International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-4 Issue-4, September 2014

Interconnection of Electrical Power System Grids via Cloud: Vision and Framework

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Abstract: ***This paper deals with the interconnection of electrical power system grids using cloud. This cloud includes the type of each user interface and the linkages between them.' A modern power grid needs to become smarter in order to provide an affordable, reliable, and sustainable supply of electricity. For these reasons, considerable activity has been carried out and the majority of these activities emphasized only the distribution grid and demand side leaving the big picture of the transmission grid in the context of smart grids unclear. In this paper I had tried to produce a unique vision for future transmission grids, in this vision, each smart transmission grid is regarded as an integrated system that functionally consists of three interactive, smart components, i.e., smart control centers, smart transmission networks, and smart substations. The features and functions of each of the three functional components, as well as the enabling technologies to achieve these features and functions, are discussed in detail. With the help of this paper propose Greenhead, a holistic resource management framework for embedding VDCs across geographically distributed data centers connected through a backbone network. The goal of Greenhead is to maximize the cloud provider's revenue while ensuring that the infrastructure is as environment-friendly as possible with use of cloud, where Cloud computing promises to provide on-demand computing, storage, and networking resources. However, most cloud providers simply offer virtual machines (VMs) without bandwidth and delay guarantees, without hurting the performance of the deployed services. To evaluate the effectiveness of proposal, conducted extensive research on various cloud service providers like amazon, windows azure, hp cloud etc.. Results show that with use of cloud improves requests' acceptance ratio of endurance and while ensuring high usage of renewable energy and minimal carbon footprint***.

Keywords: power system grid, interconnections of grids, cloud, bilateral network connection of grids.

I. INTRODUCTION

After enactment of Electricity Act '2003 in India, a comprehensive change is happening in Indian power sector, and power distribution utilities are going through a reformation process to cope up with the regulatory change for reduction in Aggregated Technical and Commercial Loss, improvement in Power Quality, Reliability of Power Supply, Improvement in Customer Satisfaction and rationalization of electricity tariff. Apart from restructuring and unbundling of the power sector there is a need for introduction of 'cloud computing technology to increase the operational as well technological efficiency of the power distribution network to meet the growing energy demand of India in line with the GDP growth of the country.

Manuscript published on 30 September 2014.
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Computing is being transformed to a model consisting of services that are commoditized and delivered in a manner similar to utilities such as water, electricity, gas, and telephony. In such a model, users access services based on their requirements regardless of where the services are hosted. Several computing paradigms have promised to deliver this utility computing vision. Cloud computing is the most recent emerging paradigm promising to turn the vision of "computing utilities" into reality. Cloud computing started with a risk-free concept: Let someone else take the ownership of setting up of IT infrastructure and let end-users tap into it, paying only for what is been used. A service offering computation resources is frequently referred to as Infrastructure as a Service (IaaS) and the applications as Software as a Service (SaaS). An environment used for construction, deployment, and management of applications is called PaaS (Platform as a Service).

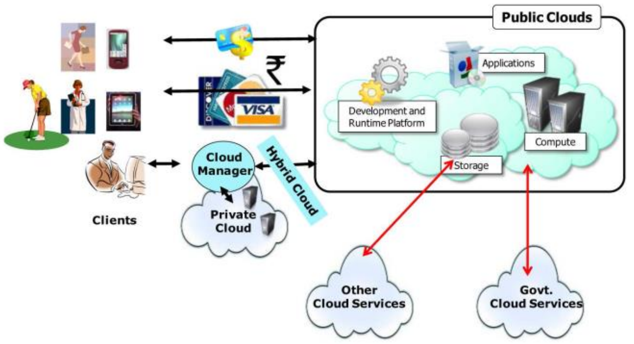

Fig. 1 Over View Of CLOUD Services

Clouds can be classified into three categories, depending on their accessibility restrictions and the deployment model. They are:

- Public Cloud,
- Private Cloud, and
- Hybrid Cloud.

A public Cloud is made available in a pay-as-you-go manner to the general public users irrespective of their origin or affiliation. A private Cloud's usage is restricted to members, employees, and trusted partners of the organization. A hybrid Cloud enables the use of private and public Cloud in a seamless manner. In a typical public Cloud scenario, a third-party vendor delivers services such as computation, storage, networks, virtualization, and applications to various customers. In a private Cloud environment, internal IT resources are used to serve their internal users and customers. Businesses are adopting public Cloud services to save capital expenditure and operational costs by leveraging Cloud's elastic scalability and market-oriented costing features.

Cloud Connected Grid is sophisticated digitally enhanced power systems where the use of modern communications and control technologies allows much greater robustness, efficiency and flexibility than today's power systems. A smart grid impacts all the components of a power system especially the distribution level. One subset of cloud connected grids is smart metering / advanced metering infrastructure (AMI) etc. In a smart grid, all the various nodes need to interconnect to share data as and where needed. In a cloud computing environment, an infrastructure provider (InP) partitions the physical resources inside each data center into virtual resources (e.g., virtual machines (VMs)) and leases them to service providers (SPs) in an on-demand manner. On the other hand, a service provider uses those resources to deploy its service applications, with the goal of serving its customers over the Internet. InPs like **HP Helion** [1] mainly offer resources in terms of virtual machines without providing any performance guarantees in terms of bandwidth and propagation delay. The lack of such guarantees affects significantly the performance of the deployed services and applications [2]. To address this limitation, recent research proposals urged cloud providers to offer resources to SPs in the form of virtual data centers (VDCs) [3]. A VDC is a collection of virtual machines, switches, and routers that are interconnected through virtual links. Each virtual link is characterized by its bandwidth capacity and its propagation delay. Compared to traditional VM-only offerings, VDCs are able to provide better isolation of network resources, and thereby improve the performance of service applications. Despite its benefits, offering VDCs as a service introduces a new challenge for cloud providers called the VDC embedding problem, which aims at mapping virtual resources (e.g., virtual machines, switches, routers) onto the physical infrastructure. So far, few works have addressed this problem [2], [4], [5], but they only considered the case where all the VDC components are allocated within the same data center. Distributed embedding of VDCs is particularly appealing for SPs as well as InPs. In particular, an SP uses its VDC to deploy various services that operate together to respond to end-users requests. As shown in Fig. 1, some services may require to be in the proximity of end users (e.g., web servers), whereas others may not have such location constraints and can be placed in any data center. In this paper, we propose a management framework able to orchestrate VDC allocation across a distributed cloud infrastructure.

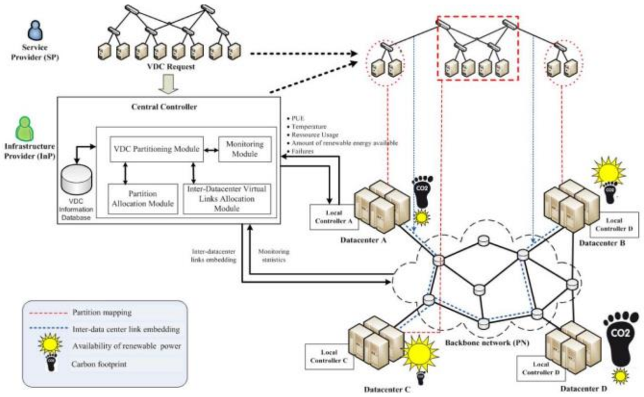

Fig. 2 VDC Embedding Across Multiple Data Centers

II. SYSTEM ARCHITECTURE

In this work, consider a distributed infrastructure consisting of multiple data centers located in different regions and interconnected through a backbone network (see Fig. 2). The entire infrastructure (including the backbone network) is assumed to be owned and managed by the same infrastructure provider. Each data center may operate on on-site renewable energy (e.g., wind, solar) and resorts to electricity grid only when its on-site renewable energy becomes insufficient. Unfortunately, renewables are not always available as they depend on the data center location, the time of the day and external weather conditions. While renewable energy has no carbon footprint, energy from the Grid is usually produced by burning coal, oil, and gas, generating high levels of carbon emissions. As a result, whenever electricity is drawn from the Grid, the cloud provider has to pay a penalty proportional to the generated carbon emission. The generated carbon depends on the source of power used by the electric grid supplier, which could be a renewable source or a conventional one or a mix of both. Furthermore, it is also worth noting that prices of the grid electricity differ between regions and they even vary over time in countries with deregulated electricity markets. As shown in Fig. 2, an SP sends the VDC request specifications to the InP, which has the responsibility of allocating the required resources. Naturally, the cloud provider will make use of its distributed infrastructure with the objective of maximizing its revenue and minimizing energy costs and carbon footprint; this is where proposed management framework, Greenhead, comes into play. Greenhead is composed of two types of management entities: 1) a central controller that manages the entire infrastructure and 2) a local controller deployed at each data center to manage the data center's internal resources. The central management entity includes five components as depicted in Fig. 2:

The Partitioning Module is responsible for splitting a VDC request into partitions such that interpartition bandwidth is minimized. The aim of this module is to reduce the number of virtual links provisioned between data centers. Each partition is supposed to be entirely embedded into a single data center. The motivation behind such partitioning will be explained in later Section .

The Partition Allocation Module is responsible for assigning partitions to data centers based on runtime statistics collected by the monitoring module. It ensures that all partitions are embedded while achieving cost effectiveness, energy efficiency, and green IT objectives such as reducing energy costs from the power grid and maximizing the use of renewable sources of energy.

The Inter-Data Center Virtual Link Allocation Module allocates virtual links in the backbone network. Those virtual links connect VMs that have been assigned to different data centers.

The Monitoring Module is responsible for gathering different statistics from the data centers. The collected information includes PUE, resource utilization, outdoor temperature, electricity price, and the amount of available renewable energy.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

International Journal of Innovative Technology and Exploring Engineering (IJITEE)
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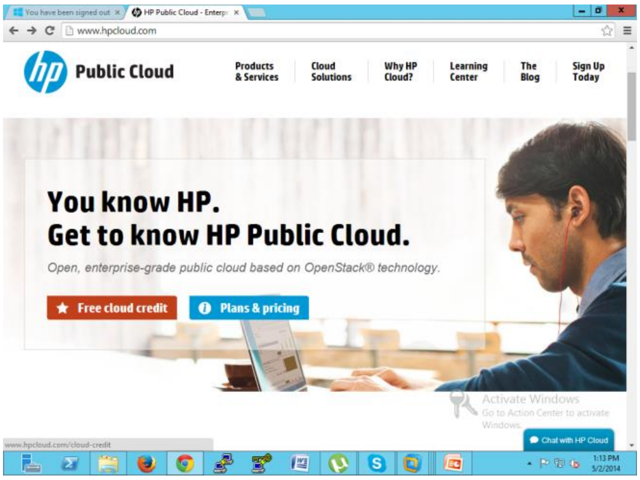
The VDC Information Base contains all information about the embedded VDCs including their partitions and mapping either onto the data centers or the backbone network.

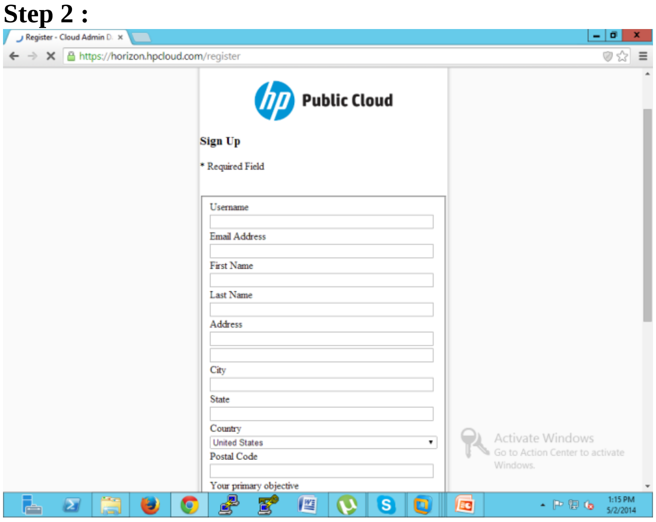
III. PROCEDURE OF CREATING HP CLOUD DOMAIN

Step 1 :



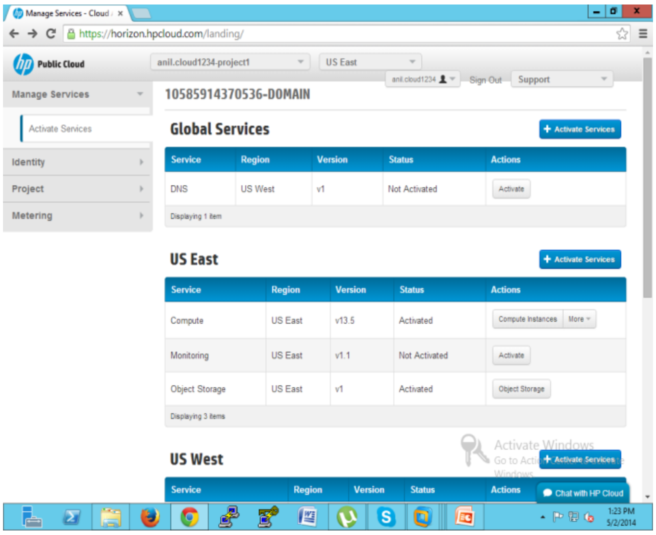
After reaching website as per need plan has to be choosen here we take free cloud credits.

Step 2 :



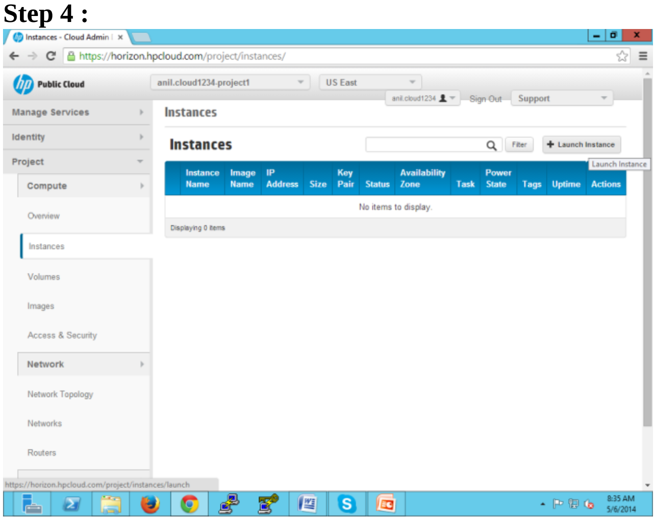
After registering on to the portal will have to enter the personal credentials and payment credentials.

Step 3 :



After registering and authentication process , process , activation is needed. Then console wil be provided for commissioning of cloud.

Step 4 :



With the help of this window instances are created with the help of which storage , network and ip are allocated to the cloud. In instance we can either choose windows server or linux or may use sql data server according to the requirement

FINAL OUTPUT CONSOLE :

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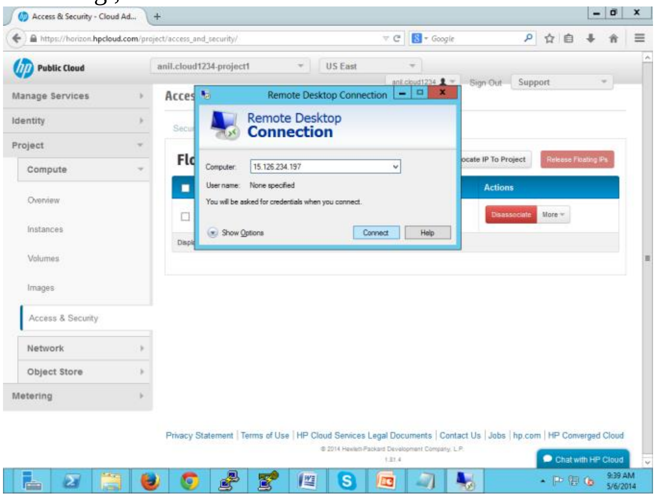
This is the required output console from where we can control, access, manage cloud deployed.
Or second way to access this deployed ``electric cloud`` is following ,



For alternate way to logging in to this cloud is to access through MSTSC (Remote Desktop connection) . In this any one have to just punch the ip address, username and password , provided from the service provider , then the user will have the access to the deployed cloud.

IV. ADVANTAGES OF CLOUD

1. Instrumented :
   Smart Connected Devices
2. Interconnected
   Intgegrated Communication Network
   System Integration platform
3. Intelligent
   Apllication and analytics
4. Instantaneous
   Speed gets increased
5. Secured
   Eliminates threat of physical damage
   Eliminates condition of conjunction and dead locks.

V.CONCLUSION

This paper has presented a unique vision of the next-generation smart transmission grids. It aims to promote technology innovation to achieve an affordable, reliable, and sustainable delivery of electricity. With a common digitalized platform, the smart transmission grids will enable increased flexibility in control, operation, and expansion; allow for embedded intelligence, essentially foster the resilience and sustainability of the grids; and eventually benefit the customers with lower costs, improved services, and increased convenience. The last few years witnessed a massive migration of businesses, services, and applications to the cloud. Cloud providers take advantage of the worldwide market to deploy geographically distributed infrastructures and enlarge their coverage. In this paper, we proposed Greenhead, a holistic resource management framework for embedding VDCs across a geographically distributed infrastructure. The goal of Greenhead is to find the best tradeoff between maximizing revenue, reducing energy costs, and ensuring the environmental friendliness of the infrastructure. The key idea of the proposed solution is to conquer the complexity of the problem by partitioning the VDC request based on the andwidth requirements between the VMs. The partitions and the virtual links connecting them are then dynamically assigned to the infrastructure data centers and backbone network to achieve the desired objectives.

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