# For Infrastructure & Operations Professionals

# November xx, 2011 The Future Of Infrastructure-As-A-Service Cloud Standards

**by James Staten and Lauren E. Nelson** with Christopher Voce, Doug Washburn, and Lindsey Kempton

## **EXECUTIVE SUMMARY**

Cloud adoption, particularly of infrastructure-as-a-service (IaaS), is still in the early-adopter phase, and as a result there are no set industry standards. For IT infrastructure and operations (I&O) professionals, this means inconsistent terminology, service-level agreements (SLAs), security features, and functionality — as well as the biggest fear of all: the specter of vendor lock-in. Forrester spoke with a number of industry thought leaders regarding the current and future state of cloud standardization and, as expected, there wasn't a consensus on who will lead the way. This report focuses on the state of cloud standards today, the likely leaders of future standards, and how I&O professionals should navigate these uncertain waters.

TABLE OF CONTENTS	NOTES & RESOURCES
Jumping From One IaaS Cloud To Another? Not So Fast	Forrester interviewed several users, standards development organization representatives,
It's Still Early For IaaS Cloud Standards	vendors, and industry thought leaders on cloud standardization including Amazon.com,
De Facto, Open Source, And SDOs Vie To Set Cloud Standards	Citrix, the IEEE, OCCI, The Open Group, TechAmerica, and Ubuntu.
Who Holds The Most Influence Over Cloud Standards? Amazon Leads, Everyone Else Follows	Related Research Documents
While Not On The Map Yet, I&O Pros Should Keep An Eye On Three SDOs	"Market Overview: Public laaS Clouds, Q4 2011, Part 2" [60978] November 7, 2011
Real Cloud Standardization Won't Come Until 2015	"Market Overview: Public IaaS Clouds, Q4 2011, Part 1" [58925]
RECOMMENDATIONS	November 7, 2011
Don't Wait For Cloud IaaS Standards	"2011 Top 10 laaS Cloud Predictions For I&O
Supplemental Material	Leaders" [58779]
	February 14, 2011

# JUMPING FROM ONE IAAS CLOUD TO ANOTHER? NOT SO FAST

It's been a few years since cloud computing hit the IT marketplace and you, like many other early adopters, began testing the infrastructure-as-a-service (IaaS) cloud waters with Amazon Web Services' Elastic Compute Cloud (EC2). You started small with new differentiated workloads and over time expanded to include multiple projects.<sup>1</sup> By now, you've got the configuration just right, high availability (HA) is working well, and you've really started to take advantage of the benefits of an elastic scalable environment.

But just as you look to optimize cloud economics, costs have begun to escalate and a move to another market offering could result in potential savings given your cloud-based application portfolio. Luckily, there's no yearly contract keeping you locked in, and you can simply take your business elsewhere — right?<sup>2</sup>

Unfortunately, it's not that easy to move. The application programming interfaces (APIs) for another IaaS cloud are likely to be totally different, how you configure load balancing is not the same, and let's not even get started with network configuration. Despite the apparent freedom of IaaS pricing structures, switching services is surprisingly difficult. You'd think there'd be an easier way. But how? The answer is cloud standardization. Unfortunately, we're just not there yet.

# IT'S STILL EARLY FOR IAAS CLOUD STANDARDS

Let's look at the facts: In a recent Forrester survey, 70% of IT decision-makers considered IaaS to be a low priority or not a part of their agenda.<sup>3</sup> Despite the excitement over the past few years, IaaS is still in the early stages of adoption and standardization. And likewise, cloud standards are still in their infancy. Thus far, the standards development organizations (SDOs) have focused only on cloud terminology, common use cases and best practices, and business value to potential users — rather than meeting the needs of early adopters. Forrester has seen these early adopters struggle with:

- **Portability.** Between APIs, price structure, load balancing, network, and infrastructure configuration inconsistencies, moving from one provider to another isn't easy. Although you won't need to rewrite applications when moving from one environment to the next, the unique infrastructure configurations of each solution and APIs make switching solutions difficult. Currently, the only SDOs with portability on their radar are the Cloud Security Alliance (CSA) and the Institute of Electrical and Electronics Engineers (IEEE), and right now they're more focused on interoperability.<sup>4</sup>
- Management. Unfortunately, the cloud market lacks consistency in general management practices such as security, configuration, and operations, which further complicates the vendor evaluation process and the switching of vendors. SDOs such as CSA, TechAmerica CLOUD<sup>2</sup>, and Distributed Management Task Force (DMTF) each address aspects of management

standardization but with little influence on the current market.<sup>5</sup> Thus far, features, capabilities, and architecture differ drastically from one service to the next, which further complicates the issue of centralized management between clouds.<sup>6</sup> Some specific areas of focus include security, capabilities, storage, networking, and load balancing.

• Interoperability. Today, there are no full service IaaS solutions that meet all enterprise needs — and customization introduces higher cost and performance penalties.<sup>7</sup> Enterprise I&O teams look to weave together cloud services to achieve the right combination of functions, security, and price, but the lack of interoperability stops them dead in their tracks. SDOs such as CSA, DMTF, IEEE, and Global Inter-Cloud Technology Forum (GICTF) are currently working toward standardization around interoperability.<sup>8</sup>

# De Facto, Open Source, And SDOs Vie To Set Cloud Standards

Standards come out of a combination of momentum and adoption of best practices. Proposed standards must be created from existing best and or common practices and muster enough support to become a market standard. Hundreds of players have invested in standardization so far, which includes: 1) early market leaders; 2) open source contributors; and 3) standards organization contributors. Early market leaders become de facto standards, which ultimately matter most in the early stages as market share drives vendor R&D and enterprises like safety in numbers. However, competitors rarely want to make themselves dependent upon the market leader. Open source initiatives look to break the de facto hold by giving competitors a level playing field upon which look to differentiate, but their relevance also hinges on market share. Forrester believes that each element plays a role in the cloud standardization process:

- De facto standards set expectations. Early market leaders set the expectations of the end user for elements like design, process, functionality, pricing structure, cost model, and ease of use.<sup>9</sup> Other solutions within the marketplace must start from this point while improving certain components of this solution and supporting standardization efforts. Often, the top priority of the early leaders is staying on top rather than trying to advance the market by supporting industry efforts toward standardization and although the market progresses through innovation, it often slows the standardization process. Eventually, whether this solution stays on top depends on the development and momentum behind other market solutions and its ability to respond to customer feedback/demand and comply with new industry standards once they're set.
- **Open source efforts work to fill in the gaps.** One of the aims of open source is to free the end user from vendor lock-in from commercial market leaders. Often, the collaboration and effort comes from other industry solutions to help shift the market away from the early market leader. The advantage? Open source solutions deliver quick results with minimal cost to the end user and free them from lock-in. Many IaaS providers fill gaps in their own solutions with open source tools and often recommend them alongside their own solutions. Open source tools like

Gomez and Zeus gain popularity as multiple providers across the marketplace incorporate them into their standard offering.<sup>10</sup>

• SDOs build from existing offerings to develop standards. Both the committee-based process employed by SDOs as well as end user feedback ensure that standards aren't entirely different from those set by the early market leaders and open source efforts. But like any committee-based organization, SDOs are often slow to act, making it difficult to keep up and meet the demands of early adopters. It becomes a balance of ensuring consistency with current best practices to garner enough market adoption while not missing the momentum of market for specific standards. Historically, it has been these organizations that have set market standards.<sup>11</sup> Some level of collaboration between SDOs is essential to ensure that groups aren't working on the same exact efforts with differing results, which could diminish momentum for both.

## Who Holds The Most Influence Over Cloud Standards? Amazon Leads; Everyone Else Follows

The current state of cloud standardization lies with the early leader in the market: Amazon Web Services (see Figure 1). VMware seems the likely competitor to challenge Amazon's dominance given its recent market move and gaining momentum. Open source initiatives have started to garner substantial consolidated support through OpenStack, whereas SDOs really aren't on the map yet as far as delivered and adopted market standards go (see Figure 2). Here are the players that drive the IaaS market and cloud standards today:

- Amazon is the de facto leader in the public IaaS cloud market. Fifty-two percent of enterprises surveyed either use or plan to use Amazon Web Services (AWS).<sup>12</sup> As such, the cloud market today is working to incorporate and integrate with its APIs as if AWS was an industry standard. Amazon's technology and ecosystem footprint presents a significant challenge to competitors. But Amazon isn't focused on industry standards in fact, it's one of the only providers today that isn't a member of the 40-plus cloud-focused SDOs or OpenStack initiative. Although Amazon has opened some of its APIs to allow for developers to build atop its solution, it still keeps the rest undisclosed, which makes portability an issue. Staying on top is a delicate balance of meeting customer/market demands but not at the expense of losing ground to competitors.
- VMware vCloud builds on the strength of its virtualization beginnings. In the IaaS marketplace, the best positioned solution to upset Amazon's lead is VMware's vCloud. Why? VMware holds the majority of the enterprise virtualization market. Existing vSphere customers will look for compatibility and consistency with their existing environment in the IaaS marketplace which gives VMware a leg up in the private cloud market. On the public side, VMware decided to enter the game as a cloud platform rather that providing its own public-facing portal. It already has 720-plus xSPs licensed for vCloud Director, 41 providers already signed on to vCloud Powered, and more than 1,400 ISVs that base their solution on it.<sup>13</sup> If vCloud

Director gains a strong foothold in private and public clouds — and it's off to a good start — VMware could take the lead in the marketplace.

• OpenStack carries the open source flag today, but competition is fierce. A growing number of other vendors, such as Rackspace, Dell, HP, IBM, Red Hat, and Citrix, are looking to break the AWS API stranglehold by joining together in open source communities. Right now, the community with the most momentum is OpenStack.<sup>14</sup> While not a standards effort, the community looks to position the OpenStack APIs as an alternative API set — one with a fair amount of compatibility with AWS' APIs. There are currently very few public IaaS clouds based on OpenStack. Although OpenStack has taken most of the momentum away from another open source effort, Eucalyptus, other open IaaS initiatives such as Red Hat CloudForms are coming up behind OpenStack.<sup>15</sup>

# While Not On The Map Yet, I&O Pros Should Keep An Eye On Three SDOs

Currently, only two actual standards have been pushed to the market, but neither of which has gained industry adoption thus far. Although SDOs are in the early stages of developing standards, there are a few organizations that are likely to lead the way to standardization:

- DMTF leads the SDO efforts around management interoperability. Of the SDOs in the market today, DMTF's deliverables have been the most significant: Since 2009, DMTF released three white papers: 1) "Use Cases and Interactions for Managing Clouds"; 2) "Architecture for Managing Clouds"; and 3) "Interoperable Clouds" one of which outlines an architecture around management interoperability.<sup>16</sup> But thus far, this architecture hasn't had much momentum behind it. But it's still early in the game and DMTF's efforts around the Open Virtualization Format (OVF) along with its partnerships with the CSA, OGF, Storage Networking Industry Association (SNIA), and TMF and vendor contributors like Citrix, EMC, HP, IBM, Savvis, and VMware, make it likely that it will be a key contributor in cloud standardization.
- **CSA tackles interoperability and portability.** Cloud Security Alliance (CSA) developed eight working groups that target various aspects of standardization (including interoperability and portability) and adoption barriers, most of which look at cloud security issues.<sup>17</sup> Thus far, they've delivered two white papers, neither of which address standards, a Certification of Cloud Security Knowledge (CCSK), and a security standard audit called CloudAudit. These efforts, its list of contributors like CSC, Dell, HP, Rackspace, Savvis, Tata Communications, Verizon, VMware, etc., and the current focus on improving cloud security will set the stage for market recognition.
- The IEEE just entered the game, focused on interoperability. The IEEE, a large contributor to Internet standardization, started two cloud-focused working groups in April 2011.<sup>18</sup> One group focuses on exploring current standards efforts to identify issues within the market while the other

zeroes in on interoperability. Thus far, there hasn't been any notable deliverables in this area but the IEEE looks to establish standards around this in their next publication. The IEEE is partnered with CSA and its members include HP and IBM. The IEEE benefits from previous standardization efforts, which gives its standards credibility that will likely carry some influence in the IaaS market. However, it will need to work in collaboration with the other SDOs and deliver these standards in a timely manner.



"Which vendor(s) does your firm currently use/plan to use for pay-per-use hosting of virtual servers?"

Base: 278 North American and European hardware decision-makers that currently use or plan to use pay-per-use hosting of virtual servers (multiple responses accepted)

Source: Forrester's Forrsights Hardware Survey, Q3 2011

## Figure 2 Current SDO Players In Cloud Standardization

#### Cloud Security Alliance (CSA)

Within this organization there are eight working groups on cloud standardization, most of which focus on security features, but some are starting to tackle interoperability and portability. Thus far, they've delivered a Certification of Cloud Security Knowledge (CCSK), a security standard audit called CloudAudit, and two white papers: "Security Guidance for Critical Areas of Focus in Cloud Computing V2.1" and "Top Threats to Cloud Computing V1.0."

#### Distributed Management Task Force (DMTF)

Currently, the DMTF is working on interoperability APIs and it has delivered several white papers around cloud: "Architecture for Managing Clouds", "Interoperable Clouds", and "Use Cases and Interactions for Managing Clouds."

#### National Institute of Standards Technology (NIST)

NIST is a government organization focused on cloud standardization. Thus far, it has sought to provide an official definition of cloud and cloud-specific terminology, along with common use cases and pain points.

## Storage and Network Industry Alliance (SNIA)

In 2010, SNIA released its official SNIA cloud storage architecture and in 2011 released its Cloud Data Management Interface (CDMI). There hasn't been significant momentum behind these standards.

#### Institute of Electrical and Electronics Engineers (IEEE)

The IEEE formed two working groups in April 2011: One focuses on outlining existing standards efforts and the other aims to target interoperability standards.

#### Cloud2

TechAmerica's cloud standards work group. Cloud2, released a set of recommendations for both end users and cloud providers. This government-driven initiative could gain ground especially with the executive orders around government cloud adoption.

#### Global Inter-Cloud Technology Forum, Japan (GICTF)

This is currently the only international cloud-focused SDO gaining ground. It published a white paper last year on "Use Cases and Functional Requirements For Inter-Cloud Computing." At the beginning of 2011, it formed a group focusing on standards around network protocols.

#### Enterprise Cloud Leadership Council (ECLC)

Formed by parent organization, TM Forum, the ECLC is an enterprise-only council that aims to address the needs of the end user, specifically looking at overcoming barriers to cloud adoption. Thus far, there hasn't been any major deliverables.

## **REAL CLOUD STANDARDIZATION WON'T COME UNTIL 2015**

The demand for cloud standards is present in today's market but SDOs aren't ready to provide them. The necessary, lengthy committee-based review process slows the delivery of information and standards to the marketplace, pushing standardization back to at least 2014 and adoption of these standards is always up to a year past ratification. Here's how Forrester sees cloud standards evolve over the short and long term:

• In the short term, management tools bridge the gap. The lack of formal IaaS standards today creates a market opportunity for management vendors that can help I&O professionals bridge the gap between disparate IaaS solutions. For example, RightScale delivers a single platform where end users can access multiple clouds within a single UI in lieu of interoperability standards.<sup>19</sup> Vendors like Kaavo and BMC's CLM offer cloud life-cycle management, seeing each

workload request from start to finish.<sup>20</sup> Finally, monitoring tools such as Rackspace's Cloudkick fill the monitoring gaps within the marketplace for both public and private solutions and HP CSA provides higher levels of automation service.<sup>21</sup>

• SDOs will eventually catch up with the market. SDOs started off by defining best practices across cloud environments, which outline current standards that influence the IaaS market (e.g., web services and Internet protocol standards) and areas where new standards are required — a necessary step preceding the creation of industry standards. With that in mind, more focused work around defining and working toward industry agreement on new protocols and command sets won't come until 2013 at the earliest, and then the lengthy committee process will further delay standards for another 12 months, 2014, before ratification — and adoption of those standards won't be until 2015 at the earliest. By then, the proposed standards will need to draw from other standards markets, best practices, and market leaders (which will likely emphasis key players involved in the decision-making process for these SDOs) to gain enough market support.

#### RECOMMENDATIONS

## DON'T WAIT FOR IAAS CLOUD STANDARDS

Unfortunately, cloud standards around portability and management won't materialize until 2015. However, your competition has already begun to take advantage of cloud services to increase agility — and waiting for standards will only put you further behind. How do you take advantage of IaaS today while minimizing the risk of vendor lock-in and future rework? Forrester recommends that I&O professionals:

- Stick with safer bets on solutions from Amazon, VMware, and OpenStack. AWS is the current de facto standard and any competitive market solution writes to Amazon's APIs and ensures interoperability. The combination of its ecosystem, technology, and market share makes Amazon a likely influencer of future cloud standards. Cloud standards are also likely to draw from virtualization standards and VMware has a strong hold over this market as well as significant presence in the laaS market. Although OpenStack-based solutions haven't captured significant market share, many of Amazon's competitors contribute to OpenStack and will fight hard to influence future standards.
- Manage your deployments through a cloud management software tool. Management tools fill the gaps in functionality and interoperability before the arrival of standards. Take advantage of these solutions by managing your cloud portfolio through a single platform like RightScale for security, monitoring, and cloud life-cycle management tools. Not only does this help ensure interoperability between cloud solutions, but it also shields you from potential API changes.

- Use Internet, management, and web services standards when possible. In lieu of cloud standards, look for Internet, management and web service standards. It is likely that cloud standards will draw from these existing standards for consistency between markets. For example, when evaluating networking monitoring and analytics, look for standard monitoring methods, data center-to-data center protocols, and policy controls that are consistent with existing networking standards.
- Work with other leaders within your industry. Another trend that is emerging in the absence of cloud standards is the concept of industry-specific cloud solutions.<sup>22</sup> Each industry has specific needs; especially in those with substantial security and compliance requirements. Industry-specific clouds do this work on the front end so that each enterprise has an easier process before standards are set. Working with leaders within your industry might give you more clout with a vendor to negotiate higher levels of customization or management enhancements specific to your industry.
- Push your vendor to adopt SDO standards once released or get involved in the process. In the long term, vendors will adopt standards based on end user mandate. When SDOs release standards, be vocal to your vendors about supporting these standards. Do you want to help drive the process? Think about joining an SDO like the Enterprise Cloud Leadership Council (ECLC).<sup>23</sup>

## SUPPLEMENTAL MATERIAL

## Methodology

Forrester's Forrsights Hardware Survey, Q3 2011, was fielded to 2,343 IT executives and technology decision-makers located in Canada, France, Germany, the UK, and the United States from companies with two or more employees. This survey is part of Forrester's Forrsights for Business Technology and was fielded during July and August 2011. The LinkedIn Research Network fielded this survey online on behalf of Forrester. Survey respondent incentives include a choice of gift certificates or charitable donations. We have provided exact sample sizes in this report on a question-by-question basis. Forrester's Forrsights for Business Technology fields 10 business-to-business technology studies in 12 countries each calendar year. For quality control, we carefully screen respondents according to job title and function. Forrester's Forrsights for Business Technology ensures that the final survey population contains only those with significant involvement in the planning, funding, and purchasing of IT products and services. Additionally, we set quotas for company size (number of employees) and industry as a means of controlling the data distribution and establishing alignment with IT spend calculated by Forrester analysts.

## **ENDNOTES**

<sup>2</sup> Almost all the solutions have a pay-per-use billing model for their base service as well as additional pricing structures. The most popular of which are monthly rates that are either a customized flat rate based upon your compute needs or from a packaged selection. The end user benefit is a reduced cost for base cloud use combined with the ability to pay-per-use for overages. Amazon and a select few other solutions have also added in two other pricing models: six-plus month commitment discounts and spot instances. See the November 7, 2011, "Market Overview: Public IaaS Clouds, Q4 2011, Part 1" report. [58925]

<sup>3</sup> Source: Forrester's Forrsights Hardware Survey, Q3 2011.

<sup>4</sup> The CSA formed in March 2009 and it works to promote best practices for providing security assurance and provide education on use cases of cloud computing. Of its working groups, it has one working group focused on portability, Group 4: Portability& Interoperability and Application Security. For more information on CSA's mission statement and working groups, go to the Cloud Security Alliance website (https://cloudsecurityalliance.org/research/initiatives/). IEEE started a working on cloud standards in 2009 but officially launched two cloud working group in April 2011 with the approval of two new standards groups: IEEE P2301 and P2302. The first of which is a Draft Guide for Cloud Portability and Interoperability profiles. For more information on IEEE's work on portability, visit the IEEE website (http://standards.ieee.org/).

<sup>5</sup> Most of CSA's working groups focus on cloud management including groups 2, 3, 5, 6, and 7. For more information on CSA's mission statement and working groups, visit the Cloud Security Alliance website (https://cloudsecurityalliance.org/research/initiatives/). TechAmerica has a number of initiatives it targets in its mission statement, including standards around security and privacy. For more information, visit its website (http://www.techamerica.org/cloud-computing). The DMTF has a working group that focuses on cloud management standards. The majority of its new efforts focus on interoperability but it has released a white paper with use cases and interactions for managing clouds along with standards called the Cloud Auditing Data Federation (CADF) that focuses on providing standards around event audits, information log and report based on per-tenant and application etc. For more information, visit the DMTF website (http://dmtf.org/standards/cloud).

<sup>6</sup> In Forrester's Market Overview of Public IaaS Clouds, we outline the state of the market for security, networking, management, storage, geographic reach, and pricing structures. For more information on the current market state for each of these components, see the November 7, 2011, "Market Overview: Public IaaS Clouds, Q4 2011, Part 1" report. [58925]

<sup>&</sup>lt;sup>1</sup> Through inquiries and customer reference calls, Forrester found that early adopters have started with new workloads to differentiate their business from competitors rather than moving an existing workload to the cloud. And once they had gained experience with cloud environments, they moved existing workloads, which could benefit from its economics, to the cloud.

<sup>7</sup> Enterprises rely on third-party tools to provide more full service platforms for its enterprise customers. As enterprises build private environments and ramp up their cloud knowledge, many will look to create hybrid solutions by connecting to public cloud environments. In the meantime, third-party tools will look to fill in these gaps — and they are most likely to build their solutions around de facto standards like Amazon. Beyond their own road maps, cloud providers look to increase the value of their offerings by growing its current ecosystems of supporting third-party software. See the November 7, 2011, "Market Overview: Public IaaS Clouds, Q4 2011, Part 1" report. [58925]

<sup>8</sup> The majority of DMTF's efforts focus on interoperability — for more information on its working groups and deliverables, see its website (http://dmtf.org/standards/cloud). IEEE started a working on cloud standards in 2009 but officially launched two cloud working group in April 2011 with the approval of two new standards groups: IEEE P2301 and P2302; the second of which looks to tackle interoperability. For more information on IEEE's work on interoperability, check out the IEEE website (http://standards.ieee.org/). The CSA formed in March 2009 and works to promote best practices for providing security assurance and provide education on use cases of cloud computing. Of its working groups, they have one working group focused on portability, Group 4: Portability& Interoperability and Application Security. For more information on CSA's mission statement and working groups, go to the Cloud Security Alliance website

(https://cloudsecurityalliance.org/research/initiatives/). The GICTF is the only substantial international standards organization that has made significant headway thus far. For more information on its efforts around interoperability, visit the GICTF website (http://www.gictf.jp/index\_e.html).

<sup>9</sup> Amazon Web Services' EC2 platform is the 800-pound gorilla in the IaaS space today. It boasts the largest number of (and largest in scale) enterprise implementations; commercial applications supporting licensed deployment to the platform (although no one has made significant progress in this area); management tool vendors support; and SaaS and other cloud and web services running on the platform. It has broad geographic reach, and a plethora of unique capabilities and surrounding services. Its ecosystem is by far its greatest strength as it has self-sustaining momentum for further growth. On the technical front, enterprise integration has become far more robust as the service supports rich integration with Active Directory and LDAP servers, direct connections over MPLS lines that lower WAN costs (especially for data ingress) and a robust API set for gaining visibility into workload performance and availability. See the November 7, 2011, "Market Overview: Public IaaS Clouds, Q4 2011, Part 1" report. [58925]

<sup>10</sup> Gomez is an application performance management and monitoring tool that a number of current IaaS solutions rely on for its monitoring capabilities. For more information, visit the Compuware website (http://www.compuware.com/application-performance-management/). Zeus is a load-balancing tool that is heavily relied upon by many of the current IaaS solutions within the market. For more information, check out the Zeus website (http://www.zeus.com/).

<sup>11</sup> The example that is frequently referenced is Internet standardization. An account of this standardization process is provided by the Federal Communications Commission (FCC). To read this account, visit the FCC website (http://transition.fcc.gov/omd/history/internet/common-standards.html).

<sup>12</sup> Source: Forrester's Forrsights Hardware Survey, Q3 2011.

<sup>13</sup> xSP refers to any kind of service provider. For more information on the impact and significance of VMware's presence in the market, read the blog post: James Staten, "The Cloud Computing Market Grows Up," James Staten's Blog For Infrastructure & Operations Professionals, July 12, 2011 (http://blogs.forrester.com/james\_staten/11-07-12-the\_cloud\_computing\_market\_grows\_up).

<sup>14</sup> For a more pervasive list of OpenStack's 115 vendor supporters, check out the OpenStack website (http://www.openstack.org/community/companies/).

<sup>15</sup> Currently in Beta, Red Hat created CloudForms, an IaaS solution that incorporates application life-cycle management and the ability to created integrated clouds from a range of computing resources to ensure portability across physical, virtual, and cloud resources. For more information, go to the Red Hat website (http://www.redhat.com/cloudforms/beta/).

<sup>16</sup> The majority of DMTF's efforts focus on interoperability, but it has released a white paper with use cases and interactions for managing clouds. For more information on its working groups and deliverables, go to the DMTF website (http://dmtf.org/standards/cloud).

<sup>17</sup> The CSA has eight working groups that target different areas around cloud standardization. For more information on CSA's working groups, visit the CSA website (https://cloudsecurityalliance.org/research/initiatives/).

<sup>18</sup> IEEE started a working on cloud standards in 2009 but officially launched two cloud working group in April 2011 with the approval of two new standards groups: IEEE P2301 and P2302. For more information on IEEE's work on portability, visit the IEEE website (http://standards.ieee.org/).

<sup>19</sup> For more information, visit the RightScale website (http://www.rightscale.com/).

<sup>20</sup> For more information on BMC's cloud life-cycle management offering, go to its website (http://www.bmc.com/products/product-listing/cloud-lifecycle-planning-management-software.html), and for more information on Kaavo's IMOD Application Centric Management offering visit its website (http://www.kaavo.com/products-and-services/product).

<sup>21</sup> Cloudkick, recently acquired by Rackspace, is a cloud management tool. For more information on Cloudkick, check out its website (https://www.cloudkick.com/). Likewise, HP provides advances in cloud automation with its Cloud Service Automation (CSA) solution. For more information visit its website (http://www8.hp.com/us/en/software-product.html?compURI=tcm:245-936856&pageTitle=cloud-service-automation).

<sup>22</sup> There's been significant development in the community cloud space for specific industries (for example, finance, government, retail, and healthcare). The federal US government developed a cloud strategy and looks to form a government community cloud that meets its specific needs as detailed in the "Federal Cloud Computing Strategy." Source: Vivek Kundra, "Federal Cloud Computing Strategy," US CIO Council, February 8, 2011 (http://www.cio.gov/documents/federal-cloud-computing-strategy.pdf).

In the media and entertainment business, Windows Azure is working with the National Association of Broadcasters and key members of the media and entertainment industries to address specific business needs. Source: Larry Grothaus, "Windows Azure platform supports Media and Entertainment industry," *TechNet Blogs*, April 13, 2011 (http://blogs.technet.com/b/itinsights/archive/2011/04/13/windows-azure-platform-supportsmedia-and-entertainment-industry.aspx).

In the healthcare industry, we've seen a number of solutions (e.g., Dell) that specifically target the needs of the healthcare industry, and we've seen interest in hospital systems joining forces to create a community cloud to deliver higher value to its patients. Within the retail industry, ARTS, a retail industry-focused SDO, released best practices and an example RFP for cloud adopters within the retail industry. For more information on ARTS, visit its website (http://www.nrf-arts.org/).

For more information on Forrester's prediction that community clouds will rise, see the February 14, 2011, "2011 Top 10 IaaS Cloud Predictions For I&O Leaders" report. [58779]

<sup>23</sup> TM Forum started the Enterprise Cloud Leadership Council (ECLC), a group of companies that work to share actionable best practices, standing up real-world reference implementation, and advancing the adoption of enterprise cloud operating models. To read more about the ECLC, go to its website (http://www.tmforum.org/EnterpriseCloudLeadership/8009/home.html).