GigaOm Radar for Leveraging Federated Kubernetes

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TOPIC: CLOUD
1. Summary

This report explores the nascent Federated Kubernetes landscape and looks at current, emerging, and future solutions and approaches that will impact enterprise cloud customers. It also provides insight into the emerging providers in this dynamic market space.

Keep in mind that it is early days still for Federated Kubernetes, both in terms of progress toward an industry standard and the emergence of infrastructure players moving to support this approach (if not the standard itself). Included among these players are the major public cloud providers, such as AWS, Microsoft, and Google.

Also addressed in this report are existing mid-tier players that are a large part of the ecosystem, such as Rancher, CoreOS, and Docker. Finally, there are the third-tier hosted players offering Kubernetes as a service, security systems, and management stacks that all support distributed Kubernetes clusters.

What’s helpful about the Federated Kubernetes approach, whether leveraging the KubeFed standard or a more closed approach, is that the architecture should make it easy to deal with multiple clusters running on distributed systems, even on multiple clouds. This capability is based on using two major building blocks.

- **Syncing resources across clusters:** As you may expect, syncing resources is the core challenge for those deploying federated or distributed Kubernetes clusters. Mechanisms within Kubernetes can automatically sync deployments on plural clusters, running on local or remote systems, cloud and not cloud.

- **Inter-cluster discovery:** This addresses the ability to automatically configure DNS servers and load balancers with backends that support all clusters running across many public clouds. This is important considering that while good Kubernetes architects can basically DIY a Kubernetes architecture that’s federated, the ability to automate this architecture in terms of the build and operational processes (DevOp) will hasten adoption.

The benefits of leveraging multi-cloud/Federated Kubernetes include high availability, considering you can replicate active/active clusters across multiple public clouds. Thus, if one has an outage, the other can pick up the processing without missing a beat. Also, you avoid the specter of provider lock-in. Kubernetes acts as the abstraction layer that can remove you from the complexities and native details of each public cloud provider. And in this regard, it replaces both cloud services brokers (CSB) and cloud management platforms (CMP).

Note: In evaluating Federated Kubernetes technology we found that the approaches were all over the place in terms of how clusters are distributed. Most provide a DIY approach, meaning that the building of Federated Kubernetes architecture was hands-on. Indeed, most of the distribution and federation of Kubernetes clusters to date have been built this way, including using many of the tools and technologies evaluated here.
2. About the GigaOm Radar

HOW TO READ THIS REPORT

This GigaOm report is part of a series of documents that help IT professionals understand, explore, and evaluate a specific technology and its attendant market. It enables organizations to assess competing solutions in the context of well-defined criteria and metrics. For a fuller understanding, consider reviewing the following reports:

Key Criteria report: A detailed market sector analysis focused on a specific technology domain. The report enables IT decision-makers to make better decisions by defining key features and criteria for a product sector and assessing their impact on core evaluation metrics. This framework provides a strong overview of a technology sector and the solutions and vendors enabling it. The Key Criteria report is critical to informing the GigaOm Radar report.

Radar report: A market landscape analysis that provides a forward-looking evaluation of vendors and their solutions in a specific technology sector. The GigaOm Radar leverages scoring and qualitative analysis to plot a chart that depicts the relative value, character, and progression of vendors’ solutions. The Radar report includes a breakdown of each vendor’s offering in the sector.

Vendor Profile: An in-depth vendor analysis that provides an accessible, deep dive into a company’s engagement with a technology sector. The analysis builds on coverage presented in the Key Criteria and Radar reports, drilling into details of the vendor’s solution and assessing the company’s strategy as it relates to the market sector. This analysis includes forward-looking guidance around both strategy and product.
3. Market Categories & Segmentation

Keep in mind that this report is not covering the general Kubernetes market. The focus here is on the ability to offer distributed/Federated Kubernetes, including support for distributed clusters. Also, it’s worth noting that in some cases enterprises are approaching this as DIY customization, taking on the platform work themselves.

For a better understanding of the market and vendor positioning, we broke distributed/Federated Kubernetes vendor solutions into three distinct categories, as shown in Figure 1:

1. **Public cloud IaaS players with Kubernetes services.** All of the large public IaaS cloud providers such as AWS, Microsoft, and Google sell Kubernetes-based services. Thus, they have the ability to do federation using DIY facilities. However, most have not tossed their hat into the Federated Kubernetes ring, in large part because doing so would promote multi-cloud, which is not in these companies’ best interests.

2. **Kubernetes distribution players.** These are companies that provide distribution of open-source Kubernetes, meaning that they sell add-ons and support in order to monetize a Kubernetes offering. Indeed, some of these Kubernetes distributions are sold as public cloud offerings (for instance, Rancher on Oracle public cloud), and typically provide versions that can be run on premises or in the cloud. Kubernetes federation is either in a DIY state or on the radar with some providers waiting for the standard to emerge. A few, such as Red Hat/IBM, are pressing forward with federated offerings, including the recently released OpenShift 4.

3. **Niche Kubernetes players.** While the word “niche” can sometimes denote a negative, that is certainly not the case in this emerging market category. For purposes of this report, “niche” describes companies that offer Kubernetes distributions with special capabilities that the larger players may not offer. SUSE, for instance, provides Kubernetes as a service using their container-as-a-service platform, which is more developer focused. Other Kubernetes players provide other niche features, such as management and monitoring, focus on DevOps integration, and even using Federated Kubernetes as an add-on to a single-cluster platform offering.
In addition, we broke out solutions by their appeal to target market segments. We recognize three segments in this report: small/medium enterprise, large enterprise, and specialist provider, as shown in Table 1:

- **Small-medium enterprise:** In this category we find solutions that appeal to customers that value ease of use and deployment. These solutions may be adopted by large enterprises for departmental use cases of limited scope and scale.

- **Large enterprise:** Usually adopted for large-scope, business-critical projects. Solutions optimal for this category have a strong focus on flexibility, performance, data services, and features to improve security and data protection.

- **Specialist provider:** Designed for specific workloads and use cases, such as IoT and edge-based computing. This segment is focused on a distinct category of systems and is not considered general purpose.
### Table 1: Market Segment

<table>
<thead>
<tr>
<th>Market Segment</th>
<th>Small/Medium Enterprise</th>
<th>Large Enterprise</th>
<th>Specialist Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alibaba (Cloud Kubernetes)</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Appscode</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>AWS</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Canonical</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>CoreOS</td>
<td>+</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Google</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>D2IQ</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Microsoft</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Mirantis</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Oracle</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Rancher</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Red Hat</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

+++: Strong focus and perfect fit of the solution
++: The solution is good in this area, but there is still room for improvement
+: The solution has limitations and a narrow set of use cases
-: Not applicable or absent.

Source: GigaOm 2020
4. Key Criteria Comparison

Following the general indications introduced in the GigaOm Report “Key Criteria for Federated Kubernetes,” Table 2 summarizes how each vendor included in our research performs in the areas that we consider differentiating and critical. The objective is to give the reader a snapshot of the technical capabilities of different solutions and define the perimeter of the market landscape.

**Table 2: Key Criteria & Evaluation Metrics Comparison**

By combining the information provided by Table 1 and Table 2, the reader should be able to get a clear idea of the market and the available technical solutions.
5. GigaOm Radar

This report synthesizes the analysis of key criteria and their impact on critical metrics to inform the GigaOm Radar graphic in Figure 2. The resulting chart is a forward-looking perspective on all the vendors in this report, based on their products’ technical capabilities and feature sets.

![GigaOm Radar Diagram]

Figure 2: GigaOm Radar

As you can see in the Radar graph, most vendors are clustered on the Platform Play side of the graph—hardly surprising given what Federated Kubernetes is. At the same time, the leaders in this nascent space show a strong open-source pedigree, while public cloud giants like AWS, Microsoft and Alibaba must maneuver their federation strategies around competitive platform concerns.
Inside the GigaOm Radar

The GigaOm Radar focuses on each vendor’s technology roadmap, execution, and ability to innovate. It excludes vendor market share as a metric to yield a forward-looking analysis that emphasizes the value of innovation and differentiation over incumbent market position. The resulting graph plots the relative market position and movement of each vendor across three fundamental data points:

- The current position on the chart provides insight into the present state of each solution
- The direction models the impact of ongoing product strategy and development on the solution
- The vector module shows how quickly the vendor is executing on its vision and strategy

The GigaOm Radar aligns solutions along four characteristics, set in the chart as opposing pairs: Maturity and Innovation, and Feature Play and Platform Play. The closer a solution is to the axis line of a characteristic on the Radar chart, the stronger its execution in that regard:

**Maturity:** Expresses the stability and user acceptance of the solution, and overall ecosystem sustainability. Vendors on this axis may be more conservative in their approach.

**Innovation:** Indicates the level of differentiation of the solution from others in the market. Technical innovation and an aggressive approach to the market are often implied here.

**Feature Play:** Represents a focus on differentiating features and technical aspects, often advanced by niche players, point solutions, and new vendors leveraging cutting-edge tech.

**Platform Play:** Recognizes solutions that provide a broad, horizontal platform, with a comprehensive feature set and extensive ecosystem.

Finally, the GigaOm Radar is organized into three concentric circles around a bullseye. The closer to center, the better the solution. The three levels are:

**Leaders:** Vendors that are competing for market leadership in the metrics described above, even if they are competing in different market segments.

**Challengers:** Vendors with the potential to become a leader soon, niche or traditional players with an established market, and other companies that have interesting solutions but are still maturing.

**New Entrants:** Usually companies with a limited feature set and too little history to be included in the Leaders or Challengers categories, but with potential to move there soon.

The center-most circle of the GigaOm Radar is almost always empty, reserved for extremely mature and consolidated markets with very few competitors and mature solutions lacking space for further innovation.
6. Vendor Insights

Keep in mind that each of the key criteria listed earlier are not uniformly as important to all IT operations. Thus, it’s a good idea to weigh each component to help develop a forced ranking for each. Here is an example of applied weights:

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federated Architecture</td>
<td>25%</td>
</tr>
<tr>
<td>Cost Efficiency</td>
<td>20%</td>
</tr>
<tr>
<td>Workload Migration</td>
<td>20%</td>
</tr>
<tr>
<td>Federated Data</td>
<td>15%</td>
</tr>
<tr>
<td>Performance</td>
<td>20%</td>
</tr>
</tbody>
</table>

Sum 100%

Note that I use the above rankings for my analysis, looking at the approximate needs of most enterprises as they relate to federation. The idea is that we can do a scoring of each service, from 1 to 5, where 1 is the least amount of support, and 5 is the most. For example:

<table>
<thead>
<tr>
<th></th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federated Architecture</td>
<td>5</td>
</tr>
<tr>
<td>Cost Efficiency</td>
<td>4</td>
</tr>
<tr>
<td>Workload Migration</td>
<td>3</td>
</tr>
<tr>
<td>Federated Data</td>
<td>5</td>
</tr>
<tr>
<td>Performance</td>
<td>4</td>
</tr>
</tbody>
</table>

Then, by multiplying the forced weights and scores, we come up with an index for what solution works best, based on what is most important to the enterprise. For instance:

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th>Score</th>
<th>Index score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federated Architecture</td>
<td>25%</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Cost Efficiency</td>
<td>20%</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Workload Migration</td>
<td>20%</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Federated Data</td>
<td>15%</td>
<td>0.8</td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td>20%</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>

Index score 100% 4.2
This process then generates the following chart:

*Figure 3: Sample Chart*

What follows is the result of analysis of information gathered from market sources, briefings, and demonstrations. Again, no hands-on testing was performed, and the evaluations are based on the best information available at the time this report was written.
Alibaba Cloud, Alibaba Cloud Kubernetes

To address federation, Alibaba Cloud Kubernetes (ACK) manages the control plane of customers’ Kubernetes clusters using a meta-Kubernetes cluster. This solution is known as a Kube-on-Kube (KoK) architecture. Alibaba Cloud (also known as Alicloud) has approached Federated Kubernetes strategically, with most portions of the Kubernetes stack hosted in its public cloud platform. Like the other cloud providers, Alibaba leverages distributed Kubernetes clusters for resiliency purposes.

Alibaba is considered among the top four cloud providers and is seeing growth both in the Asia Pacific and Europe regions. Its public cloud is offered in the USA and in the UK as well.

Alibaba’s KoK architecture is able to leverage many clusters using cluster managers that allow for rollout of clusters automatically. This works across multiple regions. So you can deploy many clusters to many regions with the ability to support active-active cluster redundancy from one region (known as an availability zone, or AZ) to another. This means a master cluster spreads the components of the customer Kubernetes clusters across multiple AZs, running them in active-active mode.

**Strengths:** Alibaba is a leading public cloud provider in China and other global market geographies. Its ACK implementation provides federated containers as part of its core services and leverages cluster distribution for resiliency purposes.

**Weaknesses:** Essentially limited to the non-US market, and thus not a good fit for the North American or European cloud computing markets.

*Figure 4: Alibaba Cloud, Alibaba Cloud Kubernetes Chart*
**Appscode, Pharmer**

The new version of Pharmer from Appscode provides a cluster-API supporting all of the major cloud providers, as well as DigitalOcean and Linode. This allows for the automation of an infrastructure controller, which enables developers to create machine, machine-set and machine deployments using YAML and Pharmer. This will automatically add nodes to your cluster and if any resource goes down, it will automatically recover. Also, there is multi-master (high availability) support for AWS, Azure, GCE, DigitalOcean and Linode providers, as we saw with Alibaba.

**Strengths:** Good fundamental support for single, non-distributed clusters that are able to work and play well with most major public cloud providers.

**Weaknesses:** Distribution of clusters is somewhat limited compared to the larger federated players such as Red Hat.

![Federated Architecture Diagram](image-url)

*Figure 5: Appscode, Pharmer Chart*
AWS, EKS/Kops

There are many approaches in deploying Kubernetes clusters on AWS, including the well-used Elastic Kubernetes Service (EKS). This service helps organizations deploy and manage Kubernetes clusters.

Kubernetes Operations (Kops) is an open-source system that allows for the deployment and management of a high-availability Kubernetes cluster on different cloud providers. This technology works by operating a cluster of instances and scheduling containers to execute on clusters that have available resources.

While AWS does not seem to desire to support multi-cloud when using Kops, it’s possible that you can leverage Kops for multi-cloud directly from AWS. Indeed, AWS is really well supported by Kops. This gives you the ability to easily integrate EC2 resources into Kubernetes clusters. The cost of EKS seems to be high for most users, but the native AWS services offer more value at your fingertips for those building net new on EKS or migrating.

**Strengths:** AWS is the top public cloud provider and enjoys broad support for both EKS and the AWS ecosystem. The solution supports cluster distribution for high availability purposes.

**Weaknesses:** Lacks support for multi-cloud platforms and shows reluctant support for platforms outside of the AWS public cloud.

*Figure 6: AWS, EKS/Kops Chart*
Canonical, Canonical Distribution of Kubernetes

This distribution of Kubernetes can be accessed as a service or on-premises. It provides the ability to scale master nodes independently of worker nodes, and the workloads are automatically portable from one public cloud provider to another, including direct integrations with Google Kubernetes Engine (GKE).

The distribution offers support for a Kubernetes dashboard, Prometheus, providing granular monitoring and alerting, as well as collection, processing, and debugging. Also supported is Elastic Stack for Insights with Beats log collection and monitoring, as well as analysis and visualisation with Elasticsearch and Kibana.

Strengths: Flexible support for distributed clusters, either on premises, in the public cloud, or both. Well-known open-source player that has exceptional operating systems distributions. Native cluster distribution capabilities.

Weaknesses: More focused on-premises than in public clouds and thus offers limited support for multi-cloud and heterogeneous distribution.

Figure 7: Canonical, Canonical Distribution of Kubernetes Chart
D2IQ, Mesosphere Kubernetes Engine

The D2IQ Mesosphere Kubernetes Engine (MKE) supports federations using something called High-Density Multi-Kubernetes (HDMK). Using this system, MKE can consolidate and bin packs of many Kubernetes components, and do this with isolation of an operating system that can run on many platforms. HDMK employs operations pools that are compute or storage resources that any node can take advantage of.

**Strengths:** Native distribution features supporting cluster distribution and high scalability. Ability to support most public cloud providers.

**Weaknesses:** More DIY than closed products from other providers, meaning that extending the capabilities of the product will require custom coding by D2IQ users.

*Figure 8: D2IQ, Mesosphere Kubernetes Engine Chart*
Google, Google Kubernetes Engine

Like Alibaba, Google is able to support widely distributed regional clusters. Google Kubernetes Engine (GKE) uses a cluster control plane, which functions as the master, with all nodes running in a single compute zone that you name when creating the cluster.

This architecture is able to increase the availability of both the control plane and the nodes by replicating them across many availability zones or regions. This means that you can benefit from this type of federation to enable active-active business continuity/disaster recovery (BC/DR), as well as to take down clusters for maintenance without interrupting service.

From a strategic perspective, Kubernetes is core to what Google does, and the company is innovating with products such as Anthos and hybrid Kube, which together justify a leadership position for the organization.

**Strengths:** As the creator of Kubernetes, Google supports distribution through public cloud regions for the purpose of operational resilience.

**Weaknesses:** Lacks a focus on cluster federation among different cloud brands.

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**Figure 9: Google, Google Kubernetes Engine Chart**
Microsoft, Azure Kubernetes Service

Microsoft’s Azure Kubernetes Service (AKS) offers support for federation, with the ability to distribute clusters to different availability zones (AZ) to provide enhanced resiliency. This redundancy can be leveraged to enable active-active BC/DR. Microsoft has developed a robust ecosystem of Azure tools and support; however, it does not support managing clusters across public cloud providers.

**Strengths:** Competitive with other public cloud players that support cluster distribution for resiliency purposes. As with AWS, the Azure cloud platform possesses a strong ecosystem of tools and support.

**Weaknesses:** Lacking support for multi-cloud deployments, AKS has limited value as a solution to multi-cloud complexity.

*Figure 10: Microsoft, Azure Kubernetes Service Chart*
Mirantis, Mirantis Cloud Platform/Docker EE

Mirantis purchased Docker and thus now has a combined Kubernetes offering. The system provides centralized cluster management, where you can link up thousands of physical or virtual machines to support any number of clusters to allow your applications to scale. Moreover, the company allows you to manage the distributed clusters using a native management and monitoring system. This lets you make sure the distributed heterogeneous clusters are operating correctly.

**Strengths:** Support for native cluster distribution allows Kubernetes and container engineers to craft truly federated solutions.

**Weaknesses:** When leveraging cloud-based platforms, you will need to leverage a DIY approach.

*Figure 11: Mirantis, Mirantis Cloud Platform/Docker EE*
Oracle, Oracle Container Engine

Oracle runs the Rancher Kubernetes Engine (RKE), which is one of the strongest federated products on the market (please refer to the Rancher capsule for more detail on its capabilities). The Oracle solution is able to distribute clusters using a load balancer, which allows for the distribution of service traffic among the nodes assigned to a specific container.

**Strengths:** While Oracle lacks a native cluster manager for Kubernetes, the Rancher product hosted on Oracle’s public cloud is arguably a stronger offering than the services offered up by AWS or Microsoft.

**Weaknesses:** The use of a third-party product means that Oracle Container Engine is dependent on the capabilities and maturation provided by Rancher.

*Figure 12: Oracle, Oracle Container Engine Chart*
Rancher, Inc., Rancher Kubernetes

Rancher Kubernetes Engine (RKE) is a supported distribution of Kubernetes that can run on many different platforms and infrastructure. Rancher also integrates with and manages cloud-hosted Kubernetes services such as the ones found on Azure and AWS. Keep in mind that besides Red Hat OpenShift (discussed next), Rancher is one of the few Kubernetes providers that has existing purpose-built federations and moves beyond the current DIY approaches.

**Strengths:** One of the strongest federated products listed in the report, Rancher is able to support distribution using native mechanisms. Moreover, the company is focused on Kubernetes distribution as a strategy, meaning that more distributed cluster features will likely arise from their product road map.

**Weaknesses:** Potential platform volatility. As a smaller company, Rancher could be acquired and the product set changed quickly to support a larger player.

*Figure 13: Rancher, Inc., Rancher Kubernetes Chart*
Red Hat, OpenShift

Red Hat has been working in the Federation Working Group to develop Kubernetes Federation V2. While the standard has been slow-moving, OpenShift has moved ahead with something that’s as close to KubeFed as you’ll find in the market today. This service is designed to allow users to deploy services and workloads to multiple clusters from a single API.

Federation V2, supported by Red Hat, is a Kubernetes operator using Custom Resource Definitions. These provide tools for managing applications and services in multiple Kubernetes clusters, which are tracked by the Kubernetes Cluster Registry.

**Strengths:** Best native support for distributed Kubernetes, both from the emerging standard and the current deployment. RedHat is well on its way to becoming the federated operating system for multi-cloud.

**Weaknesses:** OpenShift has moved quickly to establish functionality ahead of adoption of industry standards, which means that those using OpenShift today may have to refactor for the forthcoming standards in the future.

*Figure 14: Red Hat, OpenShift Chart*
7. Analyst’s Take

Federated Kubernetes is a new and emerging space. One thing that became clear during the research for this report is that both the standard (KubFed) and non-standard deployment patterns of Federated Kubernetes remain very much a work in process for most vendors. That being said, we recommend the following:

- **Test the solution before deployment**: You’ll find that vendors may take different approaches and tactics when implementing distributed clusters, and this is not something well understood within a vendor demo. You need to dig deeper.

- **Check back on core business requirements for cluster distribution**: Don’t make things more complex than they need to be. For instance, your development teams may be keen on cluster distribution, but the technology is actually a poor fit for business requirements. Stay focused on business needs.

- **Consider this technology as a true platform**: Federated Kubernetes will be leveraged for a host of different solutions patterns, most of which are still unknown. Keep an eye toward the future as you assess solutions.

- **Consider cost**: Building applications for native containers and Kubernetes is more costly than traditional development approaches. Does the business case justify the costs?

No matter where you are in your federated container cluster journey, it’s helpful to have a pragmatic understanding of the capabilities of this technology, while considering both its potential and tradeoffs.
8. About David Linthicum

David Linthicum is a CTO and internationally renowned thought leader in cloud computing. David has spent the last 25 years leading, showing, and teaching large global enterprise organizations across all industries how to use technology resources more productively and constantly innovate.

David has been a CTO five times for both public and private companies, and a CEO two times in the last 25 years. David has published 13 books on computing and his thought leadership has appeared in Wall Street Journal, NPR, Forbes, InfoWorld and Lynda.com. He has expanded the vision of both startups and established corporations as to what is possible and achievable.

All of David's opinions are his own.
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