ROLE OF ANEKA CLOUD APPLICATION PLATFORM IN GROWING MARKET

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Abstract: The concept of cloud computing has been prevailing in minds of every people, business as well as scientific organizations. The hype of cloud is at high pace. Technology has become so advanced that most operating systems are compatible to work with cloud providers because cloud computing is based on *pay per usage* and *market oriented* policy. They provide facilities and easy accessibility to users for accessing resources in multiple environments. In this paper, various aspects of cloud computing and its applications are presented.

The paper also presents pros and cons of ANEKA-one of .NET application framework to develop cloud computing platform in multiple virtual environment as well as physical environment. It is compatible with Windows and Linux both. It describes various programming models that convert applications into cloud application thus enabling ANEKA cloud infrastructure in system. ANEKA is proven to be one of scalable and reliable technologies in cloud terminology.

Keywords: Cloud computing, Cloud services, ANEKA, Programming Models (Task, Thread, MapReduce and Parameter Sweeping).

1. INTRODUCTION

Before explaining about cloud computing, we first define *evolution of cloud computing*. The first reference to CLOUD was originated from telephone industry in 1990's when Virtual Private Network (VPN) service was offered. It has following applications:

(i) VPN eliminates the use of hardware data circuits between customers and producers.

(ii) This service offers same amount of bandwidth at lower cost.

(iii) It is compatible with changing network from time to time.

Reason of failure of VPN service: -

(i) Since network changes from time to time, so it is not possible to predict path actually.

(ii) The computers connected through VPN are not able to work in multiple portions due to non distributed and de-centralized environment of hosts.

It leads to evolution of cloud computing that works in distributive environments with multiple sources of information. Cloud computing is one of increasing trends in world of technology. It is given as name "dujour" says Gartner's Ben Pring [1]. It is big idea that will revolutionize the change in IT sector services. The effect of cloud computing providers like Amazon, Google Docs is also seen in mobile technology also. Using these applications in mobile phones require less computational complexity as compared to using them on computers. We use emails,

galleries, Google apps, Microsoft live etc; all these are cloud platforms.

Cloud Computing is still somewhere an unknown concept to various researchers and is suffering from various challenges that are listed below:

i) Data Protection: - Data Security is one of major element that needs to be taken care of. Cloud vendors fear of losing confidential and identity of their consumers. In cloud model, service providers are responsible for maintaining data security and enterprises have to believe them.

(ii) Data Recovery and Availability: - All applications are designed by considering some laws or rules that are called as Service level agreements (SLA's). There are teams designed to support data availability at anytime. These teams perform following tasks:

- Data Replication
- System monitoring
- Maintenance
- Recovery from failure

(iii) Management Capabilities: - Although there are many multiple cloud providers, but management scale is not satisfactory. There is great need to improve on scalability and balancing features. **The solution to this problem lies in ANEKA platform that can be seen in further section.**

The remaining section of paper is categorized as follows: Section 2 gives brief introduction of cloud computing fundamentals in order to maintain link with further sections. It also presents information about cloud value added

services and their respective layers. Section 3 describes introduction to ANEKA cloud computing platform and its features in cloud environment. Section 4 presents detailed view of service oriented architecture of ANEKA. It deals with various programming models that have been developed in order to achieve sustainability and reliability in various scientific organizations. Section 5 takes readers to reach at conclusion and future scope of research.

2. CLOUD COMPUTING FUNDAMENTALS

Cloud computing is about moving computing from single desktop or PC's to the Internet. Computing means coordination, computation and storage of data resources.
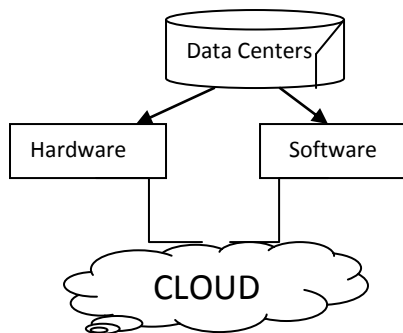
Cloud computing is combination of various technologies like Grid computing, Virtualization, Autonomic computing, Ubiquitous computing, P2P computing and many more. Time to time updations in existing computer resources at various data centers is one of the factor that led to development of cloud computing. Another definition of cloud computing is defined as **a cloud is a type of parallel and distributed system that consists of collection of interconnected and virtualized computers (dynamically provision) and presented as one or more unified resources based on service level agreements (SLA's) between providers and consumers**.

Cloud computing performs services in ascending order i.e. we can use an acronym "ASC" which stands for Application, Storage and Connectivity.
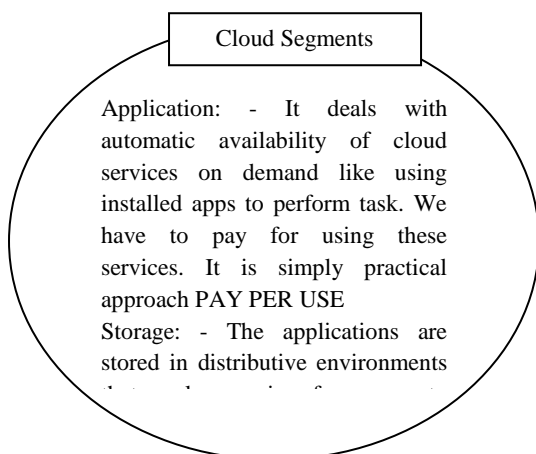

Fig 1: Cloud Segments Perspectives

2.1 Cloud Computing Layers and their Services
It consists of five abstraction layers:

- *Physical Layer (Hardware as a Service)*:- It is bottom layer consisting of cloud providers, servers, operating systems, devices and switches. Customers of this layer are big industrialists who requires large amount of hardware as service. It performs data processing.

- *Software Kernel*: - It is second layer and acts as interface between HaaS and Software infrastructure layer. Haas performs data processing whereas S/W infrastructure layer operates the hardware. This layer manages server's hardware resources and performs programs to run in parallel form

- *Software Infrastructure (IaaS)*: - It provides network resources to two layers namely: Software environment and Application layer above it. This layer leads to generation of new software environments and applications that will be delivered to end users in form of services.

- *Software environment or PaaS (Platform as a service)*:- Users of this layer include cloud application developers who use applications to implement and distribute their resources via internet. Developers are provided with programming language and set of API's. ANEKA is present in this layer. Other software that is in this layer is Windows Azure, Mims etc.

- *Application Layer or SaaS (Software as a service)*:- This layer acts as an interface between cloud applications and end users to offer them in demand. It is so because cloud users run programs by utilizing the computational power of servers and it reduces hardware requirements of machines. In this layer, we don't have to install software on computers as all cloud software is located in providers' data centers.
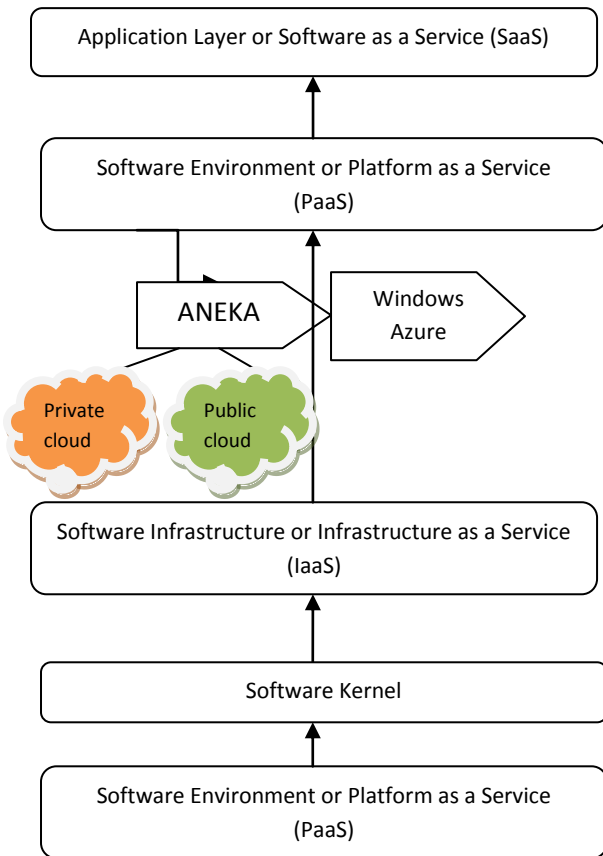
Fig 2: Position of ANEKA in cloud computing layers

3. INTRODUCTION TO ANEKA

ANEKA is one of platform that is used to build, accelerate and manage distributed applications with the help of .NET framework. It is a software that works on RAD (Rapid Application Development) environment to manage interconnected networks of systems. The word market oriented in context of ANEKA specifies that it is possible to build, schedule, monitor results by giving some money for using IT services like Quality of Service (QoS) in both public as well as private clouds.

The word ANEKA means in many ways i.e. it has multiple programming models, multiple scheduling strategies, multiple authentication models and distributive environment for operating system. ***The main aim of ANEKA is to support open-ended set of abstractions and features for distributed computing and deployment scenarios.***

WHY ANEKA IS AVAILABLE ONLY IN PaaS LAYER?

ANEKA is available at PaaS in cloud environment. It means that it provides programming application programming interfaces (API's) for developing distributed applications and virtual execution environment in which the applications developed as per API can be made to run.

WHICH ORGANIZATION GOVERNS ANEKA?

MANJRASOFT Pvt. Ltd. Is one of best companies that works on developing future technologies for saving time and money.ANEKA is one of its first cloud computing technologies that work on developing clouds using .NET framework. MANJRASOFT besides working on future technologies also develops software compatible with distributed networks across multiple servers. It manages resources in cloud without violating service level agreements (SLA's) thus enabling less cost, application scheduling etc.

3.1. Features of ANEKA

There are several features of ANEKA that helps in development of enabling cloud based environment for faster accessing of resources.

(a) It consists of RAD tools and framework.

(b) It combines with multiple virtual machines or existing machines to provide results of applications.

(c) It uses provision interface thus following parameters like Quality of Service (QoS) and SLA (service level agreements).

(d) It supports multiple programming environments.

(e) In this multiple applications can be executed simultaneously which increases utilization of resources.

(f) It is also capable of working on LINUX base.

(g) ANEKA means many forms. So, it has ability to provide different ways of working in distributed network with the help of programming models like Task Model, MapReduce model and many more.

(h) ANEKA is secure as it holds services inside container. A container acts as middleware that means it is middle part of ANEKA framework.

(i) Then there is Application level/ User level on top of middleware. It has different components and tools to make development process easier, manage and monitors entire cloud environment.

This security feature is also part of middleware.

(j) It utilizes desktop services collectively to form powerful computing model. It has led to reduction in infrastructure cost of various companies and thus reduces workload by accessing resources through multiple computers at single time.
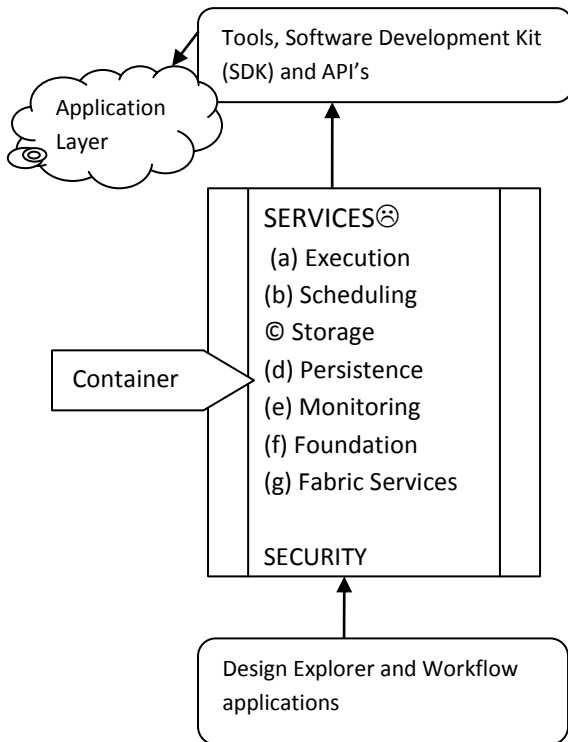
oriented applications)	(used for programming)
MapReduce Model (used in data mining)	

ANEKA builds different run time environments like virtualized data centers (clusters), public/private cloud network and multiple computers.
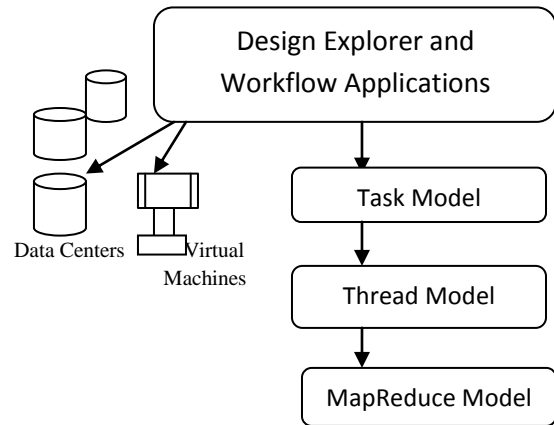

Fig 4: Part of ANEKA Cloud Platform

(b) Accelerate

It includes development and deployment of applications in virtualized environments. In general ANEKA uses existing machines or systems to access resources but when demand of resources increases, then ANEKA uses deployment models of cloud computing like Private cloud services (VM Ware), Public cloud services (Amazon EC2).

Process of Development and Deployment

(i) Deployment includes use of Design Explorer tool by using parameter sweeping facility. Parameter sweeping means producing multiple versions of same application with different parameters by passing as command line arguments.

(ii) Supports multiple language features that help to access resources from existing applications in faster time.

(iii) This phase requires development of application only one time and then uses that application in multiple environments. It supports virtual machines as well as physical machines in cloud environment.

(iv) ANEKA has scheduler that allows running of multiple applications at some time.

(v) In case of large number of applications, ANEKA maintains queue and put some applications in queue for further execution.

(c) Manage

The process of ANEKA management includes GUI and API's to monitor and maintain clouds. It has also accounting module that manages resources as per user's priority and scalability on basis of SLA's. It makes use of dynamic provisioning. For managing process, ANEKA has

Fig 3: Overview of ANEKA environment

4. ARCHITECTURE OF ANEKA

The architecture of ANEKA is very scalable and reliable because it contains separate modules for everything. ANEKA can solve some issues of cloud computing like management, security and others. It has mainly ANEKA Management Studio for providing workload management and dynamic provisioning. It has multiple programming cloud models that are mainly used for mapping of resources to make them available to clients. It is provided with ANEKA Application Module that plays vital role in real life applications of engineering, health, construction and many more.

ANEKA relies on three functions:

(a) BUILD: - It is well known concept that for building something, there is need of materials and other equipments. Similarly is case with ANEKA.

For building environment in ANEKA, it is provided with Software Development Kit (SDK) that consists of various API's and tools in order to build new applications or enable existing applications to run over multiple platforms. Multiple platforms mean heterogeneous networks. In other words, ANEKA ensures portability and relocatibility.

Various API's and tools are listed below:

API's	Tools
Task Model (deals with batch applications)	Design Explorer
Thread Model (object	Workflow applications

management studio as interface that performs following tasks:

- Quick installation of multiple clouds.
- Tuning and monitoring of system resources
- Monitors CPU performance by calculating utilization of resources.
- There are several other features like dynamic allocation of resources at run time in order to achieve high scalability, pay per usage service, allows flexibility and modularity in usage of resources an detection of services that are violating SLA's.

ANEKA is one of first platform for developing applications on cloud. It utilizes extra CPU cycles in order to access desktop services from heterogeneous networks.

> ANEKA cloud= Physical + Virtual Machines in distributed network

Each of these machines has saved resources that are stored in ANEKA container. The container provides basic management server that are divided into 3 modules:
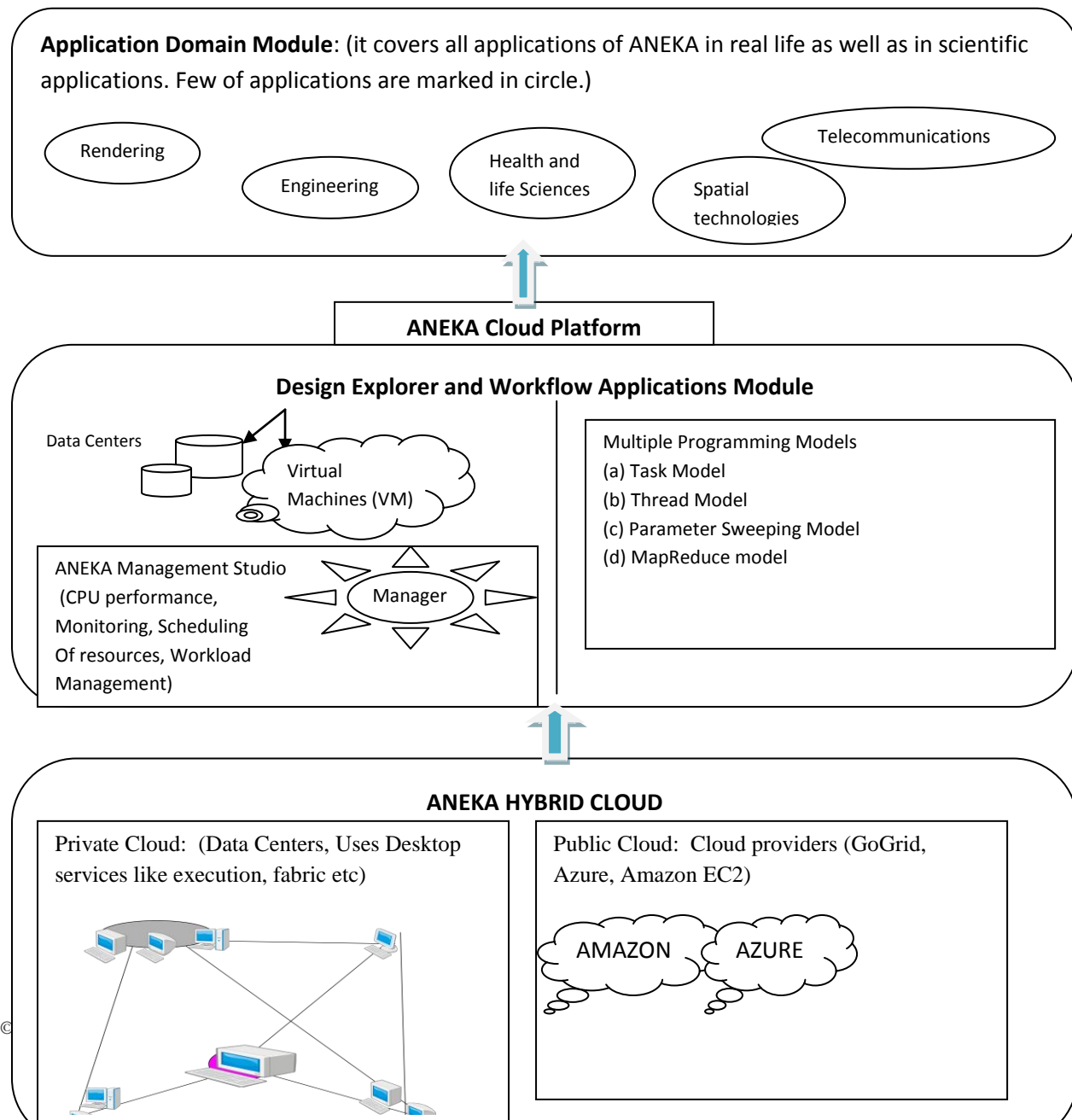
Execution Services:- This module deals with scheduling of distributed threads among various processes to execute applications in cloud.

Foundation Services: - They deals with monitoring of terms and agreements related to core system of ANEKA middleware thus enabling container by accepting their membership to perform particular task.

Fabric Services: - They are directly linked to data centers (clusters) located in network and perform dynamic provisioning.

ANEKA cloud is combination of multiple resources connected to each other in a network. These resources can be modified as per user demands by using Virtualization. As we know that ANEKA has both private and public clouds. If resources are found in single host, then it is private network. This private network can be extended to public network by maintaining interaction with other public cloud providers over the Internet.

The detailed view of ANEKA architecture is shown on next page covering all modules and programming models in it.

Application Domain Module: (it covers all applications of ANEKA in real life as well as in scientific applications. Few of applications are marked in circle.)

Rendering

Engineering

Health and life Sciences

Spatial technologies

Telecommunications

ANEKA Cloud Platform

Design Explorer and Workflow Applications Module

Data Centers

Virtual Machines (VM)

ANEKA Management Studio
 (CPU performance, Monitoring, Scheduling Of resources, Workload Management)

Manager

Multiple Programming Models
(a) Task Model
(b) Thread Model
(c) Parameter Sweeping Model
(d) MapReduce model

ANEKA HYBRID CLOUD

Private Cloud: (Data Centers, Uses Desktop services like execution, fabric etc)

Public Cloud: Cloud providers (GoGrid, Azure, Amazon EC2)

AMAZON   AZURE

Fig 5: Detailed View of ANEKA architecture

4.1. Programming Models

ANEKA consists of four programming models that plays major role in developing scientific and business applications. The models are discussed below:

(a) **Task Programming Model**

Concept: It works on independent tasks only. The model is collection of execution unit that is independent of others i.e. it means solution of one client does not depend on solution of other clients.

Operations: Submit and Forget

Compatibility: User API includes Interface and Grid Task. Interface executes only one operation. Grid Task is used for remote hosts.

Middleware deals with task scheduling services and execution services.

Application Manager:- Build task based apps by doing steps:

(i) Creating Grid application instance

(ii) Implementing Interface tasks

(iii) Submit task.

Examples: Convolution, Excel Grid etc.

(b) **Thread Programming Model**

Concept: Distributed environment threads. A thread is basic execution unit of system.

Operations: Start, Stop, State Query and Join

Features: Provides resources easily in distributed networks and multi threaded applications.

Compatibility: User API includes Grid Thread class for execution of remote hosts.

Middleware deals with thread scheduling services and maintains schedule of objects created of Grid Thread class.

Application Manager: - It is based on user views regarding cloud services provided to them. Build thread based apps by doing steps:

(i) Define worker method by implementing Grid Thread class.

(ii) Performs serialization of class i.e. convert it into object and instances.

(iii) Create and submit using Grid instances.

Examples: Mandelbrot.

(c) **MapReduce Programming Model**

Concept: Transformation Method using key values. The concept is defined as transforming initial values into list with its final values. It is called Mapping.

Reduction means using final value of list along with its source and reduces it to shorter term with new value of list.

Operations: Map (map ::(key1, value1)= list (key2, value 2)

Reduce (reduce: (key2, list value 2) = list (value 3)

Compatibility: Distributed applications User API include Mapper and Reducer.

Middleware deals with scheduling services (that monitors execution events of Mapper and reducer) and execution services (builds execution platform for Mapper and reducer like File Staging, task scheduling, Fault tolerance etc).

Application Manager: - Build map reduce based apps by doing steps:

(i) Define map operation on base class using Mapper

(ii) Define reduce operation using reducer in base class.

(iii) Run MapReduce engine.

Examples: Word Counter.

(d) **Parameter Sweeping Model**

Concept: Uses concept of task programming model. It is different from task model in such a way that all tasks are homogenous as they are subjected to different parameters and all combinations of values are checked out to generate task instance.

Operations: Parallelism

Compatibility: Legacy applications

User API deals with micro tasks like copy, delete and execute to compose interface.

Application Manager: - Build applications by doing steps:

Using Design Explorer: It setup connection among servers using Wizard.

5. CONCLUSION

The paper takes us to reach at some conclusions. It deals with one of best cloud computing platform based on Microsoft .NET framework named ANEKA. The software enables multiple applications and accessing of resources in distributed networks. It also deals with basic introduction to cloud computing layers in order to identify position of ANEKA in cloud layer. It is made available in Platform as a Service (PaaS) layer in cloud architecture. ANEKA provides security also by following service level agreements of various cloud providers like Amazon, Azure etc.

There are programming models of ANEKA that focus on management and scheduling of various services like execution services, foundation services and fabric services. The model and their concepts have been shown in paper. ANEKA is able to work with LINUX also so it is portable and relocatable also. It can be routed to different platforms.

6. FUTURE WORK

In context of ANEKA, to build cloud world there is possibility to implement user defined programming model by analyzing basic models of ANEKA. Some steps can be useful for designing user defined model like firstly define classes and their instances, provide support for middleware that gives services to clients in one go. Treat classes as entities and instanced as data entity.

- Choose some model out of four models to maintain coordination between data servers.
- Then define application logic and methodology.
- Implementation
- Execution

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