PRIVATE CLOUD COMPUTING USING ANEKA CLOUD PLATFORM

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Abstract

Aneka is an Application type Platform-as-a-Service (Aneka PaaS) for Cloud Computing. It acts as a framework which is used for creating customized applications and using them on either private or public Clouds. One of the most important features of Aneka is that it supports provisioning the resources on various public Cloud providers such as Windows Azure, Amazon EC2, and GoGrid. In this study, Aneka platform and its integration with the public Cloud infrastructures and its benefits shall be presented. Also the study aims at proving the extensibility, adaptability, and flexibility of Aneka. This study provides an overview of the framework by detailing the architecture of the system of the Aneka cloud. It tries to introduce the components and fundamental services that the Aneka Cloud comprises.

What is Cloud? – Its New Era of Opportunity

When computing resources in distant data centres are used rather than local computing systems, we talk about network-centric computing and network-centric content. Advancements in networking and other areas are responsible for the acceptance of the two new computing models and led to the **grid computing** movement in the early 1990s and, since 2005, to **utility computing and cloud computing**.

In **utility computing** the hardware and software resources are concentrated in large data centres and users can pay as they consume computing, storage, and communication resources. Utility computing often requires a cloud-like infrastructure, but its focus is on the business model for providing the computing services. **Cloud computing is a path to utility computing** embraced by major IT companies such as Amazon, Apple, Google, HP, IBM, Microsoft, Oracle, and others.

Cloud computing refers to the practice of transitioning computer services such as computation or data storage to multiple redundant offsite locations available on the Internet, which allows application software to be operated using internet-enabled devices.

Cloud computing delivery models, deployment models, defining attributes, resources, and organization of the infrastructure. There are three cloud delivery models: Software-as-a-

Service **(SaaS),** Platform-as-a-Service **(PaaS),** and Infrastructure-as-a- Service **(IaaS),** deployed as public, private, community, and hybrid clouds. [1]

The term computer cloud is overloaded, since it covers infrastructures of different sizes, with different management and different user populations. Several types of cloud are envisioned:

- **Private cloud.** The infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on or off the premises of the organization.
- **Community cloud.** The infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premises or off premises.
- **Public cloud.** The infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.
- **Hybrid cloud.** The infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

A private cloud could provide the computing resources needed for a large organization, such as a research institution, a university, or a corporation. The argument that a private cloud does not support utility computing is based on the observation that an organization has to invest in the infrastructure and a user of a private cloud pays as it consumes resources. Nevertheless, a private cloud could use the same hardware infrastructure as a public one; its security requirements will be different from those for a public cloud and the software running on the cloud is likely to be restricted to a specific domain.

A natural question to ask is: Why could cloud computing be successful when other paradigms have failed? The reasons that cloud computing could be successful can be grouped into several general categories - technological advances, a realistic system model, user convenience, and financial advantages.

A non-exhaustive list of reasons for the success of cloud computing includes these points:

- Cloud computing is in a better position to exploit recent advances in software, networking, storage, and processor technologies. Cloud computing is promoted by large IT companies where these new technological developments take place, and these companies have a vested interest in promoting the new technologies.
- A cloud consists of a homogeneous set of hardware and software resources in a single administrative domain. In this setup, security, resource management, fault tolerance, and quality of service are less challenging than in a heterogeneous environment with resources in multiple administrative domains.

- Cloud computing is focused on enterprise computing; its adoption by industrial organizations, financial institutions, healthcare organizations, and so on has a potentially huge impact on the economy.
- A cloud provides the illusion of infinite computing resources; its elasticity frees application designers from the confinement of a single system.
- A cloud eliminates the need for up-front financial commitment, and it is based on a pay-as-you-go approach. This has the potential to attract new applications and new users for existing applications, fomenting a new era of industry wide technological advancements.

Cloud computing have five universal values:

- Reduction of initial cost.
- Allocation of resources on demand without limit.
- Maintenance and upgrades performed in the back-end.
- Easy rapid development including collaboration with other systems in the cloud.
- More possibilities for global service development.

Cloud computing has the potential to improve the following aspects of an organization:

AGILITY

- **Reduces Time to Market:** Rapid deployment, lowered financial barriers to entry, and self-service capabilities increase business responsiveness and decreases the time required for realizing the value of IT projects.
- **Shortens the Solution Development Life Cycle:** A service-oriented approach to solution development and a standardized architecture help reduce the lead time between vision and deployment.
- **Enhances Responsiveness to Business Changes:** Improves the ability to respond to demand spikes and changes in IT supported business processes.

COST

- **Lowers Barriers to Entry:** Often described as a shift from Capex to Opex, Cloud services decouple fixed overhead from demand and enables a pay-as-you-go model that facilitates innovation and entry into new markets.
- **Reduces Operational Costs:** People, power, and space costs can be reduced through standardization, automation, and elastic Capacity Management.
- **Improves Cost Control:** Standardization, transparency of IT costs, and the ability to use cost or price to motivate behaviour improves budget predictability, cost effectiveness, and strategic IT alignment.
- **Enables Reuse:** A modular approach to IT provides an opportunity for significant application/functionality re-use across the enterprise, thereby lowering development costs and improving the predictability and cost effectiveness of solutions deployed across business units.

QUALITY

- **Improves Customer Satisfaction:** Cloud Computing improves an IT organization's ability to manage their customers' expectations and perceptions of solutions' responsiveness, capacity, and availability through the life cycle.
- **Enhances Service Level Efficiency:** Cloud computing enables IT to procure as well as deliver functionality at an improved service level per dollar spent over traditional IT.
- **Enriches Continuity of Service:** Cloud comp ting's inherent modularity and ability to decouple applications from the physical infrastructure creates opportunities to greatly improve the disaster recovery/business continuity aspects of an application.
- **Improves Ability to Meet Regulatory Requirements:** Cloud Computing offers sourcing options that enable CIOs and their business stakeholders to make risk managed decisions to effectively meet their businesses' regulatory, competitive, and differentiation needs.

With stories about cloud technology success and business leadership emerging daily, it's tempting to say we understand everything about the cloud, how it will evolve and who the winners in the cloud space will be. But we need to resist that temptation, because we know very little about long-term cloud trends based on near-term cloud projects. Today's cloud, according to enterprises, isn't tomorrow's cloud.

For all the excitement about cloud computing, current spending on cloud is relatively small when compared to what will ultimately be spent. Judging the whole market based on what's happened so far is like picking a marathon winner 138 feet from the starting line. But knowing that it's premature to call a winner in the cloud space doesn't explain why that is, and understanding the "why" could be a help to cloud planners. The fundamental question raises that "Is the Cloud of Today enough?" to address this question Tom Nolle, CIMI Corporation came with article Cloud computing pricing and economics which include insight about answering Why the cloud of today isn't the cloud of tomorrow? As follows-

What is moving to the cloud now?

The first reason is more financial than technical in nature. Information technology investments are "capital investments" in a financial sense, meaning they're long-lived. On average, IT assets are written down over a period of about five years. If anything is rendered obsolete before that write-down period is ended, the balance has to be written off, creating additional cost and lowering companies' profits for the period. Not surprisingly, companies don't like to write off IT assets, which mean they can't just massively shift to the cloud. Instead, they dip their toes in the cloud with early project activities that hasn't yet been invested in. According to enterprise surveys, over 65% of all their current cloud computing commitments are pilot projects, development and testing for new applications or simply cloud applications to support new business needs. Development and pilot project work, according to the surveys, tends to consume Infrastructure as a Service (IaaS) offerings because it's the most flexible in hosting multiple applications running on a range of operating systems and middleware platforms. New business needs are most often fulfilled with tactical Software as a Service (SaaS) cloud procurements. Thus, current enterprise cloud

spending is clustered at both ends of the spectrum of cloud services -- the most basic IaaS and the most integrated SaaS.

Where is the future of cloud?

Most enterprises believe their offloading missions for the cloud will require a form of Platform as a Service (PaaS). They also think that PaaS providers will have to offer Database as a Service to hold customer data. These DaaS services, hosted within the customers' data centres, will need to be accessible from the cloud in areas where it's impractical to migrate the full database or if it's prevented by security considerations or costs.

Enterprises also think that their "offload cloud" provider will offer presentation services, linking applications to the devices enterprises expect to use via virtual terminal support. These cloud presentation services, already available from some operators, will be used even for internally hosted applications. The PaaS offering will then switch work back and forth "underneath" the presentation cloud.

Many think that the most credible cloud partners are either not yet in the market or in the early stages of building out cloud services, further driving the future of cloud to a different place. Top candidates for enterprise cloud sourcing are their primary IT vendors (IBM, Microsoft and Oracle) and their primary network service providers (AT&T, Verizon, BT and other large national carriers). Enterprises believe the entry of these new players will change the market dynamic, both because these giants will define a new "mission-critical cloud" service set and because their entry into the market will change offerings of current cloud incumbents, including Amazon, Google and Rackspace. Buyers define the market, and the cloud market appears to be headed for major changes.

Cloud engineering is the application of engineering disciplines to cloud computing. It brings a systematic approach to the high-level concerns of commercialization, standardization, and governance in conceiving, developing, operating and maintaining cloud computing systems. It is a multidisciplinary method encompassing contributions from diverse areas such as systems, software, web, performance, information, security, platform, risk, and quality engineering.

Private cloud implementation

Why Private Cloud? – Key is SECURITY and AVAILABILITY

The Private Cloud is a pool of computing resources delivered as a standardized set of services that are specified, architected, and controlled by a particular enterprise. The path to a Private Cloud is often driven by the need to maintain control of the delivery environment because of application maturity, performance requirements, and regulatory or business differentiation reasons. For example, banks and governments have data security issues that may preclude the use of currently available Public Cloud services.

Using object storage generally translates into a focus on archival storage. Following the network-attached storage (NAS) or storage-area network (SAN) route can pave the way

for primary storage of active data, typically through incremental steps that lead to a more virtualized, automated and policy-driven infrastructure. Virtualization and automation play roles in storage clouds. **Private Cloud options include as follows:**

- **Self-hosted Private Cloud:** A Self-hosted Private Cloud provides the benefit of architectural and operational control, utilizes the existing investment in people and equipment, and provides a dedicated on-premises environment that is internally designed, hosted, and managed.
- **Partner-hosted Private Cloud:** A Partner-hosted Private Cloud is a dedicated environment that is internally designed, externally hosted, and externally managed. It blends the benefits of controlling the service and architectural design with the benefits of outsourcing.
- **Private Cloud Appliance:** A Private Cloud Appliance is a dedicated environment procured from a vendor, that is designed by the vendor with provider/market driven features and architectural control, is internally hosted, and externally or internally managed. It blends the benefits of using pre-defined functional architecture and lower deployment risk with the benefits of internal security and control.

The Private cloud is of **Self-hosted Private Cloud** which allow us to use the existing infrastructure with little up gradation with cost effective implementation for the **research and development cloud application.**

Why Aneka Cloud Platform?

Aneka is a platform and a framework for developing distributed applications on the Cloud. It harnesses the spare CPU cycles of a heterogeneous network of desktop PCs and servers or data centers on demand. Aneka provides developers with a rich set of APIs for transparently exploiting such resources and expressing the business logic of applications by using the preferred programming abstractions. System administrators can leverage on a collection of tools to monitor and control the deployed infrastructure. This can be a public cloud available to anyone through the Internet, or a private cloud constituted by a set of nodes with restricted access.

Aneka is an Application Platform-as-a-Service (Aneka PaaS) for Cloud Computing. It acts as a framework for building customized applications and deploying them on either public or private Clouds. One of the key features of Aneka is its support for provisioning resources on different public Cloud providers such as Amazon EC2, Windows Azure and GoGrid.

The Aneka based computing cloud is a collection of physical and virtualized resources connected through a network, which are either the Internet or a private intranet. Each of these resources hosts an instance of the Aneka Container representing the runtime environment where the distributed applications are executed. The container provides the basic management features of the single node and leverages all the other operations on the services that it is hosting. The services are broken up into fabric, foundation, and execution services. Fabric services directly interact with the node through the Platform Abstraction Layer (PAL) and perform hardware profiling and dynamic resource provisioning. Foundation services

identify the core system of the Aneka middleware, providing a set of basic features to enable Aneka containers to perform specialized and specific sets of tasks. Execution services directly deal with the scheduling and execution of applications in the Cloud.

One of the key features of Aneka is the ability of providing different ways for expressing distributed applications by offering different programming models; execution services are mostly concerned with providing the middleware with an implementation for these models. Additional services such as persistence and security are transversal to the entire stack of services that are hosted by the Container. At the application level, a set of different components and tools are provided to: 1) simplify the development of applications (SDK); 2) porting existing applications to the Cloud; and 3) monitoring and managing the Aneka Cloud.

A common deployment of Aneka is presented at the side. An Aneka based Cloud is constituted by a set of interconnected resources that are dynamically modified according to the user needs by using resource virtualization or by harnessing the spare CPU cycles of desktop machines. If the deployment identifies a private Cloud all the resources are in house, for example within the enterprise. This deployment is extended by adding publicly available resources on demand or by interacting with other Aneka public clouds providing computing resources connected over the Internet.

Aneka is a .NET-based application development Platform-as–a-Service (PaaS), which offers a runtime environment and a set of APIs that enable developers to build customized applications by using multiple programming models such as Task Programming, Thread Programming and MapReduce Programming, which can leverage the compute resources on either public or private Clouds [3]. Moreover, Aneka provides a number of services that allow users to control, auto-scale, reserve, monitor and bill users for the resources used by their applications. One of key characteristics of Aneka PaaS is to support provisioning of resources on public Clouds such as Windows Azure, Amazon EC2, and GoGrid, while also harnessing private Cloud resources ranging from desktops and clusters, to virtual datacentres when needed to boost the performance of applications, as shown in Figure 1. Aneka has successfully been used in several industry segments and application scenarios to meet their rapidly growing computing demands.

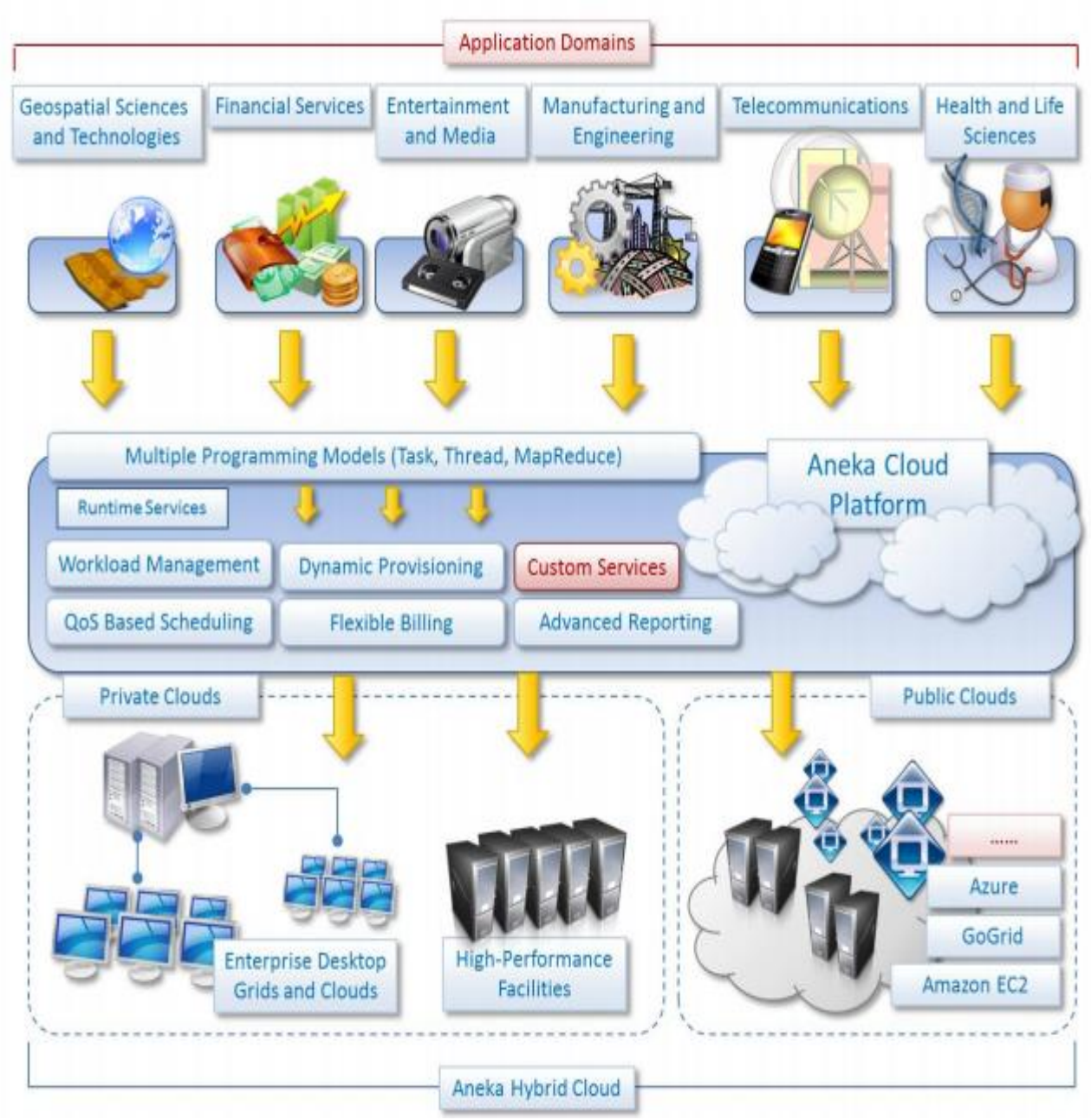


Figure 1: Aneka Cloud Application Development Platform.

Overview of Aneka Cloud Application Development Platform

Figure 2 shows the basic architecture of Aneka. The system includes four key components, including Aneka Master, Aneka Worker, Aneka Management Console, and Aneka Client Libraries.

The Aneka Master and Aneka Worker are both Aneka Containers which represents the basic deployment unit of Aneka based Clouds. Aneka Containers host different 4 kinds of services depending on their role. For instance, in addition to mandatory services, the Master runs the Scheduling, Accounting, Reporting, Reservation, Provisioning, and Storage services,

while the Workers run execution services. For scalability reasons, some of these services can be hosted on separate Containers with different roles. For example, it is ideal to deploy a Storage Container for hosting the Storage service, which is responsible for managing the storage and transfer of files within the Aneka Cloud. The Master Container is responsible for managing the entire Aneka Cloud, coordinating the execution of applications by dispatching the collection of work units to the compute nodes, whilst the Worker Container is in charge of executing the work units, monitoring the execution, and collecting and forwarding the result.

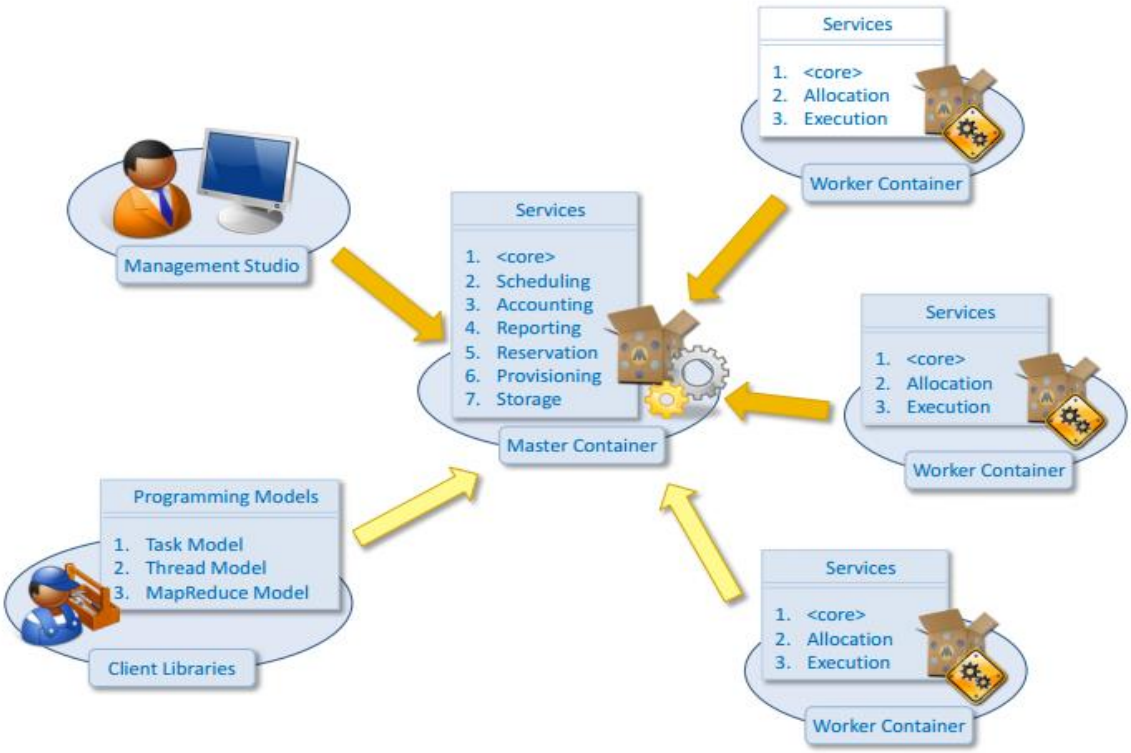


Figure 2: Basic Architecture of Aneka.

Overview of Windows Azure Service Architecture

In contrast to other public Cloud platforms such as Amazon EC2 and GoGrid, Windows Azure currently does not provide an IaaS (Infrastructure-as-a-Service). Instead, it provides a PaaS (Platform as a Service) solution, restricting users from direct access with administrative privileges to underlying virtual infrastructure. Users can only use the Web APIs exposed by Windows Azure to configure and use Windows Azure services.

A role on Windows Azure refers to a discrete scalable component built with managed code. Windows Azure currently supports three kinds of roles [4], as shown in Figure 3.

- **Web Role:** a Web role is a role that is customized for Web application programming as is supported by IIS 7.

- **Worker Role:** a worker role is a role that is useful for generalized development. It is designed to run a variety of Windows-based code.
- **VM Role:** a virtual machine role is a role that runs a user-provided Windows. Server 2008 R2 image.

A Windows Azure service must include at least one role of either type, but may consist of any number of Web roles, worker roles and VM roles. Furthermore, we can launch any number of instances of a particular role. Each instance will be run in an independent VM and share the same binary code and configuration file of the role.

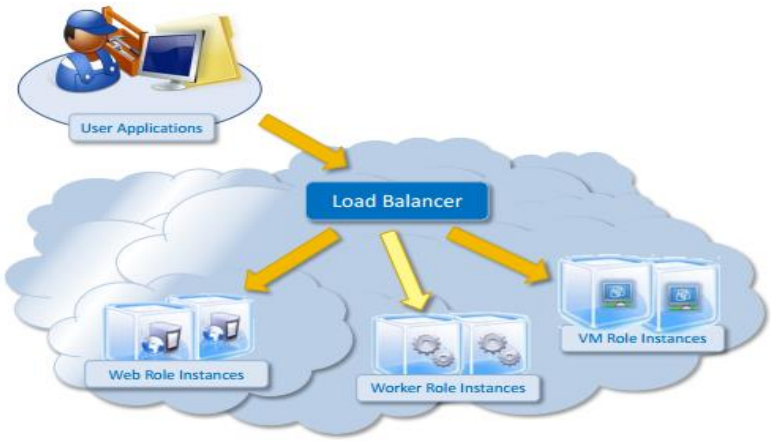
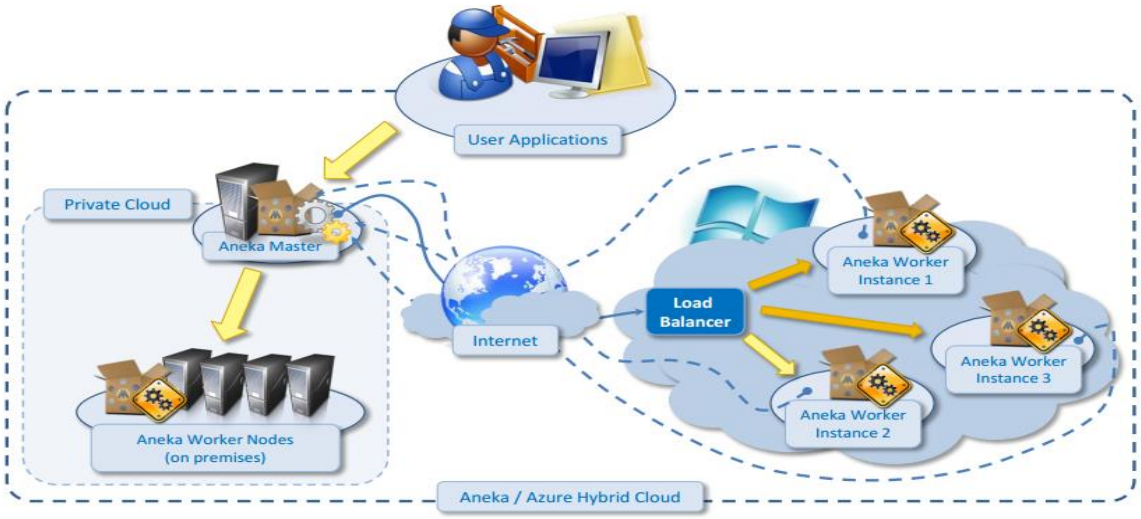


Figure 3: Windows Azure Service Architecture



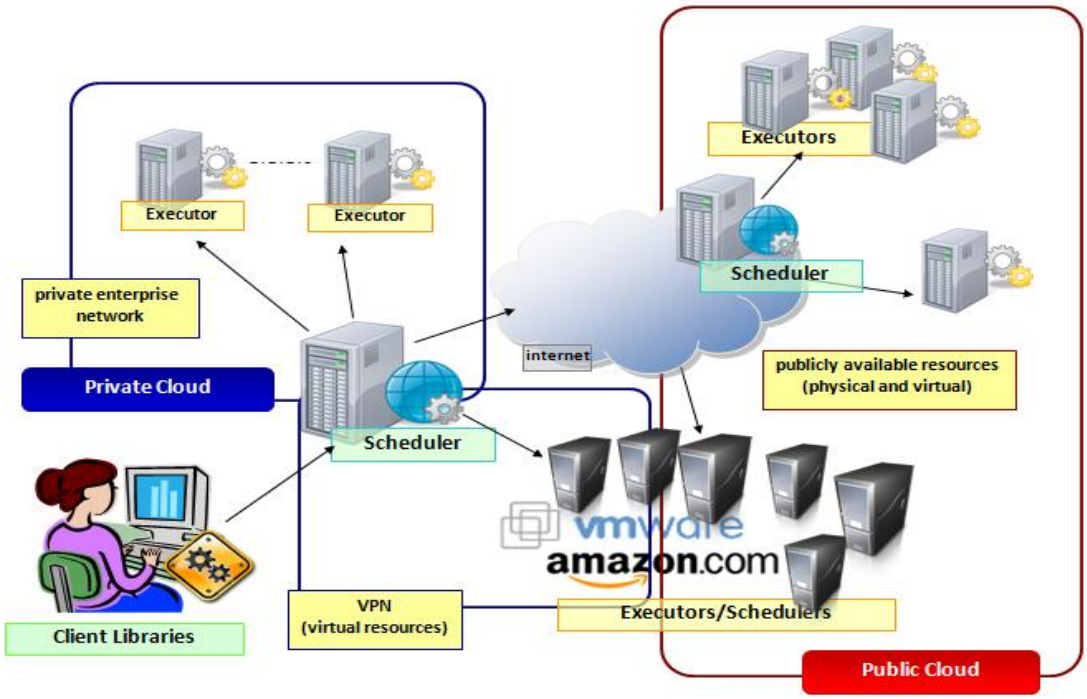


Figure 4: The Deployment of Aneka Worker Containers as Windows Azure Worker Role Instances.

Figure 4 provides an overall view of the deployment of Aneka Worker Containers as instances of Windows Azure Worker Role. As shown in the figure, there are two types of Windows Azure Worker Roles used. These are the Aneka Worker Role and Message Proxy Role. In this case, we deploy one instance of Message Proxy Role and at least one instance of Aneka Worker Role. The maximum number of instances of the Aneka Worker Role that can be launched is limited by the subscription offer of Windows Azure Service that a user selects. In the first stage of the project, the Aneka Master Container will be deployed in the on premises private Cloud, while Aneka Worker Containers will be run as instances of Windows Azure Worker Role. The instance of the Message Proxy Role is used to transfer the messages sent from the Aneka Master to the given Aneka Worker.

Architecture of Private cloud using Aneka Cloud Platform

The Management OS Xen - Xen Cloud Platform **Open source software to build private and public clouds** Xen runs in a more privileged CPU state than any other software on the machine. Xen Responsibilities of the hypervisor include memory management and CPU scheduling of all virtual machines ("domains"), and for launching the most privileged domain ("dom0") - the only virtual machine which by default has direct access to hardware. From the dom0 the hypervisor can be managed and unprivileged domains ("domU") can be launched. [5]

The dom0 domain is typically a version of Linux, or BSD. User domains may either be traditional operating systems, such as Microsoft Windows under which privileged instructions are provided by hardware virtualization instructions (if the host processor

supports x86 virtualization, e.g., Intel VT-x and AMD-V), [6] or para-virtualized operating system whereby the operating system is aware that it is running inside a virtual machine, and so makes hyper calls directly, rather than issuing privileged instructions. Xen boots from a boot loader such as GNU GRUB, and then usually loads a para-virtualized host operating system into the host domain (dom0).

Conclusion

The "Private cloud computing using Aneka Cloud Platform" is concentrate on research in efficient cloud application development and its objectives as follows:
The main Objective **Cloud Implementation at NIE** is as follows

- Developing distributed cloud applications.
- Research on developing efficient cloud application by identifying the local needs and giving efficient solution which includes optimisation of cost, improving performance etc.

Focus on giving cloud solutions for following areas:

- **Agriculture:** Today's agriculture is embedded with advance services like GPS, sensors etc that enable to communicate to each other analyse the data and also exchange data among them. To provide services in the form of cloud to agriculture the agriculture-Cloud offers expertise service to farmers regarding cultivation of crops, pricing, fertilizers, and disease detail method of cure to be used etc. Scientists working at Agriculture research stations can add their discoveries, suggestions regarding modern techniques for cultivation, usage of fertilizers, can obtain cultivation history of the region etc. our study is based on is to design and implement a simple Cloud based application on Agriculture System which is based on Agri-Cloud that enhance agriculture production and also enhance the availability of data related to research projects in field and also in lab. The impact of doing it would cut the cost, time, and make the communication system much faster and easier.
- **Retail Industries:** Internet-based technology through which information is stored in servers and provided as a service and on-demand to clients. Adopting the endogenous market structures approach to macroeconomics, by analyze the economic impact of the gradual introduction of cloud computing and emphasize its role in fostering business creation and competition.
- **Intelligent Processing for Internet of Things (IOT) Applications:** By collecting IoT data into databases, various intelligent computing technologies including cloud computing will be able to support IoT data applications. The network service providers can process tens of millions or even billion pieces of messages instantly through cloud computing. Cloud computing technology will thus be the promoter of IoT.

References

1. Christian Vecchiola, Xingchen Chu, and Rajkumar Buyya, Aneka: A Software Platform for .NET-based Cloud Computing, High Speed and Large Scale Scientific Computing, 267-295pp,

2. David Chappell, Introducing Windows Azure. David Chappell & Associates, October 2010.

3. Hassan, Qusay (2011). "Demystifying Cloud Computing" (PDF). The Journal of Defense Software Engineering (CrossTalk) 2011 (Jan/Feb): 16–21. Retrieved11 December 2014.

4. M. Armbrust, A. Fox, R. Griffith, A. D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Paterson, A. Rabkin, I. Stoica, and M. Zaharia. "Above the clouds: a Berkeley view of cloud computing." Technical Report UCB/EECS-2009-28, 2009. Also http://www.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.pdf. "Xen Overview". Retrieved 2015-04-05.

5. "OSCompatibility - Xen Wiki". Wiki.xenproject.org. 2007-02-08. Retrieved 2013-06-08.

6. W. Gentzsch, L. Grandinetti, G. Joubert (Eds.), ISBN: 978 -1-60750-073-5, IOS Press, Amsterdam, Netherlands, 2009.