

# **Trends in Cloud Computing**

Reinventing the IT Landscape

July 2012

By Mihika Kapoor

# **Contents**

Executive Summary				
The Spectrum of Cloud Te	chnologies	5		
Evolving Cloud Technologies		5		
The Hybrid Approach	5			
SAAS	6			
The Shifting Planes of Infrastructure	9			
Umbrella Of Security	11	42		
Emerging Cloud Technologies	42	12		
PAAS BPAAS	12			
Government Harness of Cloud	14 15			
Social Connectivity	17			
Joelan Commeetivity	• /			
Leveling the Playing Field				
Commoditization		18		
Standardization		19		
SAAS	20			
IAAS	20			
PAAS	20			
Consortia	21			
Bursting into the Cloud	22			
Breaking Free of Silos		23		
Piecing Together the Puzzle		23		
Horizontal Market Adoption: Importance	e of Interoperability	23		
Cloud Brokerage Services	23			
Tailor-made Solutions		25		
Vertical Market Adoption: Do One Thing,	and Do It Well 25			
Converged Infrastructures	25			
A Global Perspective		26		
Europe		26		
Latin America		27		
Asia Pacific		27		
Appendix		29		

# **Executive Summary**

As the cloud market matures, we continue to witness evolution in this revolutionary technology. Cloud is an everchanging, evergrowing segment of the IT landscape. Due to its nature, which epitomizes flexibility and agility, there is a continuous influx of "as a service" products to encompass the needs of the growing number of customers. We see the market progress as new technologies spring up and older ones are customized to cater to the growing demands of consumers.

There are four major trends on the IT horizon for cloud. The first is the uprising of new technologies that only continue to enhance performance. The second is the unification of cloud products in terms of standardization and commoditization, and its implications for the market, particularly in SaaS and IaaS. The third is methods of the dynamic sourcing of services so they can be consolidated and enabled in a business-wide environment. Finally, cloud is permeating markets in Europe, South America and Asia Pacific and this globalization will drive new service providers, customers and overall growth.

Innovation keeps things cutting edge. To ensure the continued influx of cloud customers, technologies must evolve in conjuntion with demands to provide new capabilities and exceed expections. In cloud, there are already many established technologies, most notably SaaS and IaaS, which have seen growth and success in the market, however, as virtualization continues, the services must evolve and administer more management and security practices. On the other hand, there are new technologies poised for growth. They hold promise for new functionalities up in the cloud, offering virtualization in areas it was not previously available. Overall, the continued development of services will keep the face of cloud appealing and fresh. (Refer to Spectrum of Cloud Services)

Standardization and commoditization are divergent paths fuelling new trends in public cloud. As customers become more sure of services they are buying, they are more readily moving to cloud, but they are also paying less for it. Commoditization is ignited by consistencies in financial value, and is stagnating market growth in laaS, where it is most apparent. Standardization develops due to consistencies in performance, SLAs and interoperability. Standards in laaS and PaaS are still in their early stages of development, however those in SaaS are nearly fully established. These standards combined with a whole myriad of assorted services will guarantee the most growth in this market. (Refer to Leveling the Playing Field)

Cloud will experience growth if people and businesses invest in it. The consolidation of services is necessary in the realm of business, as it allows for a unified cloud system to be deployed over a company, rather than siloed networks, systems and servers. It is imperative that companies are able to deploy their cloud services over their organization in a way that each individual user is comfortable while using their "on demand" services. We are seeing two different manners in which a company can consolidate its services. First is dynamic sourcing. In this approach, the business takes care to pick and choose services that are the most standardized in their market, with the highest levels of interoperability, hence

maximizing on the benefits of different cloud vendors. The role of integrating these services more often than not has fallen to the CIO. However, there is a lot of movement to Cloud Brokerage Services. The second form of service consolidation is a converged infrastructure, which is provided by the cloud service provider itself. The provider assumingly has made many acquisitions and is integrating those as extra features to their services. This is used in scenarios when consumers prefer to deviate from the standards in the market and operate with more customized services. There is a similar amount of adoption via each of these types of consolidation at the moment, however dynamic sourcing is ultimately more flexible and agile, and will most likely overtake converged infrastructures in years to come. (Refer to Breaking Free of Silos)

Gloabalization will expand the market for cloud. Adoption is steadily climbing in Europe and South America, while in Asia it is soaring. China in particular holds a lot of promise for growth, with major adoption in place since 2008. Local cloud providers are gaining many customers. Innovation will continue in the rest of the world, and global demands will help in the development of new possibilities. (Refer to A Global Perspective)

As these four movements continue, more viable cloud opportunities make the pheneomenon less about the hype and more about the growth. The overall shifts are anticipation for technologies which are thorough and effective; towards standardization which will increase cloud customers and enable dynamic sourcing; and globalization which will lead to more expansion due to innovation and adoption around the world. This robust growth will fuel the progressing momentum of cloud technology and imply three hypotheses for the future.

## **Strategic Implications**

Interoperability before convenience: With numerous services and functions pouring into cloud, virtualized capabilities are just spreading their wings. With such movement, agility will become the key motivator for cloud adoption. Business performance will be enhanced by the myriad of services offered in the cloud. Cost benefits will not have much of a swaying factor and the capex to opex shift will just become an added benefit to virtualization. While pre-integrated services seem very attractive, they are incompatible. The influx of services will force enterprises to adopt interoperable cloud capabilities so that they can maximize from the best of what is offered. The ability of an organization to expand in any direction on the sprawling virtual landscape embodies the concept of cloud at its finest.

Horizontal approach over vertical approach: Currently, there is a fairly even split in demand for customized converged infrastructures as for dynamically sourced infrastructures. However, as standards develop and interoperability increases, sourced dynamic workloads will emerge as the frontrunner for enabling cloud deployment. Vendor lock-ins from customized solutions will stifle virtual growth, and businesses who adopt such methods will fall behind the times on technology. Dynamic workloads will further drive relocation to the cloud and enhance virtual business performance so that it grows alongside IT.

**Big data, big movement to cloud:** Big data and analytics is one of the four skyrocketing forces driving IT growth today. It is continuously multiplying the demand for data center space. Once internal storage space is overwhelmed on a global level, unstructured data all around the world will 'cloudburst,' either for storage, or for organization and analytics. This will especially accelerate growth on an international level, where adoption is most reluctant, but opportunity and demand is soaring.

# The Spectrum of Cloud Technologies

# **Evolving Cloud Technologies**

### THE HYBRID APPROACH

In the world of small and medium businesses, adoption of public cloud plays out fairly simply. There are few bindings relegating them to on-premises services. Unfortunately, larger enterprises are faced with a whole new myriad of constraints, ranging from legalities to security to cost to complicated infrastructures. They have certain information, most prominently ERPs, which cannot be converted to data in the cloud. Therefore, they adopt a hybrid model, which minimizes costs and increases agility in delegated areas. A hybrid cloud is the integration of public, private or virtual private cloud with preexisting on-premises services. An enterprise will reload certain workloads into the cloud while continuing to maintain legally-bound and technologically-bound data on-premises.

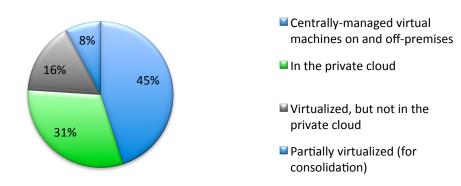
The most common services to transfer to the cloud are CRM (customer relations management) and HCM (human capital management), which are two of the most mature business application sectors. When redistributing their workloads, enterprises can work to devise a static connection, which is completed during its implementation, or a dynamic connection, which is constantly rebalancing.

The emergence of hybrid clouds has spawned a necessity for increased interoperability. The mechanics of a dynamic connection imply rapid scaling and redistribution, thus disintegrating the barriers between service providers. Federation will be administered via:

- Direct integration between APIs: This will enable connection through interfaces.
- Cloud brokerage services: These will serve as system orchestrators enabled through emerging cloud management platforms (CMPs) with integration tools and brokering (interoperability between CMPs is still developing and posed for expansion). CMPs should offer functionality and integration across service optimization, access management, service management, resource management and service resources.
- External cloud connectors (gateways): Gateways will enable service providers to merge internal services and infrastructure with public cloud and to administer unstructured data services to consumers, while serving as a foothold to public cloud storage. Eventually, large amounts of data will be transferred to the public cloud, via cloudbursting, and will be accessed through these gateways. Benefits include:
  - Data deduplication
  - Local caching
  - WAN maximization
  - DR capability

There is a race between service providers to establishing themselves in the market. Most prominently, VMware's vCloud's data center allies are adopting hybrid capabilities. Microsoft, Oracle, HP, and IBM are all contenders in this market. Hybrid scenarios have a very promising future and have just begun their cloud journey.

# **Expected Business Virtualization by 2015**



Report 33, page 5

## **SAAS**

The market for application software dominates cloud. SaaS has made its way to nearly every enterprise through management and monitoring services. It occupies 17.9% of the overall IT enterprise application spendings. (Report 7, page 2)

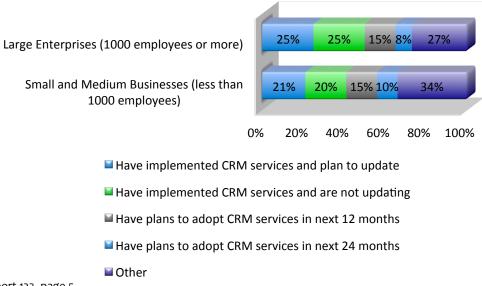
Application software is enterpises' most legally compliant component for the cloud. Salesforce.com serves as the customer relationship manager for the bulk of commercial enterprises and has left the rest of the industry following in its wake.

The market for applications is the most sophisticated, developed and standardized. Therefore it is predicted to be the most profitable in years to come. Traditional application services such as CRM (customer relationship management) and HCM (human capital management) have already shifted into the cloud and will be followed by the likes of management processes APM (application performance monitoring) and IAM (identity and access management). Telecoms and email providers now also offer the services in this manner. Current trends indicate that SaaS will drive the most growth in cloud technology. The most two prominent services are indicated below:

- CRM (Customer Relationship Management) CRM in the cloud is perhaps the most mature application domain. It serves as one of the most interoperable services. It is a paradigm for the management of companies' interactions with customers, clients and partners and uses technology to organize business processes and sales activities. Features include:
  - Pay-per-use pricing system (operational expenditure)
  - Sales automation

- Marketing automation
- Sales prospect management
- Customer service

Salesforce.com's services embody CRM and have an overwhelming presence in the market. It claims that is has over 100,000 customers.



Report 123, page 5

■ HCM (Human Capital Management) – HCM in the cloud has existed for around a decade, and there is only more growth in its future, with elevated revenue through 2015. It deploys HR services into the cloud to enable accessible workforce information. Talent management is also often integrated into HCM services in the cloud. Like CRM, HCM is extremely interoperable, allowing for integration with existing HR and ERP services, on or off-premises.

HCM is often incorporated by enterprises in a hybrid model, where only segments of deployments move to the cloud. Early on, mostly small and medium business adopted HCM solution in the cloud due to workload size and flexibility, but now larger enterprises are contributing to the trend.

The largest benefit of HCM in the cloud is deployment speed. Due to the dragging cycle this is for onpremises HCM, many companies are eager to simplify the process. There is also much more flexibility, as SaaS providers easily accept more users into the system. Therefore, Gartner forecasts that these services will overtake HR BPO.

SAP has the largest presence in the market; however, rising contenders include Workday and Taleo. Oracle Fusion HCM is also struggling to keep up.

Management of various enterprise applications is enabled through the cloud and is taking over traditional on-premises scenarios. The Big Four Management vendors are IBM (CloudBurst), CA Technologies, HP (Cloud Service Automation) and BMC (Cloud Lifecycle Management) and they are all competing and

attempting to establish a permanent footprint in the market. The following represent two markets for SaaS-enabled management and monitoring services:

- IAM (Identity and Access Management) IAM in the cloud (or IAMaaS) secures enterprise services by offering protection from internal hacks. These services are slightly less mature than the established CRM and HCM services. IAMaaS is mostly compatible with only Web—architected applications.
  Services include:
  - User authentication
  - User authorization
  - Provisioning
  - Auditing

Leaders in the market include CA Technologies, IBM, Oracle, NetIQ and Courion. These all play a major role in standardizing provisioning services. In 2010 CA acquired Arcot, an authentication company, which helped contribute to a suite with and extended emphasis on fraud prevention. The same year, VMware bought TriCipher, a leader in IAM processes. In addition, vendors like salesforc.com and Google Apps catered IAMaaS to small and medium businesses focusing on security, password proxy, integration of authentication services and costs.

The influx of providers into the market will cause the market prices to drop. As this takes places, adoption will move to larger enterprises and the spotlight will move off small and medium businesses.

- APM (Application Performance Monitoring) APM is utilized in the world of cloud to understand, breakdown and monitor the interaction of services and workloads in hybrid situations. Spending is bound to accelerate in the market. APM operates five services with regard to hybrid cloud computing:
  - End-user experience monitoring (most prominent)
  - Discovery and display of software and hardware components of applications
  - Monitoring of resources used by applications
  - Tracing of events as they occur in application execution
  - Analytics of engine behaviors, techniques, platforms and database analyses
    - Gartner predicts that in 2013, APMaaS will be used for monitoring end-user experience by 20% of Global 2000 businesses (in contrast to the 10% today) and 5% will use the other four (as opposed to the 1% today). (Report 98, pages 1-2)
    - There are three ways of collecting such application data:
  - Technologies that can collect from outside the perimeter of the enterprise administering the application

- Technologies that must be integrated with the infrastructure used by the application
- Technologies that are embedded in the application itself

In previous years it has been illogical, complicated and unrealistic to utilize the second or third types of technologies, due to collocation elements in differing locations with analysis and storage housed elsewhere, or vice versa. Therefore, information was mainly present based on end-to-end performance. In the past two years there has been an emergence of more basic and lightweight examples of the second and third groups of technology, thereby allowing the administrating of analysis of internal processes. These technologies will drive the market in the next few years.

### THE SHIFTING PLANES OF INFRASTRUCTURE

Infrastructure in the cloud represents a spawling market, with continuous evolution. It has no coice but to evolve with the demand for speed, agility and flexibility. Infrastructure serves as the backbone and support for the storage of all cloud data.

laaS is the second most mature public cloud market, to SaaS. It is standardized by leaders in the market, such as Amazon Web Services. It will be the first cloud market to fall victim to commoditization and a lowering gross margin by 2014 (Interview 4). Commoditization implies that players will be singled out as leaders in the market. Thus it is essential to provide seamless infrastructure to support the growing number of data and services in the cloud and garner as many customers as possible. This is a field where there will always be a demand and thus there should always be a supply.

There are four continuously evolving core components for provisioning cloud infrastructure:

• Storage – Storage is the most important functionality in cloud infrastructure as it serves as an outpost for the slew of unstructured data enterprises would like to reload to the cloud. Businesses initially hoped to move their vats of information to the public cloud, however faced many issues with off-premises deployment such as costs, security and limited capacity. They compromised with private cloud facilities.

There are two realms of technologies in private cloud that providers should focus on in the market: established technologies that have pleased customers, and are therefore guaranteed to be successful, and emerging technologies that pose new opportunities for vendors and enhanced capabilities for organizations. (Report 80, page 5)

# Established technologies:

- Thin provisioning maximizing on capacity by allocating "on-demand" rather than pre-allocation
- Asynchronous replication (in addition to widely-implemented synchronous replication) data being replicated efficiently based on requirements
- Automated tiering (rather than manual tiering) puts hot data on high performing disks and warm, less accessed data on cheaper disks (saves money)

- Primary deduplication looks for redundant data and deletes unnecessary information (saves capacity)
- Multiprotocol support most storage area networks (SANs) use Fibre Channel, but now there is increased interest for other protocols such as NFS and iSCSI

# Emerging technologies:

- Multihypervisor support despite VMware's dominance in hypervisors, companies would do better to leverage different workloads on other hypervisors, too
- Object storage support use of metadata to simplify extraction regular data
- Stretch clustering physical dispersion of hosts of SAN cluster nodes
- VAAI integration API integration to enable ties between servers and storage to decide capacities needed for different workloads; high server performance
- **Network functions** Networks in the cloud allow for connectivity and communication channels in the cloud. The following are important network functions to allow for maximized operability in the cloud:
  - Storage LAN (local area network) between storage resources in a single data center
  - Compute LAN between compute resources in a single data center
  - Intra-data-center between cloud environment and other environments in vendor's data center
  - External WAN (wide area network) between cloud environment and end user
  - Back-end WAN between cloud environment and customer's on-premises data center
  - Inter-data-center WAN between multiple cloud environments by a single vendor
  - Application network functions (i.e. Dynamic relocation)
  - Security functions (i.e. firewalling)
- Multitenancy In the public cloud, multitenancy allows for multiple customers to have coexisting services and environments hosted by a single vendor's virtual machine. It has to be approached at the hypervisor level, where hardware is shared or at the application software level, where vendor resources (databases, applications, etc.) are shared. There is also isolated multitenancy where nothing is shared and multitenancy where everything is shared. Multitenant environments are not customizable. If there is a need for that, customers are better suited with aPaaSs.

Multitenancy can be administered by in-memory data grids, which are extremely scalable and able to support a changing number of applications, databases and other services.

The following are characteristics of multitenant services:

- Isolation of customer data
- Isolation of customer memory

- Isolation of execution (availability requirements, etc.)
- Isolation of customized add-ons
- Tenant-aware security
- Monitoring/management of customers and their resources
- Error tracking
- Data recovery
- Horizontal scalability

In 2011, virtual management services revenue was over \$3 billion, demonstrating a 28.9% growth rate from the previous year. (Report 150, page 1) VMware far outstrips all of its competitors in virtual machine management, which administers multitenancy. It is different from its competitors in that it does not embed its services in its products. Thus, it has unconventionally established a dominance in the market, with most software providers supporting its hypervisors. Other competitors include Citrix Zen and Windows Server 2012.

Cloud-based Grid Computing – Grid computing is just beginning to soar into the cloud. It will increase the scope and scale of nearly all processes and enable faster accomplishment of the deluge of tasks through collective computing. It allows for lowered costs and business advantage by making the impossible possible.

Grid computing operates by the administration of parallel processing. Parallel processing hastens program functions with algorithmic methods at the processor level. It is extremely useful for the organization of unstructured data from large scale systems. Techniques are used to leverage and enhance the processes of software, databases and other programs.

In dynamic cloud environments, parallel process integration to more mainstream programs is crucial, especially when vendors are administering SaaS-incorporated management and monitoring. There will be extreme growth in this market segment in the coming five years, and by 2015, a majority of vendors will use these techniques to maximize on their services. New application software will be built, connected with contextual computing which will make thousands of recalculations for single changes and analyze patterns in deluges of information.

## **UMBRELLA OF SECURITY**

Security is one of the greyest areas in the cloud market and one of the largest concerns a business has when adopting cloud. Therefore, it is one of the largest evolving markets as vendors will not have customers if they are not secure. Data deployed in the cloud must be secured. It is imperative that security is scalable and not addressed with a "one size fits all" approach. Service providers must be able to prevent cyber attacks, internal and external hacks, data leakages/loss and harmful insiders, and be able to guarantee a certain degree of privacy and identity and access management. Doubt about the strength

in this sector has relegated many enterprises to internal private cloud deployments. In coming year, the ability to provide secure services will single out the frontrunning vendors in cloud. Most security services will be administered through virtual desktop infrastructure.

The following are controls, capabilities and contractual obligations for IaaS providers:

- Offline data backup (and evidence of this)
- Security analysis of architecture
- Sensitive information inaccessible to all except the customer
- Exit assistance for deal
- Security checklist
- ISO/IEC certification
- Insurance for bankruptcy

# **Emerging Cloud Technologies**

# **PAAS**

PaaS is a nascent cloud option that is just beginning to show off its capabilities. It still represents a volatile market with a deluge of capabilities and a lot of potential. As middleware, it is predominantly sold in integration with other products.

The market for middleware is overwhelmed with confusion and complexity in its current state of immaturity. 2011 was deemed a pivotal year for PaaS as all leading enterprise software vendors administered middleware services through cloud. There is a particular amount of excitement in aPaaS (application platform as a service) and iPaaS (integration platform as a service), which will be provided in contingency with other services, the most prominent of which is SaaS. aPaaS will provide an environment with integrated applications, while iPaaS will support integrates infrastructures.

Salesforce.com has held a long standing domininace in this market having helped create the category itself. It began by servicing the platform its CRM SaaS operated on: Force.com. Forrester estimates that between 10,000 and 25,000 acounts use Force.com as a development platform. (Report 125, page 16) Its acquisition of Heroku offered Ruby-focused aPaaS hosted by Amazon Web Services as a compromise for the closed partnership with Java.

There are two forms of PaaS that consumers are gravitating towards in the current market:

aPaaS (application platform as a service): aPaaS is a new and upcoming software, which offers a platform with integrated application software. In its ideal state, Gartner defines it as a "complete prepackaged development and runtime environment, embodying everything from development tools, to databases, to programming languages, to elastic application and integration middleware." (Report 52, page 23.) Its adoption challenges the position of IaaS. aPaaS serves as an alternative for enterprises without the skills needed to architect consolidated cloud-optimized solutions at a low level. Customers of aPaaS are trading in flexibility and interoperability for easier development and easier implementation. This is in stark contrast to IaaS-based integrated solutions.

As PaaS represents an uncontained landscape, there is little conformity in aPaaS. Amazon Elastic Beanstalk steers clear of any forms of standardization and barely provides an laaS management layer for IT programmers. With such abstraction, there is little transparency. By hiding complexities of autoscaling, failover, and multitenancy, service providers put enterprises at risk without their awareness. Customers' increasing awareness of such practices indicates that successful providers will have to operate with little opacity.

■ iPaaS (integration platform as a service): Application integration capability in the cloud is gaining prominence and will soon become an imperative service for leading PaaS providers, less they lose market share. Gartner states that iPaaS "enables implementation of application, process, service and data integration, and the relevant governance, "in the cloud."" (Report 63, page 1) Many businesses are able to adopt iPaaS along with SaaS integration brokerage or cloud brokerage services due to required convergence with other applications and governance platforms.

In the past decade, medium and large businesses have integrated classic integration platforms to support their large supplies of data, applications, business processes and e-commerce B2B integration.

## Benefits include:

- Interoperability
- Management services and monitoring capabilities
- Quick deployment and integration
- Low costs
- Dynamic sourcing across infrastructure
- SaaS application adapters

The demand for new capabilities such as integration with cloud APIs is being met by service providers like salesforce.com, Zuora and NetSuite. Enterprises are also looking to utilize iPaaS to add new functionalities to segments like SOA governance. Interoperability is key for iPaaS providers and the main goal for enterprises as they adopt the service.

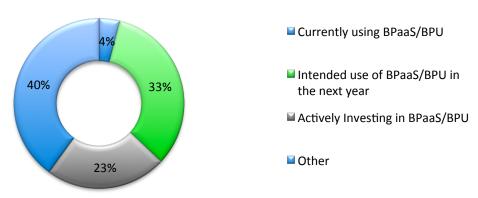
2011 proved an integral year in PaaS development as all major cloud vendors launched platforms in the cloud. The year began with salesforce.com, Google and Long Jump in the market and ended with a slew of new vendors offering aPaaS: SAP (HANA architecture), Microsoft (Windows Azure), RedHat (OpenShiftFlex), VMware (CloudFoundry) and IBM. IBM's new offering is IBM PureSystems, which offers integrated software and hardware stacks for quick deployment and management. Even Oracle, which has

had a reluctant entrace to the cloud market announced in October the upcoming Oracle Java Cloud Service. It also developed Oracle Database Cloud Service based on Oracle Fusion Middleware technology. The offering specializes in honing present skillsets and preserving current investments. Oracle's Application Express service serves an aPaaS alternative for basic database-centric services to the Java Service, yet is only offered as a part of itsdatabase management services. However, the lack of iPaaS in Oracle's offer will significantly stagnate its growth and cause customers to resort to third party vendors and on-premises middleware for integration.

## **BPAAS**

BPaaS offers services that will automate business processes in multitenant environments, mostly through reinventing the market for outsourcing. Forrester defines its services as "end-to-end business processes delivered via dynamic, pay-per-use, and self-service consumption models." It represents a natural progression of SaaS and IaaS applies to BPS, standing out against BPO (business process outsourcing) services by offering different customers open access to pooled underlying resources and shared labor force. 23% of firms have acquired SaaS for horizontal business processes and 21% more plan to follow suit. (Report 151, page 3) It is yet to see much market penetration, due to being in its infant stage. Providers need to cater their services so as to provide a low cost and low sales effort for enterprise finance and accounting, so as to set standards in the yet unchartered territory.

# **Enterprise Use of BPaaS**



Report 22, page 3

Surveys by Gartner reveal that over 60% of organizations are curently using BPaaS or cloud-enabled BPU (business process utility) for BPO services. (Report 22, page 1) BPSs transferred to the public cloud offer promise in the following segments:

- Automated services
- Multitenancy
- Elasticity and scalability

- Configuration (but no customization)
- Shared labor pool
- Standardized services
- Access through internet--based technologies
- Standard contracts and agreements with the ability to sign immediately (and "I accept" button)

Enterprises have already begun to source some business processes, such as supply chain services from delivery companies like UPS and DHL and employee salaries and HR through the cloud, via providers like ADP. Outsourcing firms such as Genpact, TCS and Cognizant have spawned BPaaS offerings in conjunction with their outsourcing services. However, there is little consistency in agility and innovation provided by these organizations and they are better applicable for systems of record. Traditional cloud vendors like IBM (Global Expense Reporting Solutions) and PlayPal also offer BPaaS.

However, an increase in providers will mostly be seen in the next two years. It is imperative that BPaaS providers have licensing relationships with leading software providers like SAP. Delivery by supplier will vary based on the delineation of its obligations in SLAs. The focus of enterprises adopting BPaaS should be proccess outcomes (accuracy, turnaround time, etc.), rather than just platform uptime and availability. Partnering will also lead to increased dominance in the market, as BPaaS providers will probably partner with cloud application platform and infrastructure vendors to undergrid their processes.

There is still time before business processes in the cloud reaches its inflection point, however BPaaS in the cloud is forecasted to overtake IaaS in the market by 2020 and relocation to the cloud hints at a changing horizon for BPS. (Report 108, page 10)

### **GOVERNMENT HARNESS OF CLOUD**

Cloud services are being implemented left, right and center, so why not in the government? The virtualization allows for easy access to data and in the case of healthcare, more fluid communication with customers.

Cloud is penetrating the government in the following three areas:

• **Healthcare** – Healthcare users and providers are both benefitting from public cloud services for storage of data on the customer and for methods of communication between the two. New services are replacing outdated technology. However, service providers must privacy and security regulations in different countries. In America compliance with the Health Insurance Portability and Accountability Act (HIPAA) and the Health Information Technology for Economic and Clinical Health (HITECH) is necessary.

The	benefits t	for bot	h are seen	below:	(Report 9	, page 5.)
-----	------------	---------	------------	--------	-----------	------------

Providers:

- Email
- Medical record systems
- Medical image archiving
- Electronic health record systems
- Health information exchanged
- Clinical collaboration
- Cycle management systems
- Enterprise content management (ECM)
- Mobile device management

#### Users:

- Cloud-based operational processes
- Member portals
- Enrollment processing
- HR administration
- Benefits management
- Claims management
- Care management applications and coordination
- Master data management (MDM)
- Business process management (BPM)
- Security Services Three major cloud service providers, IBM, CSC and Verizon, are offering Threat Intelligence Solutions for Security Services. (Report 106) Their offerings are outlined below:
- IBM X-Force Protection System offers analysis services across its MSS (maximum service size) and security information and event management (SIEM)
- Able to identify patterns that indicate threat
- Auto-prioritizes those with maximum danger
- Real-time attack and malware identification
- Identification of IP location
- Communication with command and control botnets
- Verizon Reputational Intelligence Services offers an analysis engine that consolidates threat intelligence from spam and malware data channels
- Identifies dodgy IP addresses

- Locates irregular internet interactions
- Domain name system snares
- Manages and directs the flow of data from customers
- CSC Threat Intelligence Services operates in cyber security for the private sector
- Administers a framework to indicate threats and vulnerabilities
- Monitors database usage
- Emerging into the public sector
- App Stores Government app stores are emerging and put the government in the position of vendor. It will have to be very transparent with customers in its SLAs, security, costs, etc. regarding its procurement and deployment services. Such an app store may serve as access to the whole myriad of cloud services, from infrastructure, to middleware, to applications.

Growth will be enhanced with a catalog which will access to commoditized IT services. Services should support user feedback to enhance capabilities. Offerings will have to be comparable and must meet all public procurement requirements, such as panel contracts and a framework.

### **SOCIAL CONNECTIVITY**

Email as a service for small businesses is not new to the cloud market, however adoption of enterprise-scale is just gaining momentum. Gartner predicts that by the end of the decade, cloud email will dominate 65% of the enterprise email market. (Report 126, page 5.) It offers the potential for more storage, flexibity, and modernization.

# **Usage of Email via Cloud**



Report 126, page 1

At the moment, public cloud email makes sense for small organizations (fewer that 500 people), but before larger enterprises make the leap, they should bear in mind that the market is yet to offer much security, support, and transparency in SLAs. As CSPs work to further develop these areas, there will also be adoption of a hybrid approach. In such a situation certain mailboxes will move into the cloud, while others will continue to reside on premises due to security and integration with company infrastructure.

Moreover, cloud providers are bulk packaging email services with instant messaging, telephony, shared workspaces and conferencing in their suites.

The three competing cloud email providers are:

- Microsoft Office 365
- Google
- IBM LotusLive iNotes

# **Leveling the Playing Field**

# Commoditization

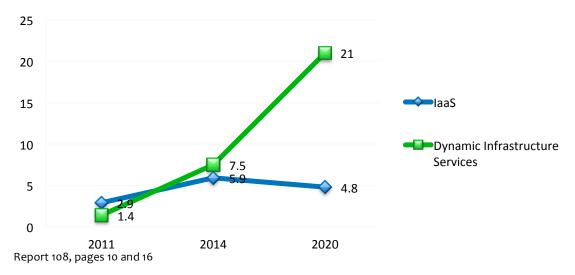
In economies of scale, commoditization is inevitable. As more contenders offer their products, prices are bound to drop due to competition. In cloud, the largest amount of commoditization is forecasted to take place in IaaS. The IaaS market currently serves as the second largest public cloud market to SaaS, with a market size of \$2.9 billion in 2011. (Report 108, page 10) However, commoditization will result in market stagnation and eventual decline within two years. (Interview 4)

Commoditization is prominent in the hypervisor and storage markets. As adoption continues, prices will continue to decline. Contending providers will be singled out based on their ability to provide easy access to customer data.

VMware dominates the market for hypervisors. However, as contenders such as Microsoft and Citrix leverage their services, revenue will decrease and move into to other markets as a result of competition.

Successful cloud infrastructure vendors in storage include Amazon Web Service's Elastic Compute Cloud (EC2) and Rackspace. Profit in the market has spurred a large increase in infrastructure providers. There an exponentially increasing number of consumers looking to virtualize unstructured data, SaaS business applications, software, and legally compliant workloads with IaaS. However, by 2014, the gross margin will have shrunk so much that it will reach an equilibrium with the demand for cloud infrastructure. Forrester analyst Stefan Ried estimated that Amazon's EC2 market price will drop to 19% of what it is today. (Interview 4) Dynamic infrastructure services, provided through virtual cloud, is expected to overtake IaaS in the market. The dynamic component allows for the constant rebalancing of data storage and capacity, and thus offered more agility.

# Market Size Forecast for laaS and Dynamic Infrastructure Services (in US \$ billions)



The IaaS market will peak at \$5.9 billion in 2014, and then will undergo rapid commoditization and plummeting costs. Price per unit will drop and by 2020, its market revenue will be at \$4.8 billion. (Report 108, page 10.)

# **Standardization**

Standardization and business opportunity have a bijectional relationship; each drives the other. In a market where few things are set in stone, customers like to sign SLAs knowing they will get what they are paying for.

SaaS is the most standardized cloud service due to its long-standing position in the market.

In IaaS, you have Amazon Web Services setting de facto standards simply by occupying such a large segment of the market. However, Forrester predicts true standardization will only come in 2015. (Report 131, page 8.)

As the PaaS market itself is still emerging, standardization is a long way off. However, there is indication of what standards will entail in years to come. Furthermore, there is the concept of "open PaaS" with desired transparency and interoperability.

Standardization will propel the market forward. Increased interoperability will allow more compatibility with other services and providers, and will ultimately lead to extreme flexibility. Such qualities are necessary for scenarios like cloud bursting (entrance to the public cloud).

## **SAAS**

In the world of standardization, SaaS is a utopia. It has has standards much longer than IaaS and PaaS due to its market penetration and presence, and so there is not much change in this realm. Standards are set and ready to go.

Not only is its application software standardized, but also its SLAs and pricing. Therefore, customers are in less power to negotiate extra services, compensations and extensions. There is now a greater emphasis for the indication of business requirements to determine whether SaaS will click with enterprise necessities.

### **IAAS**

laaS represents a semi-standardized market. Infrastructures themselves are not extremely compatible, however, de facto standards are being set by leading vendors. Furthermore, many consortia are engaging in attempts to standardize the market.

There is not much consistency in portability, due to dynamic workload balancing, varying consistencies, APIs, and pricing, nor is there much in management. Therefore, there is very little interoperability and flexibility, particularly when one wants to switch vendors.

Amazon Web Service's Elastic Compute Cloud (EC2) has set an example in the market for a successful laaS configuration. Analysis by Forrester in 2011 reveals that 52% of enterprises use or plan to use Amazon Web Services. (Report 131, page 6.) However, Amazon hides most of its APIs, decreasing workload portability.

VMware is another market dominator. It comprises of most of the enterprise virtualization market share, and so its vSphere hypervisor in vCloud is another de facto standard. Its head start in the market clearly contributed to this position.

There are some open source efforts to compensate for customers unhappy with services by Amazon and infrastructure by VMware. They are trying to minimize vendor lock-in, however such tools were not met with much success.

The current trend seems to be de facto rather than de jury. However, over time, standardization in IaaS will allow for increased integration and compatibility with customers' other services. In the long run, companies will flock to infrastructure providers able to balance their virtualized workload, comprising of SaaS, PaaS and more.

## **PAAS**

PaaS is still young and uncontained. Standards are yet to be successfully implemented. Yet, there is an emergence of open PaaS. This is made possible by vendor dominance in certain segments. Currently, there is some sort of level of conformity in open source languages. Java Platform, Enterprise Edition (Java EE) has become the unconventional "gold standard" for maximum application portability. (Report 38,

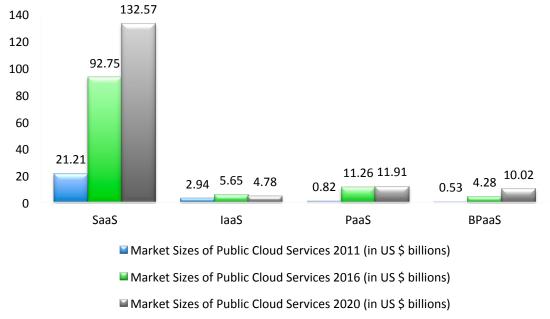
page 9.) Other open-source scripting languages are also relatively popular for customers, most notably, Ruby, Python and PHP. In the future, companies should also establish framework standards and an official scripting language.

Standards have already set in SaaS and IaaS because customers know what they are purchasing. However, PaaS is still very vague and unchartered. Expectations seldom match reality. One of the largest benefits of standardization is the ability to avoid vendor lock-in. If a customer chooses to end business with a vendor, they must get their data back. Interoperability is key.

Interoperability will only come through openness. Openness will increase market size and simpify service use. Open offerings will only be open if they are fair, equal, and executing similar activities as those from other contending vendors. Open PaaS will also enable more integration with companies via Cloud Brokerage Services.

The following indicate criteria PaaS providers ought to satisfy to continue to contend in the market

- Portability of data ease with which data can be entered and extracted
- Access to data by other programs from different environments
- Formatting of data to conform to standards to enable access and manipulation by third party tools
- Semantic interoperability standardized definitions for types of data



Report 108, page 10

#### **CONSORTIA**

There are many cloud consortia trying to catalyze standardization in areas where they are not yet established. Most prominent is the Cloud Security Alliance (CSA). This consortium comprises of eight

working groups specializing in the development of standards in secuity features. They have thus far composed two white papers titled, "Top Threats to Cloud Computing V1,0" and "Security Guidance for Critical Areas of Focus in Cloud Computing V2.1." They have furthermore established a security standard audit, CloudAudit and a Certificate of Cloud Security Knowledge. CSP contributors are HP, CSC, Dell, Rackspace, Verizon, VMware and more. (Report 131, page 8)

Another consortium is the Distributed Management Task Force (DMTF) which works to create interoperable APIs. It has written three white papers called, "Interoperable Clouds," "Use Cases and Interactions for Managing Clouds" and "Architecture for Managing Clouds." It is the driving effort behind the Open Virtualization Format, which is looking to develop a standard for VM hypervisor interoperability. Moreover, its largest pursuance is the Cloud Infrastructure Management Interface (CIMI), a prospective standard in-the-making. It has partnerships with the CSA, SNIA, and OGF and CSP contributors include VMware, IBM, HP, EMC and Citrix. (Report 131, page 7)

The third main consortium is the Institute of Electrical and Electronics Engineers (IEEE). In April 2011, it developed a working group that delineates, monitors and supports current standardizing efforts and another that is focused on interoperability standards. (Report 131, page 8)

Other minor consortia include the National Institute of Standards Technology (NIST), the Storage and Network Industry Alliance (SNIA), the Enterprise Cloud Leadership Council (ECLC), Cloud2, and the Global Inter-Cloud Technology Forum, Japan (GICTF). (Report 131, page 7)

## **BURSTING INTO THE CLOUD**

Cloudbursting occurs when peak workloads overwhelm system requirements and are thus moved into the public cloud. It can be implemented via a connection between on-premises systems and the public, or via a connection between private cloud and public cloud. Cloudbursting predominantly takes place for laaS.

Services can spread to new capacities either during their deployment, or to accommodate growing demands, while continuing to function normally. This will progress from being a manual transition to being an automated one.



Cloudbursting embodies the importance of standardization in cloud services. Enterprises will continue to grow, and thus, their processes will have to grow with them. Once companies move services to the cloud, they should be able to flourish in the cloud with ease and agility. In the absense of standards, they will have no choice but to reconfigure their existing architecture to expand their capabilities. This will cause

extreme inconvenience, and ultimately the services with the most interoperability will be the only option for cloudbursters.

# **Breaking Free of Silos**

# **Piecing Together the Puzzle**

## HORIZONTAL MARKET ADOPTION: IMPORTANCE OF INTEROPERABILITY

Through 2016, enterprises will invest more of their IT budget on application consolidation and less on building new applications. (Report 92, page 6) Integration spanning different services will be enabled and pushed by increased standardization. Vendors that take a horizontal market approach will invest in interoperable and agile offerings to comply with the relocating workloads of enterprises. As standardization and commoditization cause service fragmentation, customer options will only increase.

Dynamic sourcing in the cloud holds extreme promise for the future. It is the horizontal integration of required services sourced from different CSPs and consolidated and deployed through a company. It lowers costs and increases revenue.

Companies source their services to maximize on low costs and increase business value with IT. Dynamic sourcing across public cloud environments and internal environments leads to dynamic workloads. These have long been balanced by CIOs, but now cloud brokerage services are penetrating the market.

## **CLOUD BROKERAGE SERVICES**

Cloud brokerage services are rising to assume the position of orchestrating and consolidating enterprise services. They are the new enablers of dynamic sourcing, taking over the role from CIOs. They will ease transition to the cloud, enhance maximization of processes in the cloud and integrate services offered by cloud. By 2015 most services and will be administered in the cloud directly or through cloud brokerage services. (Report 92, page 11)

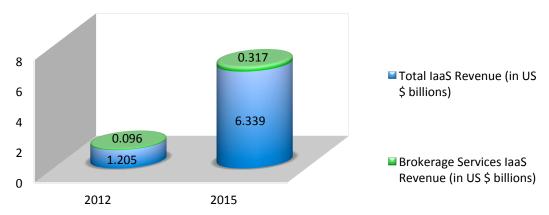
There are four types of cloud brokers: (Report 21, page 3)

- SaaS broker offers integration between SaaS providers
- Simple cloud broker offers integration between similar vendors in a single market segment (i.e. laaS)
- Full infrastructure broker offers dynamic services across private and public cloud infrastructure
- Unified cloud broker offers integration spanning all application software, infrastructure and middleware (will emerge in 2015 once IaaS and PaaS are more standardized and will serve as the quintessential broker)

Cloud brokerage services are administered via cloud management platforms. This industry is just emerging and vendors have joined the market very recently.

There are four vendor groupings administering CMP:

- Open-source platform vendors (OpenStack)
- Traditional management vendors with new virtualized platforms (IBM, HP, BMC Software, CA Technologies)
- Vendors with established virtualized platforms (VMware, Microsoft, Citrix)
- Startups (Abiquo, DynamicOps, Eucalyptus Systems): these will provide the most innovation in the short term, but in order to stay in the market, will need to be acquired down the line

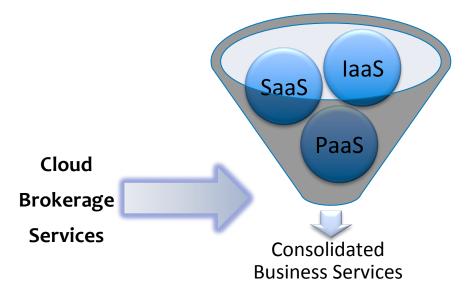


Report 21, page 9

Gartner outlines three key professional capabilities of cloud brokers (brokers may specialize in a single capability, or have mastered all three):

- Aggregation unification and categorized presentation of multiple cloud services (ie. by industry or geographical location) to enrich usage
  - Financing (billing, etc.)
  - Management
  - Cloud scale provisioning
- Integration consideration of all forms of combination between services and data on-premises and in the cloud to discover new functionalities
  - Governance
  - Application integration
  - Technology integration
- Customization administration of enhanced capabilities beyond original service offerings

- Analytics
- Implementation of new custom services
- Service refinement



# **Tailor-made Solutions**

# VERTICAL MARKET ADOPTION: DO ONE THING, AND DO IT WELL

Customized, configured and converged services represent a vertical market approach to cloud technology. This represents a viable market in years to come due to enterprise need to consolidate business services. Vendors that offer this approach address very specific customer needs. They seldom conform to standards and thus surpress interoperability and agility.

However, there are benefits with such packages such as security, as services are less public. This is externely useful, especially for banks. In addition, there is quicker deployment. Services come to companies already bound tight together and functioning, which eliminates the necessity of dynamic sourcing. This is externely convenient from a business perspecive.

The most prominent market vendors that take a vertical approach are Oracle and salesforce.com. They sell vertically-integrated technology stacks, comprising of foundational infrastructure and virtual application software.

# **CONVERGED INFRASTRUCTURES**

Bulked services are predominantly offered through converged infrastructures. Storage, servers, applications and networks are all integrated on virtual fabric. Main drivers for convergence are costs, management and speed.

Many vendors attempt to integrate the maximum number of servers and networks to satisfy customer demands. In the long run, this will only impede growth by stagnating the ability to extend workloads. This all multiplies the amount of processes in the cloud and complicates reconfiguration.

These converged infrastructures are marketed as "clouds-in-a-box." Although they are meant to fit an enterprise's business needs, they often address what vendors believe are the business needs. Companies will soom be at the mercy of vendors.

There is a widespread assumption that all pre-converged services are tightly integrated, when in fact there may be low levels of interoperability between provided services. Vendors build up their suites through acquisitions with companies that offer somewhat incompatible services. (Interview 3)

Solutions include those by Oracle (Exadata) and Egenra (BladeFrame). These offer integrated management stacks that are useful, but also cause vendor lock-in. Recently, Oracle acquired Siebel CRM Systems and somewhat replicated salesforce.com's management as a component of its integrated offering.

# **A Global Perspective**

# **Europe**

Although the hype of cloud is continuously ensnaring the rest of the world, four major inhibitors prevent much growth in Europe:

- Reluctancy to make new investments (result of European economic crisis)
- Extensive data security and privacy regulations
- Complicated B2B multienterprise integration and processes
- Time dragging caused by EU policies

As a result, cloud expansion in Europe is slower than the rest of the world; however, this does not mean it has not at all permeated the European landscape. Interest is still high, and adoption will slow but not stop. Benefits and overall outcomes outweigh the reluctancies and restrictions. Gartner advises to begin adoption in areas with the least resistance and most foundation, like SaaS.

In Western Europe and North America, demand for data center space is heightening by 20% a year. (Report 67, page 2) Soon storage of data will have to move into the cloud, accelerating virtualization in this area.

In Europe, localized vendors will be the most successful, as they will most cater to the people and comply with regional restrictions. These vendors will often sell vertical solutions, and this is an area where doing

so will be extremely beneficial, due to extreme fragmentation in regulations and landscapes across the region.

# **Latin America**

Cloud adoption in Latin America is slow, but steady. It is still in a nascent stage due to:

- Unstable broadband coverage
- Limited applications
- Lack of infrastructure (makes adoption costly)

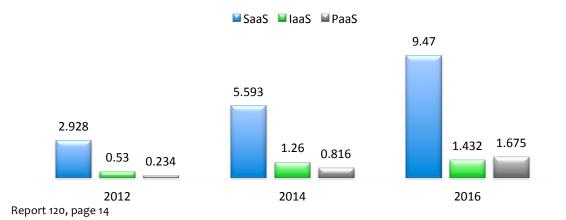
Increased broadband connections will increase the demand for data center space (by 60% a year in BRIC economies), ultimately posing an opportunity for cloudbursting. (Report 67, page 2) Interest in cloud is high, but businesses feel safer opperating under their own data centers.

Reluctant attitudes will fade as cloud adoption grows. The Brazilian government will be a key ally in this industry, as they are devoted to growth, especially in IT.

# **Asia Pacific**

Cloud expansion in Asia Pacific is by far the most prevalent. Growth is most apparent in the rising economy of China and India, where excitement floods the markets. These countries are the most willing to let cloud technology comply with their regulations and induct it into their society. Forrester predicts that the cloud computing market in Asia Pacific will grow from \$1.062 billion in 2012 to \$12.577 billion in 2016. (Report 120, page 4)

# Cloud Computing Market Size in Asia Pacific (in US \$ billions)



In 2011, China took Japan's place being the second-largest data center market worldwide, taking up 8.3% of the world market. In 2015 the number is expected to rise to more than 11%. (Report 95, page 10) The

main contributor to this will becloud technology. That year, Gartner estimates that cloud computing in China will take up over 25% of the data center market. (Report 95, page 2)

Surprisingly, in China, cloud investments only gained momentum in 2008. At that time, there were mostly small and medium companies investing, specifically in CRM services, which were the most established. This year, approximately 30% of large enterprises in China are moving information and services to the private cloud. (Report 95, page 11)

It is very difficult for global cloud providers to permeate the market in China due to low bandwith, lagging network speed, regional differenced in network speed, lack of clear security and privacy laws and government partiality toward local organizations. Therefore, there are four models for service providers to follow to enter the market:

- Direct model (i.e. SAP and salesforce.com)
- Revenue-sharing model (i.e. partnership between Zoho and Baihui)
- Licensing model (for small providers)
- Acquisition (of a local service provider)

Like in Europe and South America, it is imperative that service providers work with the government when extending their services. Especially in China, the government is keen to grow internal technologies and is partial toward local vendors, particularly in strengthening delivery infrastructure and outsourcing services.

Public cloud vendors in China all mostly tailor to small and medium businesses. Local application software vendors include Kingdee International Software group and Ufida, while leading global service providers are those like SAP and salesforce.com.

Ultimately, cloud growth on an international scale is fueled by the demand for more storage and data centers. Once the amount of collected data has reached a breaking point in terms of internal storage capacity, adoption will take off. Countries like China are ahead of the curve with virtualization, but in the near future areas in Europe and Latin America will be quick to contibute to the growth of this technology.

# **Appendix**

#### **Interviews**

- 1. Larry Ellison. "DX: All Things Digital Conference." CEO. Oracle. June 21, 2012.
- 2. Lauren E Nelson. Forrester. Telephone Interview. July 5, 2012.
- 3. Rashmy Chatterjee. VP, IBM Software Group. IBM. Telephone Interview. July 6, 2012.
- 4. Stefan Ried. Forrester. Telephone Interview. July 5, 2012.

# **Research Reports**

- 5. "Agenda for Application Services, 2012." Patrick J Sullivan and Allie Young. Gartner. February 17, 2012.
- 6. "Agenda for Cloud Computing, 2012." David Mitchell Smith and David W Cearley. Gartner. February 22, 2012.
- 7. "Agenda for Software as a Service, 2012." Robert P Desisto. Gartner. February 28, 2012.
- "Application Performance Monitoring Is the First Step to Manage the Hybrid Cloud Application Portfolio."
   Will Cappelli. Gartner. December 19, 2011.
- 9. "A Quick Look at Cloud Computing Industries, 2012." Marc Halpern, Michael Dominy, Son Scheibenreif and Simon F Jacobson. Gartner. April 13, 2012.
- 10. "A Quick Look at Cloud Computing in Healthcare Payers and Providers, 2012." Christina Lucero and Barry Runyon. Gartner. April 6, 2012.
- 11. "Are Converged Infrastructures Good For IT?" James Staten. Forrester. May 17, 2010.
- 12. "As Cloud Computing Matures, Customers Focus on Security, Availability and Management." Jean Bozman. IDC. July 2, 2012.
- 13. "Assess Your Cloud Maturity." Vanessa Alvarez. Forrester. May 29, 2012.
- 14. "Business Process Services in the Cloud Services Value Chain." Robert H Brown, Cathy Tornbohm, Michele Cantara, Benoit J Lheureux and TJ Singh. Gartner. October 2, 2011.
- 15. "Case Study: Integrating Public Cloud Storage Into Your Vision." Gene Ruth. Gartner. December 5, 2011.
- 16. "Case Study: Using Cloud IaaS for Business Continuity Solutions." Eric Knipp and Lydia Leong. Gartner. December 19, 2011.
- 17. "Choose the Right Cloud Solution for IT Modernization." Dale Vecchio. Gartner. December 16, 2011.
- 18. "Choosing the Right Cloud Solution for IT Modernization." Dale Vecchio. Gartner. December 16, 2011.
- 19. "CIOs Should Beware of a Return to Full Outsourcing." Claudio Da Rold. Gartner. April 5, 2012.
- 20. "Cloud Broker A New Bisiness Model Paradigm." Stefan Ried, Ph.D. Forrester. September 22, 2011.
- 21. "Cloud Brokers Become Change Agents." Stefan Ried, Ph.D. Forrester. June 14, 2012.
- 22. "Cloud Business Services: A Closer Look at BPaaS." Frances Karamouzis. Gartner. April 2, 2012.

- 23. "Cloud Computing: Economic, Financial and Service Impact of IT Planning Assumptions." Kurt Potter. Gartner. December 8, 2011.
- 24. "Cloud Computing in the Government: The Reality Behind the Hype." Andrea Di Malo. Gartner. August 29, 2011.
- 25. "Cloud Computing Is Driving the Evolution of IT Asset Management." Alexa Bona and Rob Schafer. Gartner. January 30, 2012.
- 26. "Cloud IaaS Networking Options." Lydia Leong. Gartner. March 7, 2011.
- 27. "Cloud Services Brokerage Is Dominated by Three Primary Roles." Benoit J Lheureux, Daryl C Plummer, Tiffani Bova and Michele Cantara. Gartner. November 23, 2011.
- 28. "Cloud Storage Gateways With Public Storage Services Support 'Outside the Data Center Box' Thinking." Gene Ruth. Gartner. June 22, 2012.
- 29. "Cloud Strategies To Drive Telco Growth." Henry Dewing. Forrester. February 19, 2012.
- 30. "Cool Vendors in Cloud Services Brokerages, 2012." Daryl C Plummer, Tiffani Bova, Paolo Malinverno, Michele Cantara, and Gregor Petri. Gartner. April 11, 2012.
- 31. "CSC Introduces the First Hybrid Cloud IaaS for Security and Simplicty." Claudio da Rold, William Maurer, Ted Chamberlin and Frank Ridder. Gartner. April 19, 2011."
- 32. "Data Center Services: Regional Differences in the Move Toward the Cloud, 2012." Claudio Da Rold, Rolf Jester, William Maurer, Ted Chamberlin, To Chee Eng and Gregor Petri. Gartner. February 29, 2012.
- 33. "Design Your Private Cloud With Hybrid in Mind." Thomas J Bittman. Gartner. February 24, 2012.
- 34. "Develop Cloud Metrics Using The Balances Scorecard." James Staten and Lauren E Nelson. Forrester. June 13, 2012.
- 35. "Drive Savings And Profits With Cloud Economics." James Staten. Forrester. May 22, 2012.
- 36. "Driving Outsourcing Success In China." Gene Cao. Forrester. November 11, 2011.
- 37. "ERP/Business Applications and the Public Cloud: A Life Cycle Assessment Methodology and Key Focus Areas." Pat Phelan. Gartner. January 5, 2012.
- 38. "Evaluating the Openness of Platforms as a Service." Daniel Sholler. Gartner. March 30, 2012.
- 39. "Five Cloud Computing Trends That Will Affect Your Cloud Strategy Through 2015." David W Cearley and David Mitchell Smith. Gartner. February 10, 2012.
- 40. "Five Ways the Cloud Is Rolling Into the Enterprise Portal Market." Jim Murphy. Gartner. January 31, 2012.
- 41. "Gartner Position: BPM Is Critical for the Adoption of Applications and Business Processes in the Cloud." Michele Cantara. Gartner. June 14, 2012.
- 42. "Gartner Reference Model for Elasticity and Multitenancy." Yefim V Natis. Gartner. June 22, 2012.
- 43. "Gartner Reference Model for PaaS." Yefim V Natis. Gartner. September 28, 2011.

- 44. "Global Cloud Providers Need The Right Strategy To Enter The Public Cloud Market In China." Bryan Wang. Forrester. March 29, 2012.
- 45. "GT Nexus and Kinaxis May Make Supply Chain Cloud Easier for Many." Michael Dominy. Gartner. May 7, 2012.
- 46. "How Cloud Computing Relates to Grid Computing." Carl Claunch. Gartner. September 22, 2011.
- 47. "How Internet Access Architecture Redesign Can Enhance External Cloud Service Performance." Bjarne Munch and John Pescatore. Gartner. March 19, 2012.
- 48. "How to Build and Enterprise Cloud Service Architecture." Donna Scott, Milind Govekar, Cameron Haight and Ronni J Colville. Garter. March 12, 2012.
- 49. "How to Evaluate Process Agility and Visibity in Cloud Business Process Services." Michele Cantara and Benoit J Lheureux. Gartner. November 15, 2011.
- 50. "How to Identify the Right Basic Approach for Your Application Integration Project." Benoit J Lheureux, Jess Thompson, Massimo Pezzini and Paolo Malinverno. Gartner. May 3, 2012.
- 51. "Hybrid IT: How Internal and External Cloud Services Are Transforming IT." Chris Howard, Drue Reeves, Anne Thomas Manes, Bob Blakley and Dan Blum. Gartner. February 8, 2012.
- 52. "Hype Cycle for Application Architecture, 2011." Daniel Sholler. Gartner. July 21, 2011.
- 53. "Hype Cycle for Application Services Outsourcing, 2011." Alex Soejarto. Gartner. July 26, 2011.
- 54. "Hype Cycle for Cloud Computing, 2011." David Mitchell Smith. Gartner. July 27, 2011.
- 55. "IAMaaS Adoption Is Increasing." Gregg Kreizman. Gartner. April 28, 2011.
- 56. "Impact of Cloud Computing on Human Capital Management Applications." Jeff Freyermuth. Gartner. October 27, 2011.
- 57. "Impact of the Cloud on Supply Chain Management." Michael Dominy, C Dwight Klappich, Mickey North Rizza, Simon F Jacobson and Tim Payne. Gartner. November 2, 2011.
- 58. "Improve Productivity With The Cloud." James Staten. Forrester. May 23, 2012.
- 59. "In a Diverse Europe, Cloud Adoption Will Be Slower." Paolo Malinverno, Gregor Petra and Carsten Casper. Gartner. June 15, 2012.
- 60. "Industries Aim to Evolve Cloud Computing Beyond Support Functions to More Strategic Uses." Kimberly Harris-Ferrante and Daryl C Plummer. Gartner. May 25, 2012.
- 61. "Infrastructure Utility for SAP Applications: HP ECS-Utility for SAP Offering." Claudio Da Rold, Gianluca Tramacere and Frank Ridder. Gartner. January 30, 2012.
- 62. "Integrate Cloud Into Existing Architecture Strategies." Randy Heffner. Forrester. May 11, 2011.
- 63. "Integration Platform as a Service: Moving Integration to the Cloud." Massimo Pezzini and Benoit J Lheureux. Gartner. March 7, 2011.
- 64. "IT Challenges for Enterprises in China, 2012." Jim Longwood and Tina T Tang. Gartner. March 14, 2012.

- 65. "IT Infrastructure And Operations: The Next Five Years." Jean-Pierre Garbani and Marc Cecere. Forrester. May 3, 2011.
- 66. "Key Considerations When Sourcing Cloud Services In Asia/Pacific." Vincent Fu. Gartner. September 26, 2011.
- 67. "Key Pitfalls of Moving to a Hybrid Data Center and Cloud Architecture." Rakesh Kumar. Gartner. October 28, 2011.
- 68. "Magic Quadrant for Application Infrastructure for Systematic Application Integration Projects." Jess Thompson, Yefin V Natis, Massimo Pezzini, Daniel Sholler, Ross Altman and Kimihiko Iijima. Gartner. June 20, 2012.
- 69. "Magic Quadrant for Enterprise Application Servers." Massimo Pezzini, Yefim V Natis, Kimihiko Iijima, Daniel Sholler and Raffaella Favata. Garter. September 26, 2011.
- 70. "Magic Quadrant for Enterprise Backup/Recovery Software." Dave Russell, Alan Dayley, Sheila Childs and Pushan Rinnen. Gartner. June 11, 2012.
- 71. "Magic Quadrant for Enterprise Information Archiving." Sheila Childs, Kennet Chin and Debra Logan. Gartner. December 6, 2011.
- 72. "Magic Quadrant for Enterprise Network Firewalls." Greg Young and John Pescatore. Gartner. December 14, 2011.
- 73. "Magic Quadrant for Managed Hosting." Ted Chamberlin and Lydia Leong. Gartner. March 5, 2012.
- 74. "Magic Quadrant for Public Cloud Infrastructure as a Service." Lydia Leong and Ted Chamberlin. Gartner. December 2, 2011.
- 75. "Magic Quadrant for User Administration/Provisioning." Perry Carpenter and Earl Perkins. Gartner.

  December 22, 2011.
- 76. "Magic Quadrant for User Authentication." Ant Allan. Gartner. January 17, 2012.
- 77. "Magic Quadrant for Workload Automation." Milind Govekar and Biswajeet Mahapatra. Gartner. February 27, 2012.
- 78. "Make The Cloud Enterprise Ready." James Staten. Forrester. June 1, 2012.
- 79. "Market Definitions and Methodology: IT Markets." Richard Gordon. Gartner. May 30, 2012.
- 80. "Market Overview: Midrange Storage, Q3 2011." Vanessa Alvarez. Forrester. November 17, 2011.
- 81. "Market Overview: Private Cloud Solutions, Q2 2011." James Staten and Lauren E Nelson. Forrester. May 20, 2011.
- 82. "Market Overview: Public IaaS Clouds, Q4 2011, Part 3." James Staten and Lauren E Nelson. Forrester.

  December 12, 2011.
- 83. "Market Trends: Disruptive Forces That Drive the Enterprise Software Markets, Worldwide, 2012-2016." Tom Eid. Gartner. January 31, 2012.

- 84. "Master 10 Trends For Your Cloud Journey." James Staten and Lauren E Nelson. Forrester. May 10, 2012.
- 85. "Onboard The Business To Your Cloud Strategy." James Staten. Forrester. May 17, 2012.
- 86. "Optimize Cloud Computing in Customer Service Organizations." Michael Maoz. Gartner. October 12, 2011.
- 87. "Oracle Moves Toward a "SaaS Unlimited" Strategy With Planned Taleo Buy." James Holincheck, Thomas Otter and Jeff Freyermuth. Gartner. February 13, 2012.
- 88. "Oracle, Salesforce.com and SAP Acquisitions Will Impact Your SaaS Strategy." Robert P Desisto and James Holincheck. Gartner. February 13, 2012.
- 89. "Oracle Steps Forward Into the PaaS Market, Looking Backward at Enterprise IT." Yefim V Natis, Massimo Pezzini, Eric Knipp and David Mitchell Smith. Gartner. Novermber 7, 2011.
- 90. "PaaS 2012: Tactical Risks and Strategic Rewards." Yefim V Natis. Gartner. January 3, 2012.
- 91. "Predicts 2012: A Maturing Competitive Landscape Brings New IAM Opportunities." Ray Wagner, Avivah Litan, Ant Allan, Gregg Kreizman and Earl Perkins. Gartner. November 28, 2011.
- 92. "Predicts 2012: Application Integration Will Increase in Scope and Complexity." Benoit J Lheureux, Jess Thompson, Yefin V Natis, Massimo Pezzini, Paolo Malinverno, Timothy Weaver and Ted Friedman. Gartner. November 10, 2011.
- 93. "Predicts 2012: Cloud Computing and Event Processing Wil Be the Key Advances in Application Architecture." Ross Altman, W Roy Schulte, Massimo Pezzini and Daniel Sholler. Gartner. November 16, 2011.
- 94. "Predicts 2012: Cloud Shift Drives Higher IT Spending, Changes in IT Funding and a Focus on New IT Performance Goals." Kurt Potter and Barbara Gomolski. Gartner. November 29, 2011.
- 95. "Predicts 2012: Data Center Growth and the Impact of Cloud Computing on Energy Efficiency." Bettina Tratz-Ryan, Jennifer Wu, Kiyomi Yamanda, Errol Rasit and Naresh Singh. Gartner. November 18, 2011.
- 96. "Predicts 2012: IT Services Sourcing Strategies and Execution Demand Proactive Diligence." Frances Karamouzis, Claudio Da Rold, Sandra Notardonato, Frank Ridder, Gilbert van der Heiden and Jim Longwood. Gartner. December 1, 2012.
- 97. "Predicts 2012: More PaaS Vendors and More PaaS Confusion." Yefim V Natis, Massimo Pezzini, Eric Knipp, Michele Cantara and Gene Phifer. Gartner. Novermber 23, 2011.
- 98. "Prepare for the Changing World of APM as a Service." Will Cappelli. Gartner. December 12, 2011.
- 99. "Private Cloud Computing: Target Services That Need Agility." Thomas J Bittman. Gartner. February 28, 2012.
- 100. "Private Cloud Storage Favored by IT Organizations." Gene Ruth. Gartner. March 2, 2012.
- 101. "Process Templates Broaden Application Options in a Pace-Layered Application Strategy." Michele Cantara. Gartner. June 13, 2012.
- 102. "Research Index: New BPM Technologies Lead the Way to Achieving Process Adaptability." Samantha Searle. Gartner. February 27, 2012.

- 103. "SaaS and Human Capital Management: Avoid Risky and Expensive Deals." Thomas Otter and Alexa Bona. Gartner. September 22, 2011.
- 104. "SAP ERP Human Capital Management Product Update, 2012." Sunil Padmanabh and Thomas Otter. Gartner. January 26, 2012.
- 105. "Securing and Managing Cloud Computing." John Pescatore. Gartner. May 7, 2012.
- 106. "Security Services in Cloud Computing." Juan Sacchi, Kevin Bailey and David Bradshaw. IDC. May 2012.
- 107. "Sizing The Cloud Markets In Asia Pacific." Michael Barnes. Forrester. February 3, 2012.
- 108. "Sizing The Cloud." Stefan Ried, Ph.D. and Holger Kisker, Ph.D. Forrester. April 21, 2011.
- 109. "Source Your Network Architecture From A Strategic Partner." Andre Kindness. Forrester. February 16, 2012.
- 110. "Storage Management Market and Vendor Guide Cross-Reference Tool, 2011." Jie Zhang and Alan Dayley. Gartner. May 7, 2012.
- 111. "Supply Chain Management Market and Vendor Guide." C Dwight Klappich, Chad Eschinger, Tim Payne, Tim Zimmerman and William McNeil. Gartner. December 7, 2011.
- 112. "Survey Reveals Security and Compliance Emerging Practices for Cloud Infrastructure Services." Claudio Da Rold and Jay Heiser. Gartner. September 19, 2011.
- 113. "Taxonomy, Definitions and Vendors Landscape for Application Platform Products." Massimo Pezzini, Yefim V Natis, Dale Vecchio and Fabrizio Biscotti. Gartner. May 21, 2012.
- 114. "Techradar For Enterprise Architecture Professionals: Infrastructure Virtualization, Q2, 2011." Galen Schreck. Forrester. May 11, 2011.
- 115. "TechRadar For SVM Professionals: Software-As-A-Service, Q4 2011." Liz Herbert. Forrester. January 3, 2012.
- 116. "Tech Vendor Outlook For The US In 2012 To 2013." Andrew Bartels. Forrester. April 9, 2012.
- 117. "Telco and the Cloud. CIO Views From Around the World." Chris Lewis. IDC. March 2012.
- 118. "Telcos and Government Leading the Cloud Adoption Wave in China and South Korea." Biswajeet Mahapatra. Gartner. August 23, 2011.
- 119. "Telcos As Cloud Rainmakers." Dan Bieler. Forrester. March 14, 2012.
- 120. "Telcos Dive Headlong Into Asia's Cloud. Bryan Wang. Forrester. May 4, 2012.
- 121. "The Changing Cloud Agenda." Henry Kisker, Ph.D. Forrester. April 24, 2012.
- 122. "The Emerging Use of App Stores in the Government: Procuring Cloud Services and Beyond." Andrea Di Maio. Gartner. June 11, 2012.
- 123. "The Forrester Wave: CRM Suites For Large Organizations, Q3 2012." William Band. Forrester. July 9, 2012.
- 124. "The Forrester Wave: Platform-As-A-Service For App Dev And Delivery Professionals, Q2 2011." Stefan Ried, Ph.D. and John R Rymer. Forrester. May 19, 2011.

- 125. "The Forrester Wave: Platform-As-A-Service For Vendor Professionals, Q2 2011." Stefan Ried, Ph.D. and John R Rymer. Forrester. May 19, 2011.
- 126. "The Future of Cloud Business Applications." Robert P Desisto. Gartner. November 3, 2011.
- 127. "The Gartner Positon on Cloud Email." Matther W Cain and Tom Austin. Gartner. June 1, 2012.
- 128. "The Impact of Cloud Computing on Sales Organizations." Robert P. Desisto. Gartner. October 11, 2011."
- 129. "The Nexus of Forces: Social, Mobile, Cloud and Information." Chris Howard, Daryl C Plummer, Yvonne Genovese, Jeffrey Mann, David A Willis and David Mitchell Smith. Gartner. June 14, 2012.
- 130. "The Role of CSB in the Cloud Services Value Chain." Benoit J Lheureux, Daryl C Plummer, Tiffani Bova, Timothy Weaver, Michele Cantara, Linda R Cohen and Robert Brown. Gartner. October 4, 2011.
- 131. "The State Of Infrastructure-As-A-Service Cloud Standards." James Staten and Lauren E Nelson. Forrester. December 1, 2011.
- 132. "Top Five Trends for Private Cloud Computing." Thomas J Bittman. Gartner. February 14, 2012.
- 133. "Top Six Adoption Trends for Compute IaaS in India." Sid Deshpande. Gartner. December 2, 2011.
- 134. "Understanding Cloud's Multitenancy." James Staten and John R Rymer. Forrester. March 15, 2012.
- 135. "Understand Differentiated Business Value Services When Developing Services Sourcing Strategy." Frances Karamouzis and Claudio Da Rold. Gartner. June 19, 2012.
- 136. "User Survey Analysis: What SaaS and PaaS Buyers Tell Us About Cloud Adoption in North America, Europe and Asia/Pacific, 2011-2012. Sharon A Mertz and Chad Eschinger. Gartner. October 28, 2011.
- 137. "Vendor Rating: AT&T." Robert F Mason, Eric Goodness, Phillip Redman, Frank Marsala, Ted Chamberlin, Margaret Schoener and Amanda Sabia. Gartner. July 28, 2011.
- 138. "Vendor Rating: CA Technologies." Cameron Haight, Ronni J. Colville, Donna Scott, Sheila Childs, Jarod Greene, Terrence Cosgrove, Jonah Kowall, Milind Govekar, Mike Chuba, Daniel B. Stang, Earl Perkins, John Rizzuto and Debra Curtis. Gartner. February 2, 2012.
- 139. "Vendor Rating: Salesforce.com." Robert P. Desisto, Michael Maoz, Chris Fletcher, Yefim V. Natis, John Rizzuto, Tiffani Bova, Donald Feinberg, Patrick J. Sullivan, Alexa Bona, David M. Coyle, Jarod Greene, Adam Sarner, Eric Knipp, and David Mario Smith" Gartner. September 11, 2011.
- 140. "vSphere 5 Raises the Bar, But Also Brings Major Licensing Changes." Gary Chen. IDC. July 19, 2011.
- 141. "What IT Leaders Need to Know About In-Memory Data Grids." Massimo Pezzini. Gartner. March 6, 2012.
- 142. "What Managers Need to Know About Amazon EC2." Lydia Leong. Gartner. March 12, 2012.
- 143. "What's in a Name for Cloud Business Process Outsourcing Services: Explaining BPU and BPaaS." Cathy Tornbohm, Frances Karamouzis and Robert H Brown. Gartner. March 20, 2012.
- 144. "With Vast Government Cloud Opportunities In Asia Pacific, Vendors Need To Know Where To Look." Manish Bahl and Jennifer Belissent, Ph.D. Forrester. February 21, 2012.

- 145. "Worldwide and U.S. Security Services Threat Intelligence 2011-2014 Forecast: Out of the Basement and into the Clouds." Christian A Christiansen, Charles J Kolodgy and Chris Liebert. IDC. November 2011.
- 146."Worldwide Cloud Security 2011-2015 Forecast: A Comprehensive Look at the Cloud/Security Ecosystem." Phil Hochmuth, Sally Hudson, Jon Grady, Christian A Christiansen and Charles J Kolodgy. IDC. December 2011.
- 147. "Worldwide Cloud Systems Management Software 2012-2016 Forecast." Mary Johnston Turner. IDC. March 2012.
- 148."Worldwide Outsourcing Services 2012 Top 10 Predictions." Alexander Motsenigos, Mukesh Dialani, David Tapper, Rona Shuchat, Lisa Rowan and Melissa Stevenson. IDC. January 2012.
- 149. "Worldwide Software 2012-2016 Forecast Summary." Patrick Melgarejo. IDC. June 2012.
- 150. "Worldwide Virtual Machine Software 2012-2016 Forecast." Gary Chen and Iris Feng. IDC. June 2012.
- 151. "Worldwide Workload Scheduling and Automation Software 2012-2016 Forecast Update: Include Submarket Breakouts." Mary Johnston Turner. IDC. June 2012.