

The Forrester Wave™: Function-As-A-Service Platforms, Q1 2021

The Nine Providers That Matter Most And How They Stack Up

by Jeffrey Hammond and David Mooter

March 25, 2021

Why Read This Report

In Forrester's 40-criterion evaluation of function-as-a-service (FaaS) platforms, we identified the nine most significant ones — Alibaba, Amazon, Google, Huawei, IBM, Microsoft, Nimbella, Oracle, and Tencent — and researched, analyzed, and scored them. This report shows how each provider measures up and helps application development and delivery (AD&D) professionals select the right one for their needs.

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FaaS Platforms Give Developers A Fast Track To Cloud-Native Services

FaaS platforms give developers a quick way to build cloud-native microservices by abstracting away the complexities of managing and scaling clusters of containers or virtual machines. In return for handing over management of lower-level infrastructure concerns to a FaaS provider, developers get a programming environment that lets them write microservices as small, simple functions in languages they already know like Java, C#, JavaScript, or Python. The FaaS provider then automatically scales these microservices up (and down) as demand for the services dictates.

By trading off control over infrastructure for abstraction from its complexity, FaaS developers report that they can quickly take new ideas from inception to deployment while matching infrastructure costs to actual demand for microservice execution. When selecting a FaaS provider, developers should look for providers that:

- **Support function and container packaging.** As developers expand the types of workloads that run on FaaS platforms, they may simply package up and deploy a function as a ZIP or JAR file or deploy frameworks for custom code packaged as an OCI-compliant container. Look for a FaaS platform that supports both options to maximize developer flexibility across web, content, and event-driven workloads.
- **Provide robust security capabilities.** As developer use of FaaS platforms expands, it's important to securely provide access to data and APIs that are encapsulated in virtual private networks or virtual private clouds (VPCs). And as functions scale up and down, it's important to quickly connect to these resources without a lengthy "cold start."
- **Invest in third-party ecosystems and open standards.** Unless you are willing to go all in with a single public cloud provider, it's important to look for FaaS providers that facilitate connection with their platform. Examples of functionality to look for include third-party observability, event bindings, and messaging protocols.

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Evaluation Summary

The Forrester Wave™ evaluation highlights Leaders, Strong Performers, Contenders, and Challengers. It's an assessment of the top vendors in the market and does not represent the entire vendor landscape. You'll find more information about this market in our reports on serverless technology.

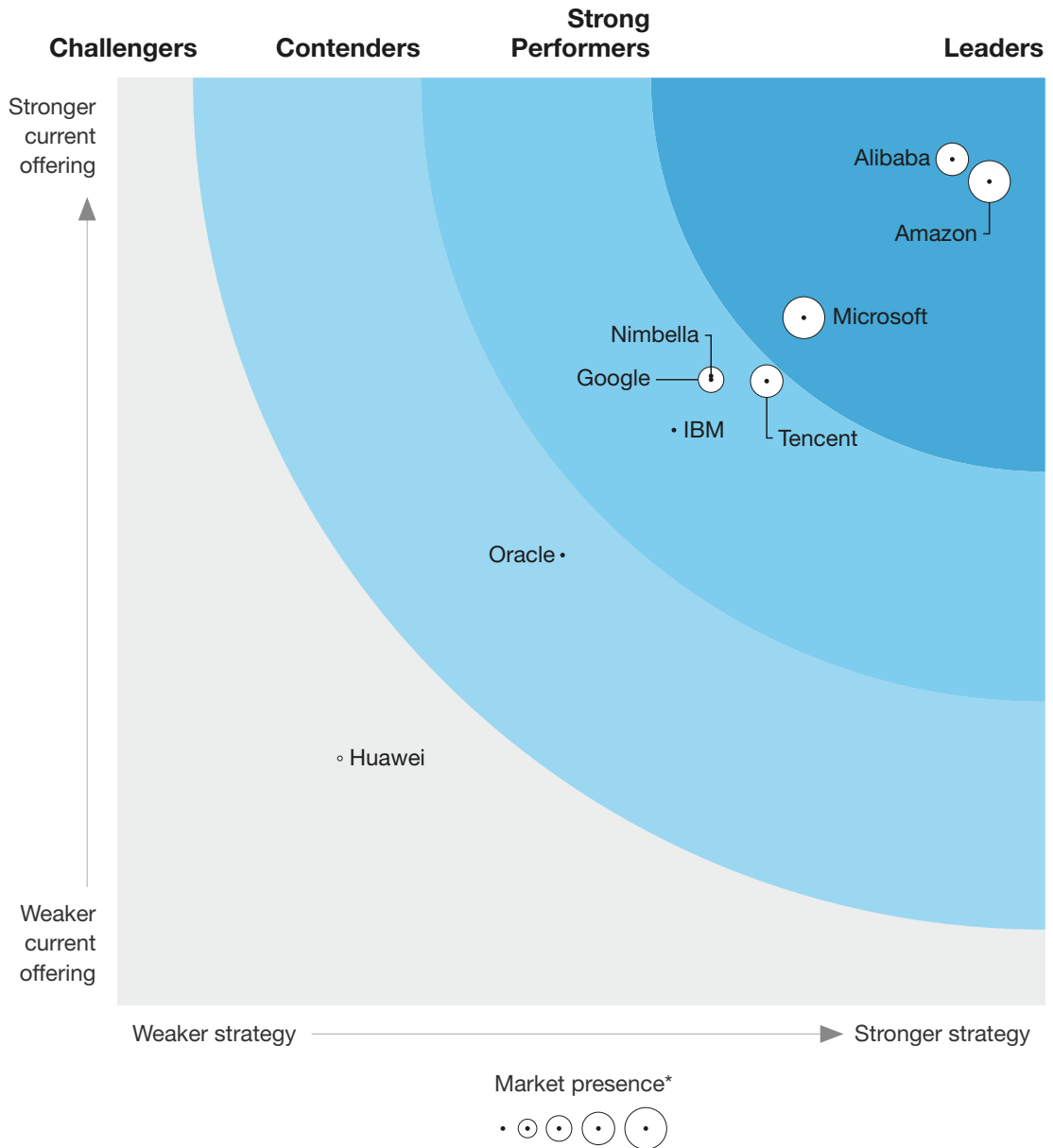
We intend this evaluation to be a starting point only and encourage clients to view product evaluations and adapt criteria weightings using the Excel-based vendor comparison tool (see Figure 1 and see Figure 2). Click the link at the beginning of this report on Forrester.com to download the tool.

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FIGURE 1 Forrester Wave™: Function-As-A-Service Platforms, Q1 2021

THE FORRESTER WAVE™
 Function-As-A-Service Platforms
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*A gray bubble indicates a nonparticipating vendor.

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FIGURE 2 Forrester Wave™: Function-As-A-Service Platforms Scorecard, Q1 2021

	Forrester's weighting	Alibaba	Amazon	Google	Huawei*	IBM	Microsoft	Nimbella	Oracle	Tencent
Current offering	50%	4.56	4.44	3.37	1.33	3.10	3.71	3.39	2.43	3.36
Developer experience	20%	4.60	4.20	3.80	1.60	3.20	4.60	3.20	2.60	3.40
Programming model	20%	5.00	4.00	3.00	1.50	3.50	3.50	4.50	1.00	4.50
Runtime execution environment	20%	4.80	4.80	3.40	1.00	3.80	3.40	3.40	3.60	3.60
Observability	10%	4.00	5.00	5.00	1.00	3.00	3.00	3.00	2.00	2.00
Integrations	10%	3.00	4.00	2.00	1.50	2.00	3.50	3.00	2.50	2.00
Security features	10%	4.80	4.80	3.00	1.60	2.00	3.60	2.40	3.00	2.60
Support for specialized workloads	10%	5.00	4.60	3.32	1.00	3.00	3.96	3.32	2.36	4.04
Strategy	50%	4.50	4.70	3.20	1.20	3.00	3.70	3.20	2.40	3.50
FaaS vision	25%	5.00	5.00	3.00	1.00	3.00	5.00	5.00	1.00	3.00
Execution roadmap	25%	5.00	5.00	3.00	1.00	3.00	3.00	5.00	3.00	3.00
Partner ecosystem	10%	3.00	5.00	5.00	1.00	3.00	5.00	3.00	3.00	5.00
Supporting product and services	15%	3.00	3.00	3.00	1.00	3.00	3.00	1.00	3.00	5.00
Practitioner engagement strategy	15%	5.00	5.00	3.00	1.00	3.00	3.00	1.00	1.00	3.00
Pricing strategy	10%	5.00	5.00	3.00	3.00	3.00	3.00	1.00	5.00	3.00
Market presence	0%	4.32	5.00	3.00	1.00	1.00	5.00	1.66	1.66	3.68
Geographic distribution	33%	5.00	5.00	3.00	1.00	1.00	5.00	3.00	3.00	3.00
Customers	33%	5.00	5.00	3.00	1.00	1.00	5.00	1.00	1.00	3.00
Product revenue	34%	3.00	5.00	3.00	1.00	1.00	5.00	1.00	1.00	5.00

All scores are based on a scale of 0 (weak) to 5 (strong).

*Indicates a nonparticipating vendor

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Vendor Offerings

Forrester included nine vendors in this assessment: Alibaba, Amazon, Google, Huawei, IBM, Microsoft, Nimbella, Oracle, and Tencent (see Figure 3).

FIGURE 3 Evaluated Vendors And Product Information

Vendor	Product evaluated
Alibaba	Function Compute
Amazon	AWS Lambda
Google	Cloud Functions
Huawei	Function Graph
IBM	IBM Cloud Functions
Microsoft	Azure Functions
Nimbella	Nimbella Platform
Oracle	Oracle Cloud Functions
Tencent	Serverless Cloud Functions

Vendor Profiles

Our analysis uncovered the following strengths and weaknesses of individual vendors.

Leaders

- Amazon leads with geographic reach, ecosystem breadth, and steady execution.** In 2020's Forrester Wave, we called out Lambda's excellent geographic availability, customer adoption, developer experience for deploying functions, and ecosystem support. That hasn't changed in 2021. But capabilities like the support for Amazon Elastic File System, ability to run OCI-compliant containers, and adoption of 1-ms-based billing increments keep Lambda on an innovative path and increase the types of workloads it is suitable for. Robust support for serverless security and specialized workloads helps Lambda maintain leadership status in 2021. Developers willing to embrace Amazon's view that FaaS workloads should be short-lived will find that Lambda gives them a robust FaaS platform that is steadily opening up to third-party tools and container-centric deployment processes. It provides distinct services for granular capabilities like state management, database operations, and APIs.

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Reference customers gave Amazon Web Services (AWS) Lambda high marks for great customer support, performance, and variety of AWS and third-party services that they can use with Lambda. Customers also called out the level of engagement with experienced practitioners. Reference customers suggested improvements to observability and more streamlined developer tools. AWS Lambda best suits asynchronous ephemeral workloads including integration of other AWS services, internet of things, batch processing, new web applications, and event-driven integration.

- **Alibaba uses containers and open standards to accelerate web and content workloads.**

In 2020, we described Alibaba Function Compute as a solid general-purpose platform. In 2021, Function Compute's embrace of containers and support for open source projects and standards like OpenTracing, OpenTelemetry, Grafana, and Jaeger give it a boost. When added to Function Compute's investment in supporting popular web frameworks, content-centric workloads, 1-ms billing increments, and runtime investments, we now view Alibaba Function Compute as a leader in the FaaS market, especially for clients looking to process video-heavy workloads or take advantage of the function concurrency their container-centric model supports.

Reference customers gave Alibaba Function Compute high marks for event integration within the Chinese ISV ecosystem and praised extra-level customer support during holidays like Christmas and New Year's. On the technical side, customers were pleased that they could scale to tens of thousands of instances in minutes. Reference customers wanted better programming language support for remote debugging and would like to see better support for GPU compute. While Alibaba Function Compute still best suits companies with workloads in Hong Kong or China, international coverage is expanding and now stands at 10 regions with 21 availability zones.

- **Microsoft Azure Functions reserves important enterprise features for premium plans.** Azure Functions supports a multitude of programming languages and stateful durable functions in its consumption plan, but preprovisioned instances, docker container support, and robust security features require developers to step up to a premium, dedicated, or Azure App Service plan. Durable Functions provides stateful capabilities and bindings for Azure Event Hub, and Azure Event Grid helps developers build event-driven microservices. This year, Microsoft has also upped its developer experience game, scoring top marks with investments in onboarding, developer tools support, and support for development and debugging on local machines.

Reference customers gave Azure Functions high marks for integration with other Azure services like Key Vault for secret storage. Strong built-in observability was also called out. Customers are generally happy with Azure Functions performance and service quality. Customers' complaints center on the added costs of the premium service plan to access important enterprise features like VPC support and preprovisioned instances. Azure Functions is best for customers exploring other Azure services or in need of a FaaS platform with global reach. Expect to upgrade to the premium version of the app service plans if your team anticipates building or integrating with enterprise workloads.

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Strong Performers

- **Tencent optimizes cloud-centric development with Serverless Cloud Function (SCF).**

Tencent has built a compelling web-based toolset for developing functions and coupled it with a robust runtime that has support for many programming languages, complex workflows, and longer-running function instances. Developers can preprovision function instances, and Tencent offers specialized support for AI workloads and industry-specific clouds. SCF also serves as an extensibility mechanism for the WeChat ecosystem, which makes it a good choice for companies that want to engage with customers via WeChat extensions. But developers looking for local development and debugging options for their functions will find Tencent's cloud-centric development philosophy wanting.

Reference customers gave Tencent SCF high marks for performance, customer support, and the low cost of workload execution. Customers expressed some concerns about platform stability and a desire for more built-in event triggers for additional cloud services from Tencent and other third parties. Tencent SCF is a good choice for clients that need to deploy FaaS capability in China, are looking to integrate and extend with WeChat to engage customers, and are comfortable with a cloud-centric development approach.

- **Nimbella fully embraces hybrid cloud with a FaaS-anywhere approach.** Like IBM Cloud Functions, Nimbella is based on the open source Apache OpenWhisk project. Nimbella adds a simple, fast developer onboarding process to a runtime that developers can use in a pure FaaS model, as an installable function platform on other public clouds, or even on-premises. Nimbella delivers this FaaS-anywhere approach with robust container support, broad support for programming languages, and configurable settings for maximum function duration. The result: a FaaS solution that well suits long-running stateful functions. But the platform's flexibility comes with some caveats. While the managed solution provides built-in isolation for tenants, the installable solution is deployable in hybrid configuration, which teams can tailor to suit a broad range of organizational needs and security policies. As a result, teams taking the hybrid route should expect to spend more time setting up and configuring production infrastructure.

Reference customers gave Nimbella high marks for customer support and help with implementation best practices. Customers also cite minimal lock-in risk as a reason for choosing Nimbella.

Customers' concerns include security and observability, along with more code samples and digital content to help speed adoption. Nimbella is a good solution for development teams that commit to a hybrid FaaS solution and want to provide their own networking and integration capabilities on top of a serverless platform. Nimbella's licensing model is also most attractive to teams that want a monthly or an enterprise agreement instead of consumption-based pricing models.

- **Google covers the bases with Cloud Functions and Cloud Run.** Google's FaaS offering reflects the transition that several FaaS platforms are going through as public cloud providers embrace containers and Kubernetes as a key platform enabler of FaaS runtimes. Google Cloud Functions support classic function packaging and deployment with a runtime that scales up well and cools

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down slowly, and Google Cloud Ops integration results in great observability. Google Cloud Run allows developers to package functions with Google's Functions Framework, deploy them using Knative, and run them in hybrid deployment scenarios. Programming language support has also improved from 2020's evaluation.

Reference customers gave Google high marks for performance and simplicity and called out the security and scalability of Cloud Functions. Customers also called out direct involvement and support by the product management and customer support teams as an added plus. Areas for improvement include better extensibility for packaging up third-party libraries with functions (e.g., to process Kafka messages) and greater transparency of the dependencies that support the Cloud Functions runtime. Customers that are interested in global scale and want a smooth transition from functions to containers in hybrid FaaS deployment scenarios will find Google Cloud Run fits the bill.

- **IBM rounds out Cloud Functions and preps Code Engine for launch.** IBM Cloud Functions is based on the open source Apache OpenWhisk project. It adds a built-in API gateway, good event streaming support, and strong function isolation at the container level. IBM also offers the best service-level agreement terms and availability of any vendor in this review. But there are still areas where Cloud Functions could be better, including limited network isolation options and preprovisioned function instance support. In 2020, we also noted that IBM needed a unified function runtime strategy after its Red Hat acquisition. That now appears nigh with IBM Cloud Code Engine. While it's not generally available (GA) yet (and thus not included in our analysis), Code Engine adds Kubernetes and Knative support to IBM's FaaS strategy.

Reference customers gave IBM high marks for fast autoscaling of function instances and high concurrency of compute-oriented workloads. Other customers called out the OpenWhisk support as an enabler of portability that limits lock-in risk. Areas for improvement include better orchestration, observability, and support for preprovisioned functions instances. Existing IBM customers will find Cloud Functions to be a good fit for integration workloads, and its broad support for many programming languages gives most developers a smooth path to serverless. Clients should also check out IBM Cloud Code Engine when it's GA, especially if they are making investments in Kubernetes-based infrastructure and want to add functions as a packaging option.

Contenders

- **Oracle prioritizes security, containers, and event-driven integration.** When we looked at Oracle Cloud Functions in 2020, it was a relatively new service, and it showed in our evaluations. In 2021, Oracle's FaaS platform has moved from Challenger status well into the Contender zone. Oracle Functions are built on the open source Fn project, and functions are packaged as OCI containers. As Oracle builds out its FaaS platforms, it's focusing on a secure-by-design model that will please many enterprise shops. By default, function instances are only exposed inside a subnet of a client's virtual cloud network. Unlike some other FaaS vendors, there is no additional charge for private cloud support. As a result, Oracle is seeing balanced global adoption across North America, Europe, Asia, and Latin America.

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Reference customers gave Oracle Cloud Functions high marks for performance, ease of use, development time, depth of documentation, and overall execution cost. Concerns included occasional latency issues that required workarounds, likely due to a lack of current support for preprovisioned instances. Oracle Cloud Functions well suit enterprises that are using other OCI services. Customers with worldwide deployment needs will also appreciate its 23-region availability.

Challengers

- **Huawei FunctionGraph is a new market entrant that shows promise.** FunctionGraph is still an evolving offering, but in our evaluation, it's already reached market parity with its development tool support, local development capabilities, and event-driven integration support. FunctionGraph can execute functions of up to 15-minutes maximum duration and supports Node.js, Java, Python, Go, C#, and PHP. But as a new market entrant, there are some limitations to the FunctionGraph platform. Documentation is somewhat sparse, support for specialized workloads in low, and integration support is below part. Current availability is also limited in some regions. Therefore, we think FunctionGraph best suits developers looking to deploy workloads in China or international locales where Huawei Cloud has regional support, including Brazil, Chile, Mexico, Singapore, South Africa, or Thailand. Huawei declined to participate in the full Forrester Wave evaluation process.

Evaluation Overview

We evaluated vendors against 40 criteria, which we grouped into three high-level categories:

- **Current offering.** Each vendor's position on the vertical axis of the Forrester Wave graphic indicates the strength of its current offering. Key criteria for these solutions include the developer experience, programming model, runtime execution environment, and security features.
- **Strategy.** Placement on the horizontal axis indicates the strength of the vendors' strategies. We evaluated the FaaS platform providers' vision, execution ability, ecosystem, engagement, and pricing strategy.
- **Market presence.** Represented by the size of the markers on the graphic, our market presence scores reflect each vendor's geographic distribution, customer base, and product revenues.

Vendor Inclusion Criteria

Forrester included nine vendors in the assessment: Alibaba, Amazon, Google, Huawei, IBM, Microsoft, Nimbella, Oracle, and Tencent. Each of these vendors:

- **Has a FaaS platform.** Each vendor has a FaaS platform that is readily available to customers and runs production workloads.

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- **Participated in Forrester’s serverless Now Tech.** FaaS platforms are a key component of a serverless approach to building cloud-native applications. We detailed the scope of serverless options for developers in Forrester’s “[Now Tech: Serverless, Q1 2021.](#)”

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Supplemental Material

Online Resource

We publish all our Forrester Wave scores and weightings in an Excel file that provides detailed product evaluations and customizable rankings; download this tool by clicking the link at the beginning of this report on Forrester.com. We intend these scores and default weightings to serve only as a starting point and encourage readers to adapt the weightings to fit their individual needs.

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The Forrester Wave Methodology

A Forrester Wave is a guide for buyers considering their purchasing options in a technology marketplace. To offer an equitable process for all participants, Forrester follows [The Forrester Wave™ Methodology Guide](#) to evaluate participating vendors.

In our review, we conduct primary research to develop a list of vendors to consider for the evaluation. From that initial pool of vendors, we narrow our final list based on the inclusion criteria. We then gather details of product and strategy through a detailed questionnaire, demos/briefings, and customer reference surveys/interviews. We use those inputs, along with the analyst's experience and expertise in the marketplace, to score vendors, using a relative rating system that compares each vendor against the others in the evaluation.

We include the Forrester Wave publishing date (quarter and year) clearly in the title of each Forrester Wave report. We evaluated the vendors participating in this Forrester Wave using materials they provided to us by January 21, 2021, and did not allow additional information after that point. We encourage readers to evaluate how the market and vendor offerings change over time.

In accordance with [The Forrester Wave™ and New Wave™ Vendor Review Policy](#), Forrester asks vendors to review our findings prior to publishing to check for accuracy. Vendors marked as nonparticipating vendors in the Forrester Wave graphic met our defined inclusion criteria but declined to participate in or contributed only partially to the evaluation. We score these vendors in accordance with [The Forrester Wave™ And The Forrester New Wave™ Nonparticipating And Incomplete Participation Vendor Policy](#) and publish their positioning along with those of the participating vendors.

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