A REVIEW AND COMPARISON OF AD HOC AND VOLUNTEER COMPUTING PARADIGMS

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Abstract: Computational and storage resources within organizations are often under-utilized. Ad hoc cloud computing enables to run cloud services on existing heterogeneous hardware. Ad hoc clouds gather resources from existing intermittently available, non-dedicated and unreliable infrastructures .They offer more benefits than of conventional public or private clouds. Volunteer computing is similar to desktop grid computing except that the computing resources are volunteered by the public. This paper investigates two closely related paradigms volunteer computing and ad hoc cloud computing and also compare and contrast both.

Index terms: cloud computing, ad hoc, volunteer computing, resource allocation, cost

I. INTRODUCTION

Even though Cloud as well as volunteer computing relies on similar principles, the ad hoc cloud computing infrastructures differs from volunteer computing platforms with respect to the hardware and software stack. From the user's perspective these paradigms are dissimilar with regard to homogeneity and quality-of-service. While cloud computing offers a homogeneous resource pool, the heterogeneity of Volunteer hardware and operating system is not transparent to the application developers. Cloud computing also provide higher quality-of-service than volunteer computing systems. An enumeration of Ad hoc cloud computing is discussed in section II. Section III discussed volunteer computing. Section IV details a comparative study of ad hoc computing and volunteer computing based on identified parameters.

II. AD HOC CLOUD COMPUTING

In an Ad hoc cloud, the infrastructure software is dispersed over resources that are gathered from machines already in existence within an enterprise. The resources can be extracted either from personalized setups with a number of underutilized computers or from large-scale organizational infrastructures. Ad hoc mean that the set of machines comprising the cloud changes rapidly. In spite of being similar to volunteer and Grid computing the ad hoc cloud computing paradigm has many key differences with respect to resource allocation, trust mechanisms, workloads [1].

Virtualization plays vital role in adhoc cloud computing which makes it different from other massive systems. Ad hoc clouds empower existing infrastructure as cloud compliant and the available resources in the system are employed non-intrusively .An ad hoc cloud harvests resources from existing intermittently available hosts used by host users and allocates these resources to jobs of cloud users. Cloud jobs that are submitted to the ad hoc server which schedules jobs to ad hoc guests or virtual machines, that runs on each of the hosts within the cloud. Every host machine has an ad hoc client connected that manages the guest, monitoring of r resources and deliver the state information to the server. Thus an ad hoc cloud, creates a set of cloudlets to offer a particular service or compute environment

Ad hoc cloud computing allows cloud services to run on prevalent diverse hardware and related to volunteer computing as demonstrated by Condor [2] and BOINC [3]. The resource provisioning is done prior and dedicated resources are not available but facilitate ad hoc allocation of resources on demand. Even though a participating machine is not dedicated to the cloud and has a primary purpose it can be utilized as part of ad hoc cloud. An ad hoc cloud would enable us to harness services offered by fixed cloud and services created and composed within an ad hoc cloud.

Ad hoc clouds benefits individual enterprises in many ways. The reduction in physical infrastructure , specialized infrastructure for resilience, such as redundant power and cooling systems, battery backup, etc. and overall power consumption as these costs are borne directly by enterprises commissioning private clouds, and ultimately by `external cloud providers. The usage of ad hoc clouds also reduces the data center costs .The reduction number of physical machines employed significantly reduces energy costs as well [4]. The architecture of an adhoc cloud is shown in Figure 1.

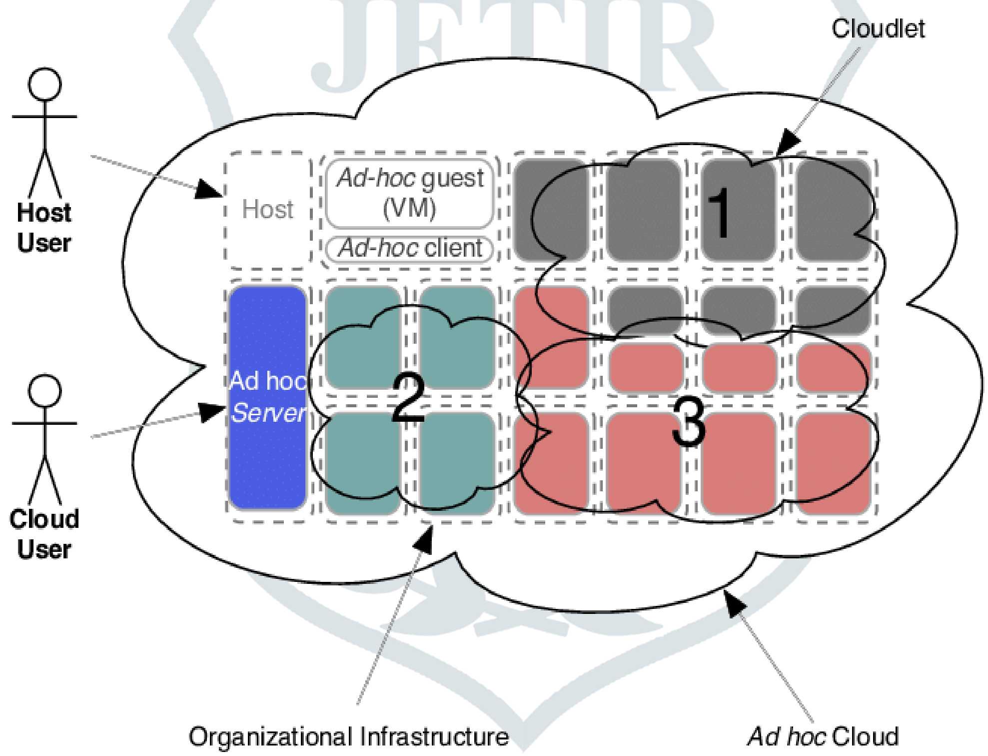

Figure 1: Ad hoc cloud architecture

III. VOLUNTEER COMPUTING

Volunteer computing offers processing power up to teraflops scale for scientific and academic project infrastructures. Data intensive applications include the handling of large datasets obtained from simulations or from large-scale experiments that are able to produce terabytes or petabytes of data. Many computational solutions use large-scale distributed systems for the execution of data intensive applications like cluster, grid computing, and cloud and volunteer computing. Volunteer computing is a paradigm in which large numbers of computers, volunteered by members of the general public, provide computing and storage resources.

Many methodologies and approaches exists that aims to obtain the benefits of cloud computing using volunteer machines. These projects started with ad-hoc cloud that sketches the major implementation challenges, and how under-utilization of computing resources in an organization can be addressed. A typical example is the Cloud@Home [6] that targets to provide a cloud infrastructure that is capable of providing and sharing resources and services for the scientific purposes. The volunteer computing is the base for "@Home" idea of sharing or donating resources. The basic Cloud@Home architecture is organized in three hierarchical layers: frontend, virtual, and physical layer. The physical layer is composed of cloud generic nodes geographically dispersed across the internet. Volunteer Computing platforms are another cost efficient and powerful platform that use volunteered resources over the Internet. The Volunteer resources operates over a set of nonexclusive and sporadically available hosts which cannot be predicted. This is in unlike to offering a service from a dedicated cloud, cluster or grid infrastructure where each host's resources are fully committed to the service.

IV. COMPARISON OF AD HOC CLOUD COMPUTING AND VOLUNTEER COMPUTING

This section discusses the comparison of ad hoc cloud computing and volunteer Computing systems based on the following parameters:

a. Compute power

The cloud equivalence of a volunteer computing system is examined as how many nodes in a volunteer computing system are essential to offer the identical compute power in flops of a trivial dedicated EC2 instance [7]. In order to compute cloud equivalence ratio, the statistics for SETI@home presented in [8] was utilized. For an average of 514.798 Teraflops with a replication factor of 3 the calculated cluster equivalence is 2.83 active volunteer hosts / 1 dedicated small EC2 instance. [7]. This indicates that ad hoc clouds performance in terms compute is much better compared to volunteer computing.

b. Heterogeneity

The volunteer computer is extremely dissimilar in terms of processor type and speed, RAM, disk space, operating system, version, bandwidth, proxies, firewalls. Compilation of applications for several platforms may be needed for various projects which can be enabled by running applications in virtual machines. Even while the ad-hoc cloud runs on different set of machines at different instances, the heterogeneity in the environment significantly effects the design of the cloud. The Data-center need to provision dynamic heterogeneity of the participating machines. Heterogeneity might be in terms of computing power shared and disk space offered, RAM and network bandwidth which necessitates the virtualization to be exceedingly vibrant in nature. The ad-hoc cloud accomplishes this problem through tables with attributes Node-id, Max CPU Speed, %CPU-usage, MAX Storage, %Storage-usage [6].

c. Scalability:

The grid and cluster systems need to meet the demands of large volunteer projects with more number of hosts and enormous number of jobs. An effective server architecture grounded on a relational database, dispersed across multiple machines is used to for this. The communication architecture relies on exponential back off post the failures, so as the rate of client requests continues to be limited even when a server comes back post an outage. Cloud services and computing platforms presented by Clouds can be scaled across many concerns, for example, geographical locations, performance of hardware and also software configurations. The computing platforms must be able to cater requirements of a potentially large number of users.

d. Security:

Volunteer computing has a security challenges like malware, hacking that can be partially resolved using account-based sandboxing where the applications run using an unprivileged user's account which has no access rights assigned. Stronger sandboxing may be possible using virtual machine technology. Insecure interfaces, API, vulnerabilities in virtual machines are challenges in ad hoc clouds which can addressed using identity and access management techniques. Ad hoc cloud environment offers high levels of customization in clouds largely due to elasticity and dedicated resources. In volunteer computing, the resources are supplied by the general public, and therefore defined by their needs and not by the researchers.

e. Cost

Development costs are comparatively low for cloud computing as users do not require spending for the physical infrastructure. In contrast to the on-site hosting the price for deploying applications in the cloud can be lower due to less expensive hardware and more effective use of resources.it is on service model and users have to only pay per use which can equate to potentially higher day-to-day running costs. This is utility computing, similar to paying for a public utility, such as electricity. The operation cost for volunteer computing is lower than for clouds as the computer processing power resources is provided for free by the public as a community service model. The upfront development costs can be higher as the application has to be adapted for volunteer computing.

V. Conclusion

Ad hoc cloud computing empowers to run cloud services on current dissimilar hardware. Ad hoc clouds gather resources from prevailing available, non-dedicated and unreliable infrastructures .In contrast to cloud computing, volunteer computing does not cost the researchers, thus it is efficient in using the hardware .In order to effectively advance an ad hoc cloud computing platform, many components like virtualization, volunteer computing and scheduling must be incorporated. The paper has discussed ad hoc cloud computing as well as volunteer computing and presented a comparison between both with respect to identified parameters.

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