumentation.
Why This Is Important

A service mesh is lightweight middleware for managing and monitoring service-to-service (east-west) communications, especially among microservices running in ephemeral managed container systems, such as Kubernetes. It provides visibility into service interactions, enabling proactive operations and faster diagnostics. It automates complex communication concerns, thereby improving developer productivity and ensuring that certain standards and policies are enforced consistently across applications.

Business Impact

- A service mesh helps ensure resilient and secure request-response communication between services deployed in Kubernetes and other managed container systems.
- Service mesh middleware is one of many management technologies that provide software infrastructure for distributed applications deployed in managed container systems.
- This type of middleware, along with other management and security middleware, helps provide a stable environment that supports “Day 2” operations of containerized workloads.

Drivers

- Service mesh adoption is closely aligned with microservices architectures and managed container systems like Kubernetes. Service mesh supports needed functionality in ephemeral environments, such as service discovery and mutual Transport Layer Security between services.
- As microservice deployments scale and grow more complex, DevOps teams need better ways to track operations, anticipate problems and trace errors. Service mesh automatically instruments the services and feeds logs to visualization dashboards.
- A service mesh implements the various communication stability patterns (including retries, circuit breakers and bulkheads) that enable applications to be more self-healing.
- Many managed container systems now include a service mesh, inspiring DevOps teams to use it. The hyperscale cloud vendors provide a service mesh that is also integrated with their other cloud-native services.
- Independent vendors, such as Buoyant, HashiCorp and Kong provide service meshes that support multiple environments.
Obstacles

- Service mesh technology is immature and complex, and most development teams don't need it. It can be useful when deploying microservices in Kubernetes, but it's never required.

- Users are confused by the overlap in functionality among service meshes, ingress controllers, API gateways and other API proxies. Management and interoperability among these technologies hasn't yet been addressed by the vendor community.

- Many people associate service mesh exclusively with Istio, even though it isn't the most mature product in the market and has a reputation for complexity.

- Independent service mesh solutions face challenges from the availability of platform-integrated service meshes from the major cloud and platform providers.

User Recommendations

- Delay adoption of service mesh until your teams start building applications that will get value from a mesh, such as applications deployed in managed container systems with a large number of service-to-service (east-west) interactions.

- Favor the service meshes that come integrated with your managed container system unless you have a requirement to support a federated model.

- Reduce cultural issues and turf wars by assigning service mesh ownership to a cross-functional PlatformOps team that solicits input and collaborates with networking, security and development teams.

- Accelerate knowledge transfer and consistent application of security policies by collaborating with I&O and security teams that manage existing API gateways and application delivery controllers.

Sample Vendors

Amazon Web Services; Buoyant; Decipher Technology Studios; Envoy; F5; Google; HashiCorp; Istio; Kong; Microsoft; Red Hat; Solo.io; Tetrate; VMware

Gartner Recommended Reading

- How a Service Mesh Fits Into Your API Mediation Strategy
- Assessing Service Mesh for Use in Microservices Architectures
Emerging Technology Analysis: Service Mesh

API Management PaaS
Analysis By: Mark O'Neill

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent

Definition
API management PaaS (APIM PaaS) takes an on-demand approach to the delivery of API management. It provides an alternative to the purchase and installation of stand-alone, full life cycle API management software. APIM PaaS manages API access via provider-hosted API gateway services, with the option of on-premises API gateways, as well as providing an API developer portal. It is typically designed to be used with other PaaS services such as function PaaS (fPaaS) and integration PaaS (iPaaS).

Why This Is Important
APIs are increasingly built on cloud platforms and using platform as a service (PaaS), so it is natural for API management to also be delivered as-a-service. APIM PaaS takes full advantage of cloud benefits, such as autoscaling, resiliency and robust security. It also allows some vendors to offer per-API-call pricing. APIM PaaS may include the ability to deploy on-premises API gateways, to enable hybrid API management architecture with APIs on-premises and cloud-based API management.

Business Impact
APIM PaaS allows costs to scale with the business value of APIs, reducing the impact of a large outlay as an API program scales up. It enables APIs to be managed effectively when API traffic is unpredictable and potentially very large. APIM PaaS also brings business benefits when an APIM PaaS offering is provided as part of the PaaS platforms already in use by an organization, through unified procurement and billing.
Drivers

- APIM PaaS is driven by migration to and adoption of cloud platforms.
- Function PaaS (fPaaS) can act as a major driver for APIM PaaS. This is because fPaaS offerings can make use of API management on their associated cloud platforms. In some cases, they can automatically populate API gateways with endpoints so that fPaaS functions can be called via REST APIs.
- iPaaS and aPaaS are also drivers toward the need for API management provided by PaaS platforms.
- Since many organizations are building APIs in the cloud, APIM PaaS is also increasingly used in hybrid scenarios and multicloud scenarios.
- Automation is also a driver for APIM PaaS. This is because APIM PaaS also includes APIs into the API management platform itself. These are used to automate the creation and management of APIs, often as part of a DevOps pipeline, as well as for customizing the developer experience (DX) provided by an API developer portal.

Obstacles

- Perceptions of network latency can impact on the uptake of APIM PaaS for managing on-premises APIs.
- Data residency concerns, such storage of API payloads that may contain private information, are also an obstacle to the uptake of APIM PaaS for managing on-premises APIs.
- APIM PaaS can result in higher-than-expected pricing as API traffic grows.
- Architecting a hybrid or multicloud API PaaS architecture is nontrivial (see Comparing Architectures for Hybrid and Multicloud API Management).
- APIM PaaS solutions from cloud hyperscalers are generally tied to their larger PaaS platforms, and are not portable for use on other PaaS platforms.
User Recommendations

- Apply API mediation and prioritize the use of APIM PaaS to provide a cost-effective means of providing API management, even when your APIs are on-premises.

- Compare the pricing of APIM PaaS vendors, since not all provide consumption-based pricing (see How Are API Management Platforms Priced?).

- Include API PaaS as part of your API strategy, since it can accelerate time to market for mission-critical digital initiatives.

Sample Vendors

Alibaba Cloud; Amazon Web Services; Google (Apigee); IBM; Microsoft Azure; Oracle; VMware

Gartner Recommended Reading

- Magic Quadrant for Full Life Cycle API Management
- Critical Capabilities for Full Life Cycle API Management
- Ensure Your API Management Solution Supports Modern API Trends Such as Microservices and Multicloud
- Toolkit: RFP Template for API Management Platforms
- Comparing Architectures for Hybrid and Multicloud API Management

IoT Platform

Analysis By: Alfonso Velosa, Eric Goodness

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent
Definition

An Internet of things (IoT) platform enables the connection and capture of data from IoT-enabled assets or endpoints to develop, deploy, and manage business solutions that improve operations such as monitoring remote assets or optimizing maintenance. Capabilities include device management, integration data management, analytics, application enablement and management, and security. It may be delivered as edge or on-premises software, or cloud IoT platform as a service, or a hybrid combination.

Why This Is Important

Enterprises continue adding IoT capabilities to assets and products, seeking benefits such as cost optimization, process optimization, improved customer experience, and new opportunities such as product as a service. The sophistication, scale and business value of these interactions call for specialized technology resources, most often implemented as an IoT platform. While all verticals are deploying IoT, spend is highest in asset intensive industries such as manufacturing or oil and gas.

Business Impact

IoT platforms are usually required to implement IoT-enabled assets in order to make better business decisions from the data and information generated by connected products. Goals include:

- Differentiated smart products
- Cost optimization strategies centered on improved maintenance
- Process improvement by using assets at their best state
- Opportunities to sell new services and data products
Drivers

- Proliferation of IoT projects since IoT is widely proven across many industries to improve business outcomes — see Survey Analysis: Focus on Practical Outcomes for IoT Projects.

- IoT platforms are fit-for-purpose PaaS and on-premises software offerings that specifically help software teams to accelerate and improve the quality of IoT products while consolidating and structuring the data.

- Enterprises leverage their IoT assets to drive differentiation, lower costs, improve processes and enhance worker safety.

- Technology providers are driving marketing and sales efforts to engage their customers with IoT platforms. In parallel they invested in improved ecosystems and channel partners to make it easier for companies developing IoT enabled solutions to achieve business value.

- In parallel, technology providers continue to invest in their IoT platform technology to ensure they can deliver business solutions at scale for their customers.

Obstacles

- IoT platforms require extensive customization to achieve business outcomes for large-scale deployments, driving up cost and schedule.

- Many enterprises approach IoT projects as technology projects, instead of as business projects that use IoT platforms to achieve business outcomes.

- Many enterprises operate in siloed fashions, adopting different IoT platforms for each use case, limiting their ability to scale, and adding complexity.

- Projects that use IoT platforms drive greater volumes of data, complicating existing processes and overwhelming employees and other stakeholders. They often lack training or process changes to absorb this new data — leading existing systems and people to reject the output of the IoT platform.

- IoT technical complexity, security and integration challenges remain barriers to scale at enterprises.

- Technology providers have yet to develop a clear value proposition and sales strategy that helps their customers leverage their platforms on scaled up levels.
User Recommendations

- Start with smaller IoT projects that help the business unit and IT organization acquire implementation lessons, identify IoT platform strengths and weaknesses, and verify alignment to business and finance KPI requirements.

- Identify the range of IoT projects for your enterprise, and segment them by their focus (internal vs. external), complexity and business objectives. Use these insights to establish a distributed deployment and a platform of platforms architecture.

- Use a skills gap for IoT projects and IoT platforms to build a plan to improve the IT organization's capabilities such as integration or digital twin model development.

- Prioritize vendors you already work with for their IoT platform. Evaluate candidate vendors on their fit-to-your-business objectives and technology. Key evaluation criteria include: proofs of value projects (for tech and business), the ability to drive operational-scale deployments, vertical market expertise and a partner ecosystem.

Sample Vendors

Alibaba Cloud; Amazon Web Services; AVEVA; ClearBlade; COVACSIS Technologies; Detechtion Technologies; Knowledge Lens; Microsoft; Siemens

Gartner Recommended Reading

Magic Quadrant for Industrial IoT Platforms

Critical Capabilities for Industrial IoT Platforms

Use the IoT Platform Solution Reference Model to Help Design Your End-to-End IoT Business Solutions

Use 4 Building Blocks for Successful Digital Twin Design

Blockchain PaaS

Analysis By: Adrian Leow, Avivah Litan

Benefit Rating: Moderate

Market Penetration: 1% to 5% of target audience

Maturity: Emerging
Definition

Blockchain platform as a service (bPaaS) is a set of blockchain software platform services offered to subscribers in the cloud by a vendor. Services can include some or all of the distributed ledger, node or consensus mechanisms, and other ancillary services to manage a network of distributed ledgers on the vendor’s cloud infrastructure. bPaaS is separate from blockchain managed services, which include management of the solution and application stack on top of bPaaS.

Why This Is Important

Developers seeking to implement blockchain-based applications require specific services that span compute, application, storage and network services, both for initial implementation and ongoing operations. bPaaS is a cloud service offering from enterprise cloud vendors. The cloud vendors aim to combine these basic blockchain services to provide enterprises a one-stop service shop that brings the benefits of cloud elasticity and compute costs to blockchain.

Business Impact

bPaaS is attractive to enterprises experimenting with blockchain. But enterprises quickly move past needing basic blockchain infrastructure services.

Microsoft, the first cloud vendor to offer bPaaS in 2017, is exiting this business in September 2021. Enterprise developers need assistance with much more complex capabilities higher up the stack. Vendors such as ConsenSys, Kaleido, SettleMint and Simba offer more advanced services with multiple clouds, multiple protocols and services for applications, and interoperability between blockchains and legacy systems.
Drivers

- The core value of a distributed ledger, which has fueled the hype and interest among many in the technology industry, is to enable decentralized/distributed open-source applications that avoid reliance on just one organization, server, data center or network. Most versions of bPaaS trade this core value for the convenience of vendor assistance, although this trade-off is expected to be addressed by greater interoperability and standardization in the future.

- Currently, in most cases, the primary value of bPaaS is to “jump-start” the ability of enterprise developers to rapidly set up an initial test system or prototype — as opposed to a truly decentralized production system.

- Because bPaaS is dependent on a restricted perspective of blockchain, and is affected by blockchain’s immaturity, its future prospects are limited compared to enhanced competitive services.

- Each bPaaS vendor attempts to add unique elements around support for multiple blockchain platforms, security, interoperability, analytics and performance to differentiate their offerings in exchange for single-sourcing and centralization of public execution and ledger storage. In many cases, the cloud vendor’s bPaaS supports one or a few blockchain platforms. But relying on one vendor for all nodes of the distributed ledger negates some of the advantages of using a distributed ledger in the first place.

Obstacles

- bPaaS encompasses platform services or cloud-based blockchain developer toolsets. Over time, however, we expect other blockchain-based applications and business services to become available in the cloud as enhanced blockchain-based SaaS.

- Full-stack blockchain managed services are starting to emerge and are being supported by several vendors.

- Support for different consensus mechanisms, tools, frameworks and smart contract capabilities remains limited and continues to evolve. Interoperability for distributed ledgers across competing platforms or clouds is extremely limited at this early stage of evolution.

- Every blockchain platform will undergo major changes during the next two to five years. Some platforms, however, will keep up with evolutionary changes that keep them scalable and competitive.
User Recommendations

- Use current bPaaS offerings to primarily help jump-start your POCs, smaller projects or your experiments with blockchain technologies, as long as you are comfortable with limiting your experience to what bPaaS can provide.

- Expect a wider range of options to be available, with additional services and increased interoperability, as blockchain technologies and enhanced bPaaS offerings and platforms evolve.

- Be aware that cloud providers support a limited set of platforms, and their goal is to sell you more of their own services, rather than support blockchain projects in a cloud-neutral environment.

- Avoid commitments to bPaaS for mission-critical initiatives until greater maturity occurs, platforms and services are interoperable across heterogeneous environments, and services move up the stack.

- Determine all aspects of the blockchain technologies that you will need and ensure they can be supported on the bPaaS offering of interest.

Sample Vendors

Amazon Web Services (AWS); Ant Group; IBM; Oracle

Gartner Recommended Reading

Common Mistakes to Avoid in Enterprise Blockchain Projects

Serverless fPaaS

Analysis By: Anne Thomas

Benefit Rating: Low

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream
Definition
Function platform as a service (fPaaS), also known as function as a service (FaaS), is a serverless execution platform for event-triggered application components known as functions. Like all serverless platforms, fPaaS enables you to run code without provisioning or managing the underlying system or application infrastructure. fPaaS pricing models allow users to pay in microincrements only for actual usage, rather than preprovisioned resources required to support projected peak loads.

Why This Is Important
fPaaS can deliver significant savings for certain types of workloads via its consumption-based micropricing model. The programming model also enables software engineers to rapidly deploy and configure new functions with little or no assistance from operations teams.

Business Impact
- An fPaaS can offer significant cost savings and virtually unlimited scalability for applications with highly variable capacity requirements.
- Serverless technologies like fPaaS abstract and commoditize infrastructure technologies, increasing developer and operator productivity, enabling organizations to respond rapidly to digital business moments and deliver new applications and features faster.

Drivers
fPaaS is gaining momentum because of:
- Potential cost savings — The micropricing model charges for small increments of compute time per invocation, which can be advantageous for small, spiky workloads. The model is less favorable for large, consistent workloads.
- Rapid solution delivery — The serverless model reduces the amount of work developers and operations teams need to do to build, deploy and configure solutions.
- Integration with hyperscale xPaaS — The hyperscale vendors make it easy to use their fPaaS with their other cloud-native xPaaS offerings.
- Broad use-case support — fPaas can support a broad spectrum of application use cases, from basic websites to complex analytical processes.
- Edge computing efficiencies — Deploying functions at the edge enables processing close to the source.

- Embedding within other xPaaS — Some xPaaS vendors embed an fPaaS in their platforms to host code components, such as rules and workflow routines. Examples include the InRule decision management platform and the Zoho low-code application platform. These systems hide the complexity of the fPaaS programming and operating model.

Obstacles

fPaaS is facing challenges because:

- Cost savings don't always materialize — fPaaS pricing isn't favorable for applications with consistently high invocation rates. Also, fPaaS-based applications often require other xPaaS, such as API management, data management and notifications.

- Latency — fPaaS-based applications can suffer from cold-start issues.

- Lock-in — fPaaS-based applications aren't portable across vendor solutions.

- Resource constraints — fPaaS is inappropriate for memory- and compute-intensive workloads.

- Lacking infrastructure — DevOps teams require development frameworks, testing and debugging tools, security services, and management technology. A fledgling ecosystem is emerging to address these requirements, although most ecosystem players focus only on Amazon Web Services (AWS) Lambda, and tooling for other fPaaS offerings is limited.

- Alternative solutions — Many developers prefer to use more general-purpose platforms, such as Kubernetes or low-code application platforms.
User Recommendations

- Minimize vendor lock-in by ensuring that your software engineering teams don't limit their skills and practices to the proprietary features of a single fPaaS.

- Estimate fPaaS costs based on expected invocation rates, memory requirements, execution times and other xPaaS dependencies. Don't presume that fPaaS is always a less expensive option.

- Evaluate whether fPaaS is a good fit for your applications and your teams’ development skills. Consider aPaaS or managed container solutions as alternatives.

- Identify use cases where fPaaS offers a strategic benefit from a cost or agility perspective. Consider fPaaS for microservices deployments and for applications with highly variable or unpredictable capacity requirements.

- Avoid using fPaaS for high-memory or compute-intensive workloads. Don't port existing monolithic applications to fPaaS.

- Use fPaaS if it's an integral part of another solution, such as edge computing, decision management or low code.

Sample Vendors
Amazon Web Services; Cloudflare; Google; InRule; Microsoft; Netlify; Red Hat; Vercel; Zoho

Gartner Recommended Reading
A CIO’s Guide to Serverless Computing

Security Considerations and Best Practices for Securing Serverless PaaS

Decision Point for Selecting Virtualized Compute: VMs, Containers or Serverless

Citizen Integrator Tools
Analysis By: Massimo Pezzini, Tim Faith

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream
Definition

Citizen integrator tools are typically cloud-hosted services providing very intuitive, no-code integration process development tools. This way expert business users with minimal IT skills can handle relatively simple application, data and process integration tasks (or “automations”) by themselves. Citizen integrator tools also provide a rich set of packaged integration processes (PIPs) that business users can rapidly configure and run with no assistance from integration specialists.

Why This Is Important

Organizations must address a growing amount of integration challenges in shorter and shorter timeframes, which implies having at their disposal several “integrators” equipped with high productivity tools.

Citizen integrator tools enable business users with minimal IT skills to perform self-service integration work, thus increasing the organization’s overall delivery capacity. However their ungoverned proliferation can lead to security and compliance risks and duplicated costs.

Business Impact

Citizen integrator tools enable business users to automate tasks currently integrated via slow and error-prone manual methods. Integration specialists or ad hoc integrators (developers, SaaS administrators), also use these tools to quickly sort out simple tasks instead of using more powerful, but expensive and complex tools. Therefore, citizen integrator tools contribute to improving organizations’ efficiency, productivity, agility and innovation by reducing the relevant integration costs.
Drivers

- Citizen integrator tools may help deliver business value faster, reduce integration costs and support tactical or strategic digital initiatives. These outcomes are achieved by enabling rapid, pervasive integration by a wide range of employees within (and potentially also outside) the organization. However they are available in many forms, which address different markets and needs: PIPs — At times called “recipes,” these are prepackaged and configurable sets of integration flows, available stand-alone (at times for free), as embedded capabilities in SaaS or as add-ons to integration platforms. As such buyers are typically application owners or SaaS administrators. Integration software as a service (iSaaS) — Cloud services that enable users to implement brand new PIPs and to deploy, run and customize existing ones. They are typically sold to individual business users or work teams. Integration platform as a service (iPaas) — These are targeted to professional integrators, but several iPaas provide an iSaaS-like development environment and/or make available collections of configurable PIPs atop their platform.

- iSaaS tools have achieved notable traction in the consumer and SMB markets, thanks to their very low cost of entry, intuitive user experience, low skills demand and their rich set of PIPs. However, they have failed to penetrate other segments due to their lack of enterprise capabilities and services (for example, consulting).

- PIPs and iPaas providing citizen-integrator-oriented capabilities are becoming more and more popular in midsize, large and global organizations. The growing use of AI, ML, NLP and chatbots in iPaas offerings to facilitate integration development is augmenting their appeal for citizen integrators, thus further favoring adoption.
Obstacles

- Business users are increasingly technology savvy and often driven by time-to-market pressures, especially in the post-pandemic era that requires fast reaction to sudden changes in the business environment. This will increasingly urge them to adopt cloud citizen integrator tools, rather than wait for their IT colleagues to methodically perform integration work for them. However, this will create a few challenges: If not framed in a proper governance model, citizen integrator tools adoption by business users will inevitably lead to security, compliance, management and governance issues.

- Although some central IT departments will adopt a positive attitude and proactively address these challenges, others will try to stop business users from leveraging these tools to prevent these risks. In addition, excessive expectations for ultra-easy, super-fast integration and the simplistic nature of some citizen integrator tools may still lead to disappointment, thus hindering their more widespread adoption.

User Recommendations

Software engineering leaders responsible for integration should:

- Engage with business teams to understand their automation needs and identify to what extent citizen integrator tools can improve their responsiveness and productivity.

- Approve, certify and support a set of citizen integrator tools that meet these needs and make them available to internal users in a self-service way. This will help to prevent the uncontrolled proliferation of similar tools and maintain a degree of centralized governance and monitoring.

- Beware when selecting citizen integrator tools that: some tools are rather simplistic and lowest-common-denominator in nature; and PIPs provided by SaaS vendors may have been designed for a professional IT developer audience.

- Give preference to providers that can support both “professional” and citizen integrator requirements when selecting an iPaaS.

- Frame citizen integrator tools, including those embedded in SaaS applications, in your hybrid integration platform (HIP) strategies.
Sample Vendors
Adeptia; Celonis (Integromat); elastic.io; IFTTT; Microsoft; Quickbase; Tray.io; Workato; Zapier

Gartner Recommended Reading
Accelerate Your Integration Delivery by Using Packaged Integration Processes
The Applications of the Future Will Be Founded on Democratized, Self-Service Integration
Quick Answer: When to Use (or Not Use) Embedded Integration Features Provided by Your SaaS Vendor

Cloud Analytics
Analysis By: Julian Sun, Austin Kronz

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Early mainstream

Definition
Cloud analytics delivers analytics capabilities as a service. It often comprises database, data integration and analytics tools. As cloud deployments continue, the ability to connect to both cloud-based and on-premises data sources in a hybrid model is increasingly important. Cloud-native architecture or multicloud deployments are also becoming popular in order to cater to the cloud ecosystem.

Why This Is Important
There is growing adoption of cloud analytics. Most analytics deployments are originating in the cloud, and the majority of organizations say they are using or plan to use the cloud for analytics and data science. The cloud capability among analytics and BI vendors is also growing with emerging capabilities coming from cloud first. Cloud becomes an ideal place to build modular analytics capabilities that enable greater agility and reuse of existing investments in support of composable business.
Business Impact

- The cloud-enabled composition platform can achieve innovation by assembling modular analytics capabilities.

- More advanced analytics can complement key components of the analytics infrastructure in the cloud. The high computational load due to machine learning in advanced analytics can be carried in the cloud.

- Business users can pilot the cloud-first augmented analytics with an analytics sandbox provisioned by the cloud. It is a faster time to value and more targeted analytics deployment for specific business areas.

Drivers

- To better leverage scalability and elasticity from the cloud, many platforms have rearchitected themselves to be cloud-native.

- To bring more flexibility for organizations that are already using multicloud, vendors are also adding more deployment options and management capabilities. This enables portability with microservices architectures that are readily supported via Kubernetes across multiple clouds.

- Analytics solutions, such as Microsoft Power BI, are attracting organizations of all sizes to the cloud. There is a growing range of solutions available with most of the vendors in the market providing solutions as alternatives to on-premises products.

- Moreover, startups continue to join the BI market with cloud-only solutions, which are complementary to established platforms.

- The range of capabilities is growing too. Reporting and data visualization were already commodified capabilities. But customers can now also subscribe to self-service data preparation, augmented data discovery, predictive modeling, other advanced capabilities such as machine learning or streaming analytics, and even data/context broker services from several vendors.

- The growing cloud DBMS is also helping support and expand this market.
Obstacles

- Security is the No. 1 concern for organizations when moving to the cloud, but organizations need to plan how they will integrate their growing cloud analytics deployments with additional data sources, provide access to third-party analytic tools, and embed analytics in business processes. All of these are in hybrids of on-premises and cloud.

- Organizations’ adoption of the cloud is closely tied to data gravity. Data gravity is the concept that as the amount of data grows, and the levels of customization, integration and access needs increase, data has greater propensity to “pull” data services, applications and even other data/metadata to where that data resides. It follows that smaller organizations with data originating in the cloud have higher adoption rates than larger organizations with their data center of gravity predominantly in on-premises legacy solutions.

- Hype around cloud analytics continues to be high, but is now facing growth obstacles as organizations struggle with deployment challenges.

User Recommendations

- Establish a designed approach to move to the cloud incrementally rather than simply “lift and shift” as cloud analytics is becoming a dominant option in most scenarios in the analytics space.

- Include innovative cloud analytics solutions in their portfolio, renovating components or complementing their on-premises platform if organizations want to gain competitive advantage through Analytics and BI. Completely disregarding cloud analytics solutions means risk for many organizations, as most vendors don’t focus their R&D efforts on legacy products.

- Be aware of the extra cost they need to spend and the TCO while adopting other products in the same cloud stack as the vendors are adding new capability in the clouds. From a cost perspective, although not requiring significant upfront investment like on-premises solutions do, cloud analytics solutions will likely have a more expensive licensing cost when considering periods of four or more years.

Sample Vendors

Alibaba Cloud; Sigma Computing; Mode; Microsoft; Oracle; Qlik
mftPaaS

Analysis By: Bindi Bhullar, Shameen Pillai, Keith Guttridge

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience

Maturity: Early mainstream

Definition

Gartner bases its definition of cloud-managed file transfer platform as a service (mftPaaS) on the same functional criteria applied to on-premises MFT. This includes server (including data transfer and security) client, proxy and plug-in capabilities that can be deployed separately but are usually deployed as a suite. Cloud-enabled MFT functionality can be delivered as a public cloud service or as MFT software deployed in a public or private cloud.

Why This Is Important

mftPaaS potentially offers organizations access to deployment flexibility and improved time to value. These services could also help companies that lack the knowledge, experience and resources to deploy and maintain on-premises MFT software. However, these cloud services may prove more expensive on a TCO basis because the operating expense does not decrease over time.
Business Impact

- Gartner estimates that mftPaaS represents around 20% of all MFT spending in 2020. mftPaaS remains the fastest-growing segment of the MFT market, far outstripping the growth in on-premises MFT.

- Driven by the explosion of data and information that require safe and secure transportation, and ever-increasing levels of collaboration both within and outside organizations, mftPaaS adoption will continue to grow quickly both in SMBs and large organizations.

Drivers

The majority of MFT deployments today are on-premises, largely due to privacy and security concerns surrounding cloud-based MFT solutions. Highly regulated industries, such as financial services, pharma and public sector/government, have been resistant to moving to mftPaaS. However, Gartner sees a growing interest and openness toward mftPaaS offerings among all types of end-user organizations that are now more confident in these maturing offerings.

This interest appears to be driven by three broad themes:

- Increased availability of cloud-based MFT solutions.

- Exponential explosion of data, information, devices and channels that is being created today will continue. As a result, there is simply more information that needs to be transported.

- Large number of companies are increasingly struggling to manage scripts and FTP servers to move files; MFT suites manage this more smoothly as they improve the transportation process.

Obstacles

- Adjacent technologies such as iPaaS and content collaboration platforms adding deeper and broader MFT capabilities

- The viability of some pure-play providers, many of which are likely to be acquired or exit the market over the next three to five years
User Recommendations

- Implement mature mftPaaS offerings if you lack in-house MFT technical skills.
- Do not assume that a move to mftPaaS will significantly lower the total cost of ownership (TCO) or reduce complexity if your organization has complex requirements or extended implementation roadmaps.
- Select vendors whose cloud strategy aligns with your preferences, being mindful that at some point on-premises feature upgrades are likely to lag those of their cloud-based equivalents, if your organization is looking at long-term MFT strategies.
- Act tactically and think strategically in the mftPaaS acquisitions, because many of the current providers will be acquired, reposition or simply go out of business as the market consolidates — a useful recommendation for application leaders.

Sample Vendors
Axway; Biscom; HelpSystems; IBM; Progress; SEEBURGER; South River Technologies; Thru

Gartner Recommended Reading

Market Snapshot: Managed File Transfer, Worldwide, 2020

Choose the Best Integration Tool for Your Needs Based on the Three Basic Patterns of Integration

Market Opportunity Map: Application Infrastructure and Middleware Software, Worldwide
Climbing the Slope

dxPaaS

Analysis By: Irina Guseva

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition
A digital experience platform as a service (dxPaaS) is an integrated and cohesive set of capabilities that runs on a PaaS infrastructure and is designed to enable the composition, management, delivery and optimization of contextualized digital experiences across multiexperience customer journeys.

Why This Is Important
Platform as a service (PaaS) is the primary mode for most DX platform vendors. It allows organizations to employ extensible and integrated solution architectures. Cloud-first dxPaaS is driving digital experience and employee experience. Many DXP vendors have also started building out cloud-native, multitenant SaaS capabilities. It will be a journey, but transition to SaaS is underway. Many PaaS implementations that require private cloud infrastructure or significant customizations will remain.

Business Impact
dxPaaS can provide a cost-effective, elastic, scalable and reliable infrastructure for those looking to deliver digital experiences to multiple channels. DXPs are currently offered in a variety of flavors (including IaaS, PaaS and SaaS). Differentiated DXPs support the paradigms of composable DXP. A hybrid deployment as a transition phase from on-premises to cloud is slowly going away. The ability to support multiple-cloud strategies and provide both public and private cloud options is critical.

Drivers
Organizations stand to benefit greatly from dxPaaS as it allows them to respond quickly and efficiently to business needs while ensuring greater scalability and reliability. dxPaaS also often offers faster time to market at a cost that’s more in line with business value than on-premises offerings. dxPaaS approaches introduce the need for new and adapted skills and responsibilities. Business leaders will be increasingly responsible for managing content, presentation and personalization, along with constituent relationships with employees, customers, partners and citizens.

Some of the typical drivers for adoption include:

- Cloud adoption
- Ability to scale and pivot
- Faster time to market and agility
- Elasticity and scalability
- The need to improve customer and employee experience
- The need to support multiple channels of digital engagement
- The need for a multicloud strategy

**Obstacles**

dxPaaS can be applied broadly to address B2C, B2B and B2E use cases across all verticals. Organizations should increasingly regard the PaaS-based cloud deployment model as the primary delivery vehicle for DX initiatives. This is because they employ adjacent SaaS line-of-business applications and a wide range of content and context services that can enhance their DX platform's utility, appeal and overall effectiveness. Some of the most typical obstacles to adopting a dxPaaS include:

- Lack of digital maturity
- Nontraditional requirements around data governance
- Conservative verticals with low cloud penetration
- Certain geographies and legal requirements
- Cost
- Complexity
Lingering fear of cloud

User Recommendations
Organizations evaluating or using dxPaaS should:

- Prepare for the composable business by evaluating how your DXP can become composable to future-proof your technology stack.
- Evaluate requirements for your digital experience stack scalability, uptime guarantees, security, DevOps and CI/CD, and multicloud strategy as the next frontier.
- Employ a highly extensible API framework as an additional layer on top of a dxPaaS, if not already included in the core offering.
- Ensure that any customizations can be insulated from changes to underlying PaaS offerings.
- Focus on governance — including training — that allows you to safely delegate responsibility for content creation and campaign management to the business.

Sample Vendors
Acquia; Adobe; Bloomreach; Liferay; Optimizely; Sitecore

Gartner Recommended Reading
Magic Quadrant for Digital Experience Platforms
Critical Capabilities for Digital Experience Platforms
Defining the Digital Experience Platform
Adopt a Composable DXP to Future-Proof Your Tech Stack
Cloud Event Stream Processing
Analysis By: W. Roy Schulte

Benefit Rating: Moderate

Market Penetration: 5% to 20% of target audience
Maturity: Early mainstream

Definition

Cloud event stream processing (ESP) services are platform as a service (PaaS) offerings that perform computation on streaming event data in near real time. An event stream is a sequence of event objects arranged in some order (typically by time). Cloud ESP services enable situation awareness and low-latency responses to threats and opportunities, or they can be used to store data streams for use in subsequent applications.

Why This Is Important

ESP’s data-in-motion architecture is a radical departure from conventional data-at-rest architecture. It derives information from streaming data in near real time as it arrives. As data and applications migrate to the cloud, organizations are using more cloud ESP services. Providers developed cloud ESP services quickly by leveraging years of research and development for on-premises ESP platforms. Cloud ESP services trail the progress of on-premises ESP on the Hype Cycle by only a small margin.

Business Impact

Compared to on-premises ESP, cloud ESP services may reduce the cost of stream analytics and stream data ingestion, particularly if workloads vary greatly over time. Serverless deployment styles, using on-demand processing models, will further reduce infrastructure management overhead. Cloud ESP brings the generic benefits of cloud: elastic scalability, self-provisioning, continuous patching and versioning, and offloading the work required for high availability and disaster recovery.
Drivers

- Companies have ever-increasing amounts of streaming data from corporate websites, transactional applications, sensors, meters, digital control systems, social computing platforms, news and weather feeds, data brokers, government agencies and business partners.

- Cloud ESP services have become widely available. All of the hyperscale cloud providers and numerous smaller companies offer ESP services as part of their PaaS portfolios. Multiple vendors have bundled cloud ESP services into their IoT platforms, working in tandem with their distributed ESP platforms running in edge locations for industrial applications.

- Cloud ESP services have matured into stable, well-rounded products with hundreds of applications in reliable production.

- Cloud ESP services put ESP within reach of businesses with limited budgets, and replace capital expenditure with operating expenditure.

- The rapid increase in cloud data warehouses is driving demand for cloud ESP services that have specific capabilities to facilitate rapid ingestion and loading of data from streaming sources and real-time change data capture (CDC) sources.

Obstacles

- ESP technology is overkill for most applications that process low or moderate volumes of streaming data or do not require fast response times.

- Cloud ESP services will not replace on-premises ESP platforms for applications that require very low-latency computation with on-premises (including edge) data. Edge deployments in factories, field locations and moving vehicles, and some data center systems need on-premises ESP platforms to minimize latency and to provide better availability where network connections are slow or unreliable.

- Rearchitecting existing business processes to take advantage of cloud ESP requires significant redesign and evolution, which will take time to mature.

- ESP services required low-level programming in Java, Scala or proprietary event processing languages until recently. A new generation of low-code development paradigms is improving developer productivity but is still limited to a minority of cloud ESP services.
User Recommendations

Cloud ESP services are relevant for a growing number of stream analytics and stream data ingestion applications. Data and analytics leaders should:

- Implement ESP through the use of cloud ESP services or on-premises ESP platforms when conventional data-at-rest architectures cannot process high-volume event streams fast enough to meet business requirements.

- Use a SaaS offering that has embedded ESP logic if a product that targets their specific business requirements is available. Verify that the embedded logic can be customized to their specific use cases and SLAs.

- Develop their own ESP-enabled applications on cloud ESP services when appropriate SaaS offerings are not available.

- Use cloud ESP services in preference to on-premises ESP platforms when most or all of the data sources or targets are in the cloud. Also use cloud ESP services if networks are reliable, workloads are bursty and ultra-low-latency is not a requirement.

Sample Vendors

Amazon; Confluent; Google; IBM; Informatica; Microsoft; Salesforce; SAS; TIBCO Software

Gartner Recommended Reading

Market Guide for Event Stream Processing

Adopt Stream Data Integration to Meet Your Real-Time Data Integration and Analytics Requirements


Stream Processing: The New Data Processing Paradigm

Event Stream Processing

Analysis By: W. Roy Schulte, Pieter den Hamer

Benefit Rating: Transformational
Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition
Event stream processing (ESP) is computing that is performed on streaming data (sequences of event objects) for the purpose of stream analytics or stream data integration. ESP is typically applied to data as it arrives (data “in motion”). It enables situation awareness and near-real-time responses to threats and opportunities as they emerge, or it stores data streams for use in subsequent applications.

Why This Is Important
ESP is a key enabler of continuous intelligence and related real-time aspects of digital business. ESP's data-in-motion architecture is a radical departure from conventional data-at-rest approaches that historically dominated computing. ESP products have progressed from niche innovation to proven technology and now reach into the early majority of users. ESP will reach the Plateau of Productivity within several years and eventually be adopted by multiple departments within every large company.

Business Impact
ESP transformed financial markets and became essential to telecommunication networks, smart electrical grids and some IoT, supply chain, fleet management, and other transportation operations. Most of the growth in ESP during the next 10 years will come from areas where it is already established, especially IoT and customer experience management. Stream analytics from ESP platforms provides situation awareness through dashboards and alerts, and detects anomalies and other significant patterns.

Drivers
Five factors are driving ESP growth:

- Companies have ever-increasing amounts of streaming data from sensors, meters, digital control systems, corporate websites, transactional applications, social computing platforms, news and weather feeds, data brokers, government agencies and business partners.

- Business is demanding more real-time, continuous intelligence for better situation awareness and faster, more-precise and nuanced decisions.
ESP products have become widely available, in part because open-source ESP technology has made it less expensive for more vendors to offer ESP. More than 40 ESP platforms or cloud ESP services are available. All software megavendors offer at least one ESP product and numerous small-to-midsize specialists also compete in this market.

ESP products have matured into stable, well-rounded products with many thousands of applications (overall) in reliable production.

Vendors are adding expressive, easy-to-use development interfaces that enable faster application development. Power users can build some kinds of ESP applications through the use of low-code techniques and off-the-shelf templates.

**Obstacles**

- ESP platforms are overkill for most applications that process low or moderate volumes of streaming data (e.g., under 1000 events per second), or do not require fast response times (e.g., less than a minute).

- Many ESP products required low-level programming in Java, Scala or proprietary event processing languages until fairly recently. The spread of SQL as a popular ESP development language has ameliorated this concern for some applications, although SQL has limitations. A new generation of low-code development paradigms has emerged to further enhance developer productivity but is still limited to a minority of ESP products.

- Many architects and software engineers are still unfamiliar with the design techniques and products that enable ESP on data in motion. They are more familiar with processing data at rest in databases and other data stores, so they use those techniques by default unless business requirements force them to use ESP.
User Recommendations

- Use ESP platforms when conventional data-at-rest architectures cannot process high-volume event streams fast enough to meet business requirements.

- Acquire ESP functionality by using a SaaS offering, IoT platform or an off-the-shelf application that has embedded CEP logic if a product that targets their specific business requirements is available.

- Use vendor-supported closed-source platforms or open-core products that mix open-source with value-added closed-source extensions for mainstream applications that require enterprise-level support and a full set of features. Use free, community-supported, open-source ESP platforms if their developers are familiar with open-source software and license fees are more important than staff costs.

- Use ESP products that are optimized for stream data integration to ingest, filter, enrich, transform and store event streams in a file or database for later use.

Sample Vendors

Amazon; Confluent; Google; IBM; Informatica; Microsoft; Oracle; SAS; Software AG; TIBCO Software

Gartner Recommended Reading

Market Guide for Event Stream Processing

Adopt Stream Data Integration to Meet Your Real-Time Data Integration and Analytics Requirements


Cloud IMDG Services

Analysis By: Massimo Pezzini

Benefit Rating: High

Market Penetration: 5% to 20% of target audience

Maturity: Adolescent
Definition

Cloud in-memory data grid (IMDG) services are a type of platform as a service (PaaS) that provide applications with in-memory, distributed, and object-oriented or key value pair, transactional data stores. These can be partitioned, replicated and scaled-out across a set of cloud-based nodes in order to store large amounts of data in memory while supporting high availability and disaster recovery. Cloud IMDGs are key enablers for large or hyperscale distributed application deployments.

Why This Is Important

Cloud IMDG services implement versatile, distributed, in-memory datastores that support digitalization by enabling use cases such as:

- Digital integration hub
- Distributed caching
- Shared data services
- Applications that need to store high volumes of transient, low-latency data
- Streaming analytics and real-time data services
- Database of record for business-critical applications
- Augmented transaction applications and microservices combining transaction processing and analytics on the same data structure

Business Impact

- Enabling new large-scale, API-enabled cloud application development
- Supporting transactional applications extended with real-time analytics
- Empowering cloud-based microservices architectures
- Enhancing established cloud applications to reach out to global constituencies and to support low-latency, high-scale requirements

While protecting investments in those applications

- Supporting, in combination with other cloud services, hyperscale, cloud applications that could not be supported by classic aPaaS/dbPaaS.
Drivers

- User organizations and independent software vendors (ISVs) wishing to deploy in the cloud high-performance and extreme-scaling applications to support multiexperience scenarios, API economy initiatives and IoT ventures.

- The growing popularity of digital integration hub architectures to implement high throughput, large-scale and 24/7 API services, and API-enabled digital architectures.

- The necessity to combine transaction and analytical processing in augmented transactions scenarios to enable situation awareness and real-time decision making.

- Cloud IMDG services are approaching functional parity with classic IMDG software. Cloud IMDG services typically derive from these software products and many providers are moving toward a containerized, Kubernetes-enabled architecture for their IMDG software. This makes it technically easier to support cloud deployments while maintaining compatibility with the as-a-service rendition of their technology.

- The growing number of cloud services (for example, application PaaS, integration PaaS and analytic service) and SaaS applications that include a cloud IMDG service as an embedded capability.

Obstacles

- Only recently providers have started releasing cloud IMDG platform offerings, typically based on proven, often open-source (e.g., Apache Geode, Apache Ignite, GigaSpaces XAP Open Source, Hazelcast, Infinispan, memcached, Terracotta Server Open Source Kit) technology.

- Most providers can only invest limited marketing resources to increase market visibility.

- There is a lack of market awareness, which means software engineering leaders often address issues that could be easily supported by cloud IMDG services using less suitable, but more popular, approaches.

- Limited availability of skilled developers and system engineers.

- Scarce support from system integrators and ISVs.

- Growing competition from in-memory-enabled scale-out dbPaaS (in particular those based on the popular Redis open source technology).
User Recommendations

- Adopt cloud IMDG services to implement cloud applications that serve large user communities and sustain high throughputs (up to tens or hundreds of thousands of transactions per second) with low latency.

- Preferably use cloud IMDG services in combination with colocated aPaaS and dbPaaS offerings, which is the optimal deployment scenario.

- Give preference to cloud IMDG service providers that support features comparable to those of their on-premises IMDG products, in order to get the most value from the investment.

- Leverage cloud IMDG services as an entry point into IMDG technology, given that these offerings are substantially easier to get started with than their software counterparts.

- Evaluate the combination of on-premises IMDG and cloud IMDG services as a potential enabler for advanced forms of hybrid architectures, where on-premises and in-the-cloud applications share data through a distributed on-premises/cloud data store.

Sample Vendors
Amazon Web Services (AWS); GridGain Systems; Hazelcast; MemCachier; Oracle; Redis Labs; Software AG; TIBCO Software; VMware

Gartner Recommended Reading

Innovation Insight: Turbocharge Your API Platform With a Digital Integration Hub

Market Trends: The Multidimensional Evolution of Platform as a Service to Enable Business Agility

CIPS
Analysis By: Sid Nag, Yefim Natis

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream
Definition

Cloud infrastructure and platform services is the business and technology arrangement where IaaS and/or PaaS capabilities are offered as cloud services. Integrated CIPS implies integration of IaaS and PaaS. The degree of integration may vary but it includes the use of a single self-service portal and catalog, shared identity and access management, a single integrated low-latency network context, unified security, unified monitoring and unified billing.

Why This Is Important

Cloud infrastructure and platform services (CIPS) represents a continuum, and some offerings in the market have characteristics of both. For example, container management IaaS, like Google Kubernetes Engine (GKE), is often compared to an application PaaS. GKE offers no tooling and abstractions to support developer workflows. GKE does, however, offer greater control and flexibility for configuring the compute resources.

Business Impact

A well-functioning CIPS will offer enterprises a more natural, flexible and comprehensive cloud computing environment for their workloads, thereby addressing today's IT needs from an application perspective. Vendors also benefit from CIPS — those coming from IaaS and those specialized in PaaS increase their customer value proposition and ability to compete when covering the broader set of capabilities.
Drivers

- The appeal for CIPS is not in best-of-breed offerings, but in the unification and integration of platform capabilities across these services enabling broad deployment of workloads ranging from ERP to cloud-native.

- Most customers that use a hyperscale CIPS provider, such as Amazon Web Services or Microsoft Azure, have adopted a blend of the provider’s IaaS and PaaS capabilities. Indeed, the availability of this broad portfolio of services is a key aspect of choosing a strategic cloud platform provider. Hyperscalers deliver PaaS services with a direct dependency on their IaaS services. As a customer, whether you are using PaaS services or IaaS services, they are built on a common substrate. The combination of these services means you are making a strategic bet on the cloud provider.

- The complexity and level of investment required to offer a full, integrated portfolio of multifunctional PaaS and IaaS services will likely limit the vendor options in this market to a handful of hyperscalers. Some of the hyperscalers will form ecosystems, enabling smaller PaaS specialists to be included in this market. However, the maturity of this technology will be primarily dependent on the capabilities of the hyperscalers.

Obstacles

- Public CIPS markets are consolidating around the market leaders.

- Infrastructure as a service (IaaS)-only or platform as a service (PaaS)-only cloud providers will continue to exist, but only as secondary cloud providers compared to CIPS providers.

- This, in turn, could make it a monopoly of a handful of cloud providers, stifle competition, and drive stand-alone cloud providers out of the market.

User Recommendations

CIOs, CTOs, IT leaders and planners must:

- Use CIPS in both cloud-native and legacy migration projects to expand your design and deployment options. In some cases, this may involve using capabilities from multiple cloud providers.
Prioritize consolidating systems on a hyperscaler CIPS offering when you are operating and governing fleets of applications at enterprise scale. This improves your economies of scale, skills, and resources through standardization and consistency across your company and industry.

Consider integrated CIPS providers to be long-term application platforms. They should be managed as such, with appropriate attention to potential application portability issues.

Do not assume that all services of the provider are of the same maturity, functional completeness or quality of service.

When considering a smaller specialist PaaS provider, give extra credit to those that are multicloud and, therefore, can be colocated with multiple larger suites of CIPS capabilities.

LCAP

Analysis By: Paul Vincent, Jason Wong, Yefim Natis

Benefit Rating: High

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Definition

A low-code application platform (LCAP) is an application platform that supports low-code declarative and often visual, programming abstractions, such as model-driven and metadata-based programming. An LCAP supports end-user interface creation, includes a database, and is used for rapid application development with simplified software development life cycle tooling.

Why This Is Important

LCAPs are one of the most popular types of development tools supporting the low-code paradigm. They support general web and mobile application development with high productivity while reducing the need for deep developer skills, and are mostly cloud-based. They are widely adopted for developer personas ranging from enterprise software developers to citizen developers. Over 200 vendors support a wide variety of business use cases and industry specializations for digital business automation.
Business Impact

Speeding up application development while reducing developer effort can be transformative for business IT. Businesses adopt LCAP to deliver more automation and reduce their application backlogs as well as enable more self-service application development. Mostly cloud-based, LCAP vendors are also accelerating development of new capabilities to increase their use-case coverage and justify their subscription costs.

Drivers

- LCAPs have evolved from rapid application development, business process management technologies and SaaS extension platforms through their evolution of common capabilities around user interface, database, business logic definition, process orchestration and integration of now-ubiquitous API services. The demand to deliver new business automations through applications continues to outstrip conventional application development capacity. This is despite the rise of SaaS usage for standard business services — indeed the latter has resulted in more demands for custom-made extensions that has resulted in a large part of the LCAP marketing being SaaS vendors’ LCAP: the market is dominated by Salesforce.

- Through the requirement for LCAP to enable competitive SaaS and complete applications, they have evolved toward multifunction capabilities. LCAPs overlap with the business process automation/iBPMS market for workflow use cases, and the MXDP market for user-interface-driven use cases.

- Some vendors have recently focused on cloud-native scalability to support larger B2C deployments and deeper governance tooling to support remote and distributed developers to enable postpandemic business and IT development fusion team structures. Through support for composing applications from multiple API and service types, LCAPs can cover an increasingly large set of enterprise application requirements, with some enterprises starting to choose them as a strategic application platform.
Obstacles

- Current LCAP market share is heavily biased toward some very large hyperscalers and a few successful independent vendors. However, Gartner commonly speaks with clients that have multiple LCAP offerings deployed across the enterprise.

- LCAPs have been implemented by the main SaaS platform vendors whose market dominance and deep pockets could diminish the opportunities for a large number of small LCAP vendors. However, this really means that for most enterprises the question is not whether to adopt LCAP, but which LCAP(s) will they focus on and invest in.

- LCAP like most low-code trades productivity for vendor lock-in (of both applications and developer skills). Vendor cancellations (like Google App Maker) do occur.

- Licensing models vary across vendors and can be regularly updated by vendors, and may not scale for new use cases. This can lead to vendor disillusionment!

User Recommendations

Software engineering leaders, CIOs and CTOs should:

- Evaluate application lock-ins due to the lack of portability or standards for low-code models. This technical debt will accumulate fast, and means that vendor relationships (and contracts) need to be considered strategic. Architecture needs should be considered — for example whether to use the built-in database for all use cases.

- Weigh annual subscriptions against the productivity benefits during application development (and maintenance). Subscription costs for LCAP are typically per end user, encouraging maximum LCAP adoption per paid-up user.

- Ensure developers have access to the tools that make them productive, whether LCAP or others, and are governed accordingly. Different developers with different skill sets will vary in their successful adoption of LCAP.

- Assess LCAP vendors. The large number of vendors implies possible future market instability, although to date there have been few cases of LCAP retirements.

Sample Vendors

Appian; Betty Blocks; Kintone; Mendix; Microsoft; Oracle; OutSystems; Quickbase; Salesforce; ServiceNow
Gartner Recommended Reading

Magic Quadrant for Enterprise Low-Code Application Platforms

Critical Capabilities for Enterprise Low-Code Application Platforms

Identify and Evaluate Your Next Low-Code Development Technologies
Entering the Plateau

Cloud Content Services

Analysis By: Marko Sillanpaa, Michael Woodbridge

Benefit Rating: High

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream

Definition

Cloud content services are a set of services and microservices used to fulfill content-centric use cases across diverse content types: documents, files, images, and video. In the past, document management and enterprise content management systems were implemented as monolithic, on-premises systems, and often proved difficult to extend and adapt to business needs. Cloud content services have the potential to simplify deployment, shorten development cycles and provide greater ongoing flexibility.

Why This Is Important

Cloud content services are employee-centric content services platforms (CSPs) delivered as either SaaS or PaaS offerings. They are either the evolution of established content services platforms or new offerings designed specifically for the cloud. They are growing in popularity as organizations seek to provide modern, collaboration-centric ways of working with content, and look to avoid the infrastructure management and upgrade cycles of previous implementations.

Business Impact

CSPs are a key component of the digital workplace. Cloud content services solutions have the same capabilities, and are simpler to deploy, implement and address the three major business initiatives:

- Increasing employee digital dexterity by provisioning services that support the digital workplace
- Supporting digital business transformation through the ability to develop new applications
- Supporting the requirements of information governance
Drivers

- Microsoft 365 has accelerated market demand for cloud content services. The more long-standing vendors are starting to rearchitecture their on-premises products to the cloud, yet current versions are provider-managed virtual private PaaS, with varying degrees of success. Newer offerings, without the restriction of legacy architectures, tend to be public PaaS.

- Adoption of cloud content services as specialized for specific roles, is more advanced. Specialized applications of cloud content services in spaces like contract life cycle management, legal documents and employee documents have also been growing. We are even seeing adoption in traditionally conservative applications such as regulatory pharm, as evident in the SaaS-regulated enterprise data management suite (EDMS) space.

Obstacles

- Complexities around upgrades, migration and functional limitations within the cloud environments have limited broader enterprise adoption of cloud content collaboration. So organizations also express concern in storing large volumes of machine generated content in the cloud.

- Where vendors are addressing this as virtual private PaaS, upgrade costs can be additional lump sums as newer versions of the product are released. These costs along with others appear as operations charges which may be significantly higher when compared to public PaaS where this is included.

- Change management can be a challenge for organizations selecting public cloud platforms as the vendor controls the release and update cycle. Organizations should assess vendors’ capabilities to manage this challenge with sandbox environments and acceptance mechanisms for when the change is deployed and the flexibility in release schedules.

User Recommendations

- Address the business problems and the expected outcomes. The user experience and speed with which a vendor can address a particular problem are differentiating factors. Often, there are specific integrations or prebuilt solutions that can aid productivity and make a substantive difference to the evaluation and choices.

- Develop an operational model that suits the way your business works. Many vendors offer provider-managed virtual private PaaS, which can be a good fit where there is a large degree of sensitivity about the data and processes concerned.
Conceive an open API framework that provides for customization and support microservices. Cloud content services solutions provide a quick way to improve user experiences, so they are a good fit for organizations looking to continually modernize.

Sample Vendors
Box; Hyland; iManage; Microsoft; NetDocuments; OpenText

Gartner Recommended Reading

Magic Quadrant for Content Services Platforms
Critical Capabilities for Content Services Platforms

iPaaS

Analysis By: Massimo Pezzini

Benefit Rating: High

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition
An integration platform as a service (iPaaS) is a vendor-managed suite of cloud services that delivers a mix of application, data, B2B and other integration functionality, as well as API management and event brokering. An iPaaS targets multiple personas: integration specialists, application developers and business users. Organizations adopt iPaaS as their first move into integration technology, and to complement or replace classic integration software so as to enable democratized integration.

Why This Is Important
Organizations’ accelerating shift to the cloud is boosting the iPaaS market (up 38% in 2020) and has made it the biggest segment ($3.7 billion) of the integration platform technology market. Its functional breadth makes it the natural alternative to classic integration software (ESB, ETL and B2B gateway software) for large organizations. But, unlike the classic software, iPaaS also attracts midsize organizations and lines of business, due to its ease of access, versatility and low initial cost.
Business Impact

By rapidly and cost-effectively addressing integration needs, iPaaS enables organizations to improve efficiency, provide real-time business insights, increase business agility and introduce innovation faster. iPaaS adoption helps software engineering leaders achieve these goals cost-effectively, efficiently and with less costly skills than are needed for classic integration software. Also, iPaaS makes these benefits accessible to midsize organizations that cannot afford classic platform costs.

Drivers

- The vast iPaaS installed base and the COVID-19 pandemic notwithstanding, the iPaaS market grew quickly in 2020, driven by several business factors. These included organizations’ pressing need to automate processes, accelerate digital transformation, react to the dramatic business changes forced by the pandemic, and speed up plans to move to the cloud in order to contain costs and increase agility.

- These factors were strongly at play among midsize organizations — traditionally, heavy users of iPaaS — at least in the less-COVID-19-impacted verticals. Domain-specific iPaaS targeting particular industries, SaaS ecosystems, business processes or geographies has been reasonably successful in this sector, because of its appeal to time-, skill- and resource-constrained organizations.

- The main goal of iPaaS providers now is to maximize opportunities to upsell and cross-sell to their vast installed base. Therefore, they are evolving their offerings into enterprise-class suites that address a wide range of hybrid, multicloud scenarios. Hence, large and global organizations now position iPaaS as a strategic option to complement, but increasingly also to replace, classic integration platform software, which drives more widespread adoption.

- A growing number of SaaS providers “embed” in their applications their own iPaaS, or one from a third party, which they typically extend with a rich portfolio of packaged integration processes (PIPs). This makes embedded iPaaS offerings attractive to organizations that need to quickly address SaaS application integration.

- Providers will keep investing to improve developers’ productivity, reduce time to value and shorten the learning curve. The goal is to further expand their potential audience, to include business users. Hence, providers’ R&D efforts will focus on using AI, machine learning and natural language processing to assist development and operation, enrich PIP portfolios, and enable CI/CD and DevOps to entice professional developers.
Obstacles

Obstacles to even faster iPaaS adoption include:

- The market's extreme fragmentation (over 150 providers and counting). This makes it hard for user organizations to select the best-fit iPaaS for their needs, could generate a proliferation of diverse, stand-alone and embedded iPaaS offerings, and risks fragmenting service providers' investments in skills building.

- The top five PaaS providers' command of about 60% of the market, and the fact that only seven providers have over 2% share. Hence, the vast majority of providers are of dubious viability, which may discourage the most risk-averse organizations from making strategic investments in iPaaS.

- The API rhetoric of seamless “plug and play” integration, the confusion among less technically savvy users about the differences between iPaaS, RPA and API management platforms, and the growing trend for code-based integration encouraged by OSS integration frameworks. These factors could reduce iPaaS’s appeal, at least to large organizations.

User Recommendations

Despite the risks relating to market fragmentation, software engineering leaders responsible for integration should adopt iPaaS when looking for:

- An integration platform for midsize organizations moving to the cloud and for “greenfield” integration initiatives.

- A strategic complement to traditional integration platforms — increasingly in the context of hybrid integration platform (HIP) strategies — in order to empower a collaborative, democratized approach to integration.

- An enabler of self-service integration for ad hoc integrators (such as application developers and SaaS administrators) or citizen integrators.

- A platform to support well-defined, tactical integration projects with low budgets, severe time constraints, and informally defined and incrementally formulated requirements.

- A potential replacement for classic integration platforms that are obsolete or cannot support their changing requirements.
Sample Vendors
Boomi; IBM; Informatica; Jitterbit; Microsoft; MuleSoft; Oracle; SAP; TIBCO Software; Workato

Gartner Recommended Reading

Magic Quadrant for Enterprise Integration Platform as a Service

Critical Capabilities for Enterprise Integration Platform as a Service

Choose the Best Integration Tool for Your Needs Based on the Three Basic Patterns of Integration

Platform as a Service

Analysis By: Yefim Natis, Paul Vincent, Fabrizio Biscotti

Benefit Rating: Transformational

Market Penetration: 20% to 50% of target audience

Maturity: Early mainstream

Definition
Platform as a service (PaaS) is a cloud offering that delivers application engineering and operation infrastructure capabilities as services. Gartner tracks multiple types of PaaS (xPaaS), including application PaaS (aPaaS), integration PaaS (iPaaS), API management and event brokering services, serverless function PaaS, business analytics PaaS (baPaaS), Internet of Things (IoT) PaaS and database PaaS (dbPaaS). PaaS capability can be delivered multicloud, multitenant or dedicated.

Why This Is Important
Organizations that embrace cloud computing seek cloud-native digital experiences. PaaS offerings, often combined with IaaS or SaaS, deliver the next-generation computing environment, featuring greater scalability, availability, agility, productivity and consistency of operations. The breadth of PaaS services, from application development to integration, data management and analytics, makes cloud a powerful platform for business innovation, now mature and broadly present in mainstream computing.
Business Impact

The relationship between the vendors and customers changes dramatically with transition to the cloud, where the vendors shift from just the role of software manufacturers to that of active facilitators of the platform’s operations. Responsibilities, costs, skills and culture of enterprise IT undergo a progressive transformation. The new separation of concerns between the business, its IT resources and technology providers empowers business with greater pace and depth of innovation.

Drivers

- The migration of enterprise computing to the cloud forces most organizations to reskill for cloud-native computing. PaaS increasingly becomes their dominating platform for innovation.

- SaaS is the largest cloud services segment, continuously increasing its revenue and user base. Most customers using SaaS also seek services for customization, extension and integration, thus driving the growth and adoption of various xPaaS offerings.

- Low cost of entry, faster time to market and lower cost of operation force most new vendor innovations to start in the cloud. Most cloud startups are reluctant to expand to selling software, a different and more difficult business. PaaS becomes their exclusive computing context and the go-to-market strategy.

- The scale, productivity and the economies of scale of cloud engineering enable mainstream organizations to create or consume the kinds of applications that they could not afford (in terms of cost and skills) on-premises. A large number of small and medium businesses, formerly barely using platform technologies, become customers of advanced PaaS offerings, traditionally targeting only the advanced IT customers.

- Many cloud platform offerings are low-code, that is, they can be used with minimal or no programming, instead of relying on modeling and other nonprocedural expressions of business logic. This brings to the cloud platform new types of software engineers and business technologists, making PaaS an integral part of the business-IT collaboration.
Obstacles

- Some government regulations restrict access to remote data networks and force organizations to stay off the cloud. Same effect may be created by organizations mistrustful of data privacy or security when managed by a dbPaaS.

- Lack of cloud-native skills or understanding can lead to poor early cloud platform outcomes, delaying the organization's strategic adoption of PaaS.

- Poor planning, implementation or choice of technology can cause high-cost overruns and project failures. Organizations may blame the cloud and choose to discontinue the use of PaaS. Although the organization would inevitably return to the cloud, a lot of time and opportunity would be lost.

- To minimize vendor lock-in, some organizations prefer the use of IaaS+ approach, bringing their own platform technology (typically, open source) to a cloud compute (IaaS) foundation and foregoing the benefits of the managed platform service of a PaaS.

User Recommendations

- Build new business software utilizing PaaS offerings to gain advanced quality of service, including high availability, disaster recovery and security, to take advantage of the continuous business and technology innovation that will mostly be cloud-native and often cloud-only.

- Utilize PaaS offerings continuum for a full scale of their capabilities, well beyond the application PaaS, including integration, event processing and stream analytics, IoT, business process management, database management, and business analytics platform services.

- Choose the hyperscale IaaS+PaaS or SaaS+PaaS providers when looking to consolidate cloud business relationships, but avoid exclusive commitments to retain the technical and business ability to incorporate services of multiple providers.

- Add some independent multicloud PaaS offerings to the mix along with the platform services of the hyperscalers, to maintain a degree of protection from the potential hyperscalers’ changes in policies and strategies.

Sample Vendors

Amazon Web Services (AWS); Appian; Boomi; Cloudera; Google; IBM; Mendix; Microsoft; Oracle; Salesforce
Private PaaS

Analysis By: Yefim Natis, David Smith

Benefit Rating: Moderate

Market Penetration: 20% to 50% of target audience

Maturity: Mature mainstream

Definition

A private platform as a service (PaaS) is a type of PaaS that offers customer organization exclusive access. Private PaaS may be established on-premises or hosted off-premises by the customer organization (self-managed). It can be managed by a service provider (provider-managed), typically as an isolated-tenancy (dedicated) rendition of a public PaaS available from the same provider.

Why This Is Important

As the name implies, private PaaS is important to organizations that seek cloud experience, but for reasons of quality of service, security or regulation, can not accept public cloud services.
Business Impact

Private PaaS provides more consistent service performance, compared to the multitenant public cloud services, but at a typically increased cost, and reduced scale and functionality. It may resolve the conflicts between the companies’ computing requirements and their geopolitical constraints. Private PaaS is also believed by some to provide better data security than a public cloud, though in reality for most organizations the public PaaS security is more advanced and of a higher scale.

Drivers

- Organizations that wish, despite using cloud services, to retain full control of their data and other computing resources, for internal or regulation reasons, turn to local, self-managed private PaaS.
- Organizations that seek a consistent and minimally interrupted performance of their computing resources, and are willing to pay for it, choose remote provider-managed (also known as “dedicated”) private PaaS.
- Organizations that wish to achieve quality of service close to that of a public IaaS, while still protecting the privacy and security of their platform operations, choose on-IaaS remote self-managed private PaaS.

Obstacles

- Technology and skills required to support self-managed private PaaS exceed the capabilities and resources of most mainstream organizations.
- The costs of the provider-managed local (distributed cloud) or remote (dedicated) private PaaS are significantly higher than the same services provided in a multitenant public cloud.
- Mistrust of public cloud providers leaves only one option available: local, self-managed private PaaS. Managing this arrangement requires a lot of insight, skills and discipline.
User Recommendations

- Conduct the data-driven assessment of the estimated short- and long-term costs, and required skills thoroughly before settling on self-managed private PaaS.

- Choose private PaaS when you seek protection from potential interference or unauthorised access, and you determine that you have the required skills and budgets for short- as well as long-term requirements.

- Choose provider-managed public PaaS or a self-managed software platform (not cloud) in most cases. Both “private cloud on-premises” and “self-managed private platform software on public cloud IaaS” are difficult, carrying a risk of failure when the preparation and investment are insufficient.

Gartner Recommended Reading

The Many Faces of Private Cloud

Should My Cloud Be Public or Private?

Public or private cloud

Hype Cycle for Platform as a Service, 2020

Market Trends: The Multidimensional Evolution of Platform as a Service to Enable Business Agility

Application PaaS

Analysis By: Paul Vincent, Yefim Natis, Fabrizio Biscotti

Benefit Rating: Moderate

Market Penetration: More than 50% of target audience

Maturity: Mature mainstream
Definition

An application platform as a service (aPaaS) is a cloud platform service that offers an environment and tools for general-purpose application development and deployment. The major aPaaS types include low-code platforms (targeting high productivity and reduced skill sets) and pro-code platforms (providing high control of underlying design patterns and resources).

Why This Is Important

The aPaaS market is served by all the cloud megavendors as well as independents, and has replaced much of the application platform market. Cloud infrastructure vendors' aPaaS offerings are typically pro-code, container-based, while most independent vendors offer low-code aPaaS. These technologies are now mainstream and are used strategically by enterprise and departmental IT teams. The combination of pro-code and low-code aPaaS fulfills most requirements for new business application initiatives.

Business Impact

Cloud-native application development via cloud services (platform as a service) offers the modern, elastic application services and components required by enterprises for digital initiatives. These "opinionated" platform stacks provide a standardized environment for multiple application services and development life cycle tools, either built in (typically low-code platforms), or as part of a cloud integrated platform service (typically via infrastructure megavendors).
Drivers

- Organizations looking to replace Java and Microsoft.NET application server technologies to exploit cloud services and productivity are turning to pro-code aPaaS from megavendors. These megavendors’ cloud-integrated platform service strategies offer Java, C#, Python, JavaScript, etc., through container-based aPaaS, alongside other cloud services such as databases, API management and integration, for business application development.

- For business IT developers extending SaaS, low-code application platforms (aPaaS) and related bpmPaaS and citizen development tooling can often replace some of the classic pro-code applications to reduce time to market in exchange for lower application complexity limits.

- The mainstream acceptance of cloud for enterprise and departmental IT applications is driving aPaaS adoption. Pro-code aPaaS competes with self-assembly Kubernetes-based container platforms, and alternatives include PaaS frameworks as well as serverless function PaaS (fPaaS). Low-code aPaaS increasingly competes with pro-code aPaaS for composable applications based on existing services, as well as extends toward citizen development usage.

- The primary drivers for adoption of aPaaS offerings are ease of use, productivity advantages, suitability for cloud-centric use cases and versatility. These offerings serve to meet the increasing digital expectations of business users.
Obstacles

- While pro-code aPaaS offerings provide greater agility, scalability, productivity and efficiency than traditional on-premises alternatives, they carry subscription costs priced according to a variety of pricing models and metrics.

- Some pro-code development pipeline stacks are more suited to a managed container deployment than more-opinionated aPaaS.

- Low-code aPaaS are deemed as “deskilling” by some development teams resisting its adoption.

- Some vendors offer multiple choices for aPaaS, offering alternative technology visions, application frameworks or technology levels, as well as serverless fPaaS. There are no totally integrated, single-platform aPaaS, combining pro-code and low-code support.

- In some cases, other platforms can be more suitable for more demanding and complex application scenarios such as extreme performance and system control applications. In some situations (often related to geopolitical market dynamics), cloud, and therefore aPaaS, is simply not an option.

User Recommendations

- Use aPaaS as a strategic platform for most new and modernized applications as it provides cloud-first, cloud-native best practices.

- Evaluate both pro-code and low-code aPaaS for appropriate use cases. Blend usage of pro-code and low-code aPaaS for maximum flexibility in terms of technologies, development skills, and speed and sophistication of application delivery.

- Use cloud-agnostic, pro-code, container-based PaaS (e.g., OpenShift, Tanzu and Anthos) when high-control hybrid or multicloud services are desired.

- Augment or replace pro-code aPaaS with fPaaS when you require fine-grained control of costs or variability in compute resources and are not concerned with infrastructure for pro-code applications.

- Give special consideration to integration and composition needs when planning aPaaS-centered initiatives. Web-scale IT will demand continuous change, extension and integration.
Sample Vendors

Amazon Web Services (AWS); Google; Mendix; Microsoft; OutSystems; Platform.sh; Salesforce; ServiceNow

Gartner Recommended Reading

Magic Quadrant for Cloud Infrastructure and Platform Services

Magic Quadrant for Enterprise Low-Code Application Platforms

Top 10 Trends in PaaS and Platform Innovation, 2020
Appendixes

Figure 2. Hype Cycle for Platform as a Service, 2020

Hype Cycle for Platform as a Service, 2020

Source: Gartner (August 2020)
Hype Cycle Phases, Benefit Ratings and Maturity Levels

**Table 2: Hype Cycle Phases**
(Enlarged table in Appendix)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>Innovation Trigger</strong></td>
<td>A breakthrough, public demonstration, product launch or other event generates significant media and industry interest.</td>
</tr>
<tr>
<td><strong>Peak of Inflated Expectations</strong></td>
<td>During this phase of overenthusiasm and unrealistic projections, a flurry of well-publicized activity by technology leaders results in some successes, but more failures, as the innovation is pushed to its limits. The only enterprises making money are conference organizers and content publishers.</td>
</tr>
<tr>
<td><strong>Trough of Disillusionment</strong></td>
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Source: Gartner (August 2021)
### Table 3: Benefit Ratings

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<th>Benefit Rating</th>
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Table 4: Maturity Levels  
(Enlarged table in Appendix)

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Source: Gartner (August 2021)
### Acronym Key and Glossary Terms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AD</td>
<td>application development</td>
</tr>
<tr>
<td>AI</td>
<td>artificial intelligence</td>
</tr>
<tr>
<td>AIM</td>
<td>application integration and middleware</td>
</tr>
<tr>
<td>aPaaS</td>
<td>application platform as a service</td>
</tr>
<tr>
<td>BPM</td>
<td>business process management</td>
</tr>
<tr>
<td>BPMS</td>
<td>business process management suite</td>
</tr>
<tr>
<td>CAGR</td>
<td>compound annual growth rate</td>
</tr>
<tr>
<td>ESB</td>
<td>enterprise service bus</td>
</tr>
<tr>
<td>FLAPIM</td>
<td>full life cycle API management</td>
</tr>
<tr>
<td>HIP</td>
<td>hybrid integration platform</td>
</tr>
<tr>
<td>hpaPaaS</td>
<td>high-productivity aPaaS</td>
</tr>
<tr>
<td>ICC</td>
<td>integration competency center</td>
</tr>
<tr>
<td>IMC</td>
<td>in-memory computing</td>
</tr>
<tr>
<td>IMDG</td>
<td>in-memory data grid</td>
</tr>
<tr>
<td>IoT</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>iPaaS</td>
<td>integration platform as a service</td>
</tr>
<tr>
<td>LCAP</td>
<td>low-code application platform</td>
</tr>
<tr>
<td>LOB</td>
<td>line of business</td>
</tr>
<tr>
<td>ML</td>
<td>machine learning</td>
</tr>
<tr>
<td>MASA</td>
<td>mesh app and service architecture</td>
</tr>
<tr>
<td>MFT</td>
<td>managed file transfer</td>
</tr>
<tr>
<td>OSS</td>
<td>open-source software</td>
</tr>
<tr>
<td>PaaS</td>
<td>platform as a service</td>
</tr>
<tr>
<td>RPA</td>
<td>robotic process automation</td>
</tr>
<tr>
<td>SMB</td>
<td>small or midsize business</td>
</tr>
</tbody>
</table>
TPM | transaction processing monitor

**Document Revision History**

Hype Cycle for Platform as a Service, 2020 - 12 August 2020
Hype Cycle for Platform as a Service, 2019 - 29 July 2019
Hype Cycle for Platform as a Service, 2018 - 9 August 2018
Hype Cycle for Platform as a Service, 2017 - 19 July 2017
Hype Cycle for Platform as a Service, 2016 - 12 July 2016
Hype Cycle for Platform as a Service, 2015 - 23 July 2015

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**Recommended by the Authors**

Some documents may not be available as part of your current Gartner subscription.

*Understanding Gartner’s Hype Cycles*
*Create Your Own Hype Cycle With Gartner's Hype Cycle Builder*
*Top 10 Trends in PaaS and Platform Innovation, 2020*
*Hype Cycle for Cloud Computing, 2021*
*Hype Cycle for Application Architecture and Integration, 2021*
*Hype Cycle for Application Services, 2021*
*Hype Cycle for Software as a Service, 2020*
*Magic Quadrant for Enterprise Low-Code Application Platforms*
### Table 1: Priority Matrix for Platform as a Service, 2021

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<thead>
<tr>
<th>Benefit</th>
<th>Years to Mainstream Adoption</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Less Than 2 Years</td>
</tr>
<tr>
<td><strong>Transformational</strong></td>
<td>Platform as a Service</td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>Cloud Content Services</td>
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<td>Cloud MDM</td>
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<td>A breakthrough, public demonstration, product launch or other event generates significant media and industry interest.</td>
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<td><strong>Peak of Inflated Expectations</strong></td>
<td>During this phase of overenthusiasm and unrealistic projections, a flurry of well-publicized activity by technology leaders results in some successes, but more failures, as the innovation is pushed to its limits. The only enterprises making money are conference organizers and content publishers.</td>
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