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# Survey on Virtual Appliance - Technology, Merits and Case Studies

Sachin S. Pande[1] , Parth Srivastava[2]

*Department of Information Technology*
*Pune Institute Of Computer Technology*
*Pune, India*

**Abstract-For long time the IT industry was in need of a solution that can reduce the load to users in deploying the heavy enterprise based applications on the servers, save their time and the expenses for their organizations. Virtualization technology has given a good solution for this issue by providing the mechanism of developing a self sufficient software application system that is pre-installed and pre-configured, easy to distribute and can be deployed without need of more hardware configurations but it can run on already being used resources using virtual machines. This new paradigm is called virtual appliance. In this paper the comprehensive study is done on technology involved, along with benefits and covers almost all the research that has been done with respect to it till today. This paper is aimed to help the future researchers in the field of the virtual appliance by providing them most of the details they require.**

**Keywords- Virtualization, Virtual Appliance.**

## I. INTRODUCTION

In this age of high technology and internet, when everything practically is available in a click of mouse, the demand of saving time and ease of use is the prime issue for any user of software products. In IT industry today, a client does not want to be in a business of managing IT, he wants to be in business of running his main business. Clients are complaining that IT needs lot of people to understand it, configure it, deploy it, manage it and maintain it. So the need is to integrate, optimize and tune multiple functionalities. The days and time of just simply buying commodity parts and putting them together is over.

For many years, tools have been designed to simplify systems or service deployment. A. Dearle [21] had study on six cases of technologies on software deployment. He gave few future directions on the impacts of technology on virtualization. The technology of integration of hardware and software engineering that generates Virtual Machines (VMs), is called virtualization. VMs are abstraction of hardware configurations that allows a single computer/server acting as if it is simultaneously many machines [18]. Applications and software that run on these VMs are separate from the hardware resources. Virtualization technology converts traditional applications into a virtual appliance and allows those applications along with their execution environment requirements to be deployed and delivered as services [19]. Although virtualization has been existing for years before the emergence of virtual appliances, the innovation of low cost many-core processors made with the power of virtualization that has made things really effective. This increased virtualization capacity so that many virtual servers can ran together on one physical server.

The definitions and architecture for the Virtual Appliance, its benefits, guidelines to developers and the packaging format of Open Virtualization Format is covered in section II. The extensive survey on the research done in the field is covered in the section III. The next generation evolution of virtual Appliances in form of vApps is covered in section IV. The conclusion is in section V followed by references.

## II. VIRTUAL APPLIANCE

Any virtual appliance application can be easily taken out of the box by a layman user to deploy on his virtual machine platform, and within little setup time the application system will become ready to usages. The complexities and its technical intricacies of application are made transparent in its form as a virtual appliance[2]. It can be used either for stand-alone system or for cloud but is surely expected to give many deployment benefits. A virtual appliance is a self contained system which is pre-integrated and is made by combining actual software application (e.g., server software) with the just enough operating system for it to run easily on any industry standard hardware or the virtual machines like VMWare, VirtualBox, Xen HVM, KVM etc. [16].

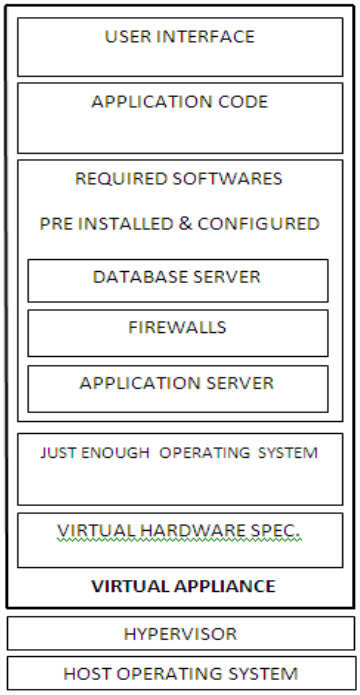


Fig 1: Generalized Architecture diagram of a Virtual Appliance

*A. **Architecture:***

A virtual appliance [17, 19, 20] is a complete application stack, as shown in figure1, which contains the application software, the Just enough Operating System (JeOS), their required dependencies, and the data and configuration files required to run this system.

It comes in the form of a data file that can be easily deployed on the virtual machine and also many times in the cloud as well.

*B. **Merits of an application being a virtual appliance:***

The advantages of any application developed as a virtual appliance is covered in the table 3.1. It covers eight parameters of comparison between the application without being a virtual appliance and application as a virtual appliance. These nine parameters are also the merits.

*C. **The development guidelines and objectives:***

The objectives for any developer[20] who is making the application into virtual appliance is gathered as follows:

- The solution should be ready-to-run at time of delivery.
- The product should be able to decrement support costs needed with traditional installation and configuration.
- Enable the client to be able to run the product on any standard virtual machine platform.

**TABLE I**
**COMPARISON OF APPLICATION WITH AND WITHOUT BEING A VIRTUAL APPLIANCE**

| Parameters | Application without Virtual Appliance | Application as a Virtual Appliance |
|---|---|---|
| Deployment time | Far more | Highly reduced |
| Migration Process | More complicated | Simpler |
| Security | Lesser as dependency on third party storage like cloud | More as no dependency on third party storage |
| Load on administrators | Harder | Easier |
| Hardware requirements | Extra needed as per requirement of application | Already running servers used with virtualization |
| Green computing | Not favourable | Favourable |
| Isolation | Lesser as many applications running on same platform | Applications in isolation from one another with lesser dependencies |
| Server utilization | Far lesser | More and optimized |
| Economical factor | More expenses to organisations | Lesser expenses to organisations |

*D. **Open Virtualization Format :***

A virtual appliance is packaged in Open Virtualization Format(OVF). OVF is a specification developed by the Distributed Management Task Force (DMTF). It avails a portable packaging format for the virtual machines. It facilitates how a virtual appliance can be packaged in a platform-neutral format to be easily deployed on any standard hypervisor. Organizations can deploy their application as virtual appliance on any virtualization platform of choice, getting free from the vendor lock-in.

## III SURVEY

Constantine Sapuntzakis et. al. (2003), in their paper present the idea of virtual networks of virtual appliances and describes the framework of the Collective utility[6]. They solve the complexity issues of system administrator by providing the load of applying software updates independent of the count of machines on which the software is getting executed. The whole network of machines are integrated up as data, which is referred to as virtual appliance. The appliances are configured according to need of users, the configuration details are taken beforehand so that it can be re-used when the appliance application is updated. Their developed Compute utility assigns virtual appliances to hardware automatically and dynamically. One of the merits gained is that Compute utility can be used to disallow working of vulnerable software[5]. They proved how Virtual Appliances can be used to create a Groupware appliance that can be used from anywhere and also provided the details on how their approach can be used to create Windows-based appliances.

The virtual appliance has provided application in variety of fields of science and technology. In the field of Natural Language Processing, the publication of Pawan Kumar et. al. (2013), they describe Machine Translation system as virtual appliance given that the complexity of cumbersome modules of natural language processing system which leads to the time consuming and difficult deployment on stand alone systems. They showed the results on how the time taken for deployment is reduced highly. Their virtual appliance can be deployed on the virtual machines in the cloud as well. Also they had simple provisioning script, adding which the application is able to auto-scale in time[2].

The research work by Weidong Shi et. al. (2010), aimed to design a scalable cloud based application which can enable delivering of real time 3D virtual appliances to users of 3D applications. For this purpose they present a framework called SHARC, scalable 3D virtual appliance delivery in cloud. The main contributions of their work is are, firstly, a scalable pipelined cloud setup to support big realtime 3D virtual appliances, secondly, many optimizations for making high performance virtual graphics processing, thirdly, a extension of virtual network computing protocol that synchronizes with overlay of streaming windows of 3D graphics appliance in cloud[1].

The utilization is also observed in the field of Geospatial research as shown by Christian Schwartze et. al. (2011), worked on developing Geospatial virtual appliance using open source software. They took one task from the field of model processing for virtualization purpose. They also presented that the in order to overcome the global changes in the environment there are many solutions and scientific applications are in progress from the earth scientific communities. The virtualization and cloud computing being the latest advantageous technology in Information technology has the role to play in this regard[3].

For the developers of operating system managing the file system related to portability issues, the research work by Michael et. al. (2012) implemented the portable file system

mechanism using the file system virtual appliances. They provided a method of packaging the file system in a virtual machine, separate from the virtual machine that runs user application. Using this the user can avoid the need to port file system in each operating system and their versions. FS-agnostic proxy maintained by the operating system developers connects the file system virtual appliance to whatever OS the user wants. They provide desired OS and virtualization features like unified buffer cache and virtual machine migration. The file system is isolated from both user and kernel space differences in user operating systems, as it interacts with single file system virtual appliance OS version[4].

The idea related to application in education field with provision of teaching a course on operating system using a virtual appliances [7] was presented by Oren Laadan et. al.(2010). They developed a unique methodology for educating OS that provides practice on kernel-level project experience without the facility of computer laboratories. They created a virtual appliance for doing operating system homework assignments and this can be deployed on students computer very easily on virtual machines without interfering other applications running on it. They combine virtual appliances with a distributed version control system to provide reliable storage for homework assignments, support together working of group assignments. Provision of live demonstration simplifies the grading and feedback facility for students. Fumino Machida et. al.(2010) in their proposed a framework named D S Renovator [8]that can convert a legacy distributed system into a virtual appliance. It also improves the system in the new hosting environment and resolves the dependencies by providing optimum deployment. Their method analyses server dependencies inherent in the legacy distributed systems and generates a graph based on dependency between the servers. In the process of deploying virtual appliance, the method applies graph partitioning algorithm to determine the optimum virtual machine placement which decreases the dependencies between the hosting servers.

In their publication Erkan Unal et. al.(2010), define virtual application appliances[9] as pre-built virtual machines for particular scientific purposes. They provide solution to complex software systems and heterogeneous environments. The virtual application appliance are meant for the solutions that run to completion and have data stage-in and stage-out requirements. In their paper, they also mention some of the key overheads including the data into and data out of the appliance and cost of virtual machine migration.

Gabor Kecskemeti et. al. (2013) in their paper proposed the concept of mimimal manageable virtual appliances [10]which have capacity to update and configure their virtual machines without the need to modify IaaS systems. Their research also revealed a method for appliance developers to incorporate minimal manageable virtual appliance in their own solutions. Their another paper on active fault injection method [11]for size optimization of virtual appliance.The reduced virtual appliances are validated with developers of appliance providing validating algorithms. This technique uses various item selection and grouping techniques in order to decrease the number of validation steps which are needed to create a virtual appliance of optimized size. In his thesis report Gabor Kecskemeti [2011] presented in depth analysis on foundations of efficient virtual appliance based service deployments [12] . The paper by J.S.Y. Chin. et. al. (2005) is based on the virtual appliance for pervasive computing[14], they used the deconstructionist model that provides the upgradation of home appliances. Xiangping Bu et al (2013) gave a model-free learning approach for the coordinated self-configuration of virtual machines and appliances [13]. The use of ontology based programming by example provides the coordination in communities of home appliances. Amir Apstein et. al. (2010) focused on the virtual appliance content distribution for a cloud service on global infrastructure. One of the latest cloud service is a virtual server shop[15] which allows cloud users to order virtual appliances to be delivered virtually on the cloud. Since customers want to customize according to need therefore large virtual server images need to be delivered and on time.

**TABLE II**
**COMPARISON FOR VARIOUS RESEARCH WORKS ON APPLICATIONS AS VIRTUAL APPLIANCE**

| Research Paper | Domain Chosen | Specific Application | Outcomes Achieved |
|---|---|---|---|
| Pawan Kumar et. al.[2] | Natural Language Processing | Machine Translation System | - Deployment time reduced.<br>- Provision for auto scale of application. |
| Weidong et. al. [1] | Cloud based application | 3D- application | - Framework for 3D virtual appliance delivery in cloud.<br>- Optimizations for virtual graphics processing. |
| Christian et. al. [3] | Geospatial research | Model Processing | - Made using open source software.<br>- Taken one task from field of model processing |
| Michael et. al. [4] | Operating System | File System related development | - Portable file system mechanism.<br>- Unified buffer cache and virtual machine migration. |
| Oren Laden et. al.[7] | Education field | Teaching operating System | - Kernel level project experience and practice without facility in labs.<br>- Deployable on students machine, helpful for assignments |
| Fumino Machida et. al.[8] | Servers dependencies | Legacy distributed system | - Framework for optimum deployment on servers.<br>- Generates graphs showing dependencies among graphs |

## IV GEN NEXT-EVOLUTION OF VIRTUAL APPLIANCES (VAPPS)

vApps are the software solutions which are optimized for the purpose of cloud computing. They generally comprise of many virtual machines, combined and maintained in a single entity form as Open Virtualization Format (OVF). As compared to a UPC bar code which contains all information about a product, vApps give a method to define operational policies for the application that cloud computing operating system can automatically interpret and execute.

In simple words, the technology of vApps are self-descriptive, and self-manageable in the platform on which they run. They are considered as the next generation in evolution of Virtual Appliances. they can comprise any application running on any type of OS. vApps also provide methodolgy for the companies to migrate their applications from internal clouds to external clouds and vice-versa, while retaining their service levels.

In future many enterprise based applications, which have complicated and time taking process of deployment and maintenance can be made as virtual appliance. Considering the benefits covered, systems like identity management system, customer relationship mangement, HR management, payment processing etc.

## V CONCLUSION

The demands of the software clients, users and server administrators to get the pre-integrated solution that decreases the load of configuration and technical dependencies for the deploying of heavy applications like enterprise software and hardware based appliances. Such applications which should be made into virtual appliances and can vitally benefit IT industry are Identity management system, accounting software, customer relationship management software, enterprise asset management software etc. The software industry and recent researches on the virtualization technique have come into rescue with the answer to such problems providing not only deployment benefits but many more. This paper provides in detail description on what is a virtual appliance, its packaging format details and points for the developer. The benefits of making a product into virtual appliance format is covered with help of a table having nine parameters on comparison. Then extensive survey on all till date research done on the field of virtual appliance is projected. The case studies of systems which have made applications as virtual appliances have been made in form of a simple table with the domain of application taken and the outcomes achieved from them. This survey paper will surely help those who want to start their research in the field of virtual appliance and will also help the developer and organizations looking for the detail survey.

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