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BUSINESS EFFICIENCY AND CONTINUITY USING VIRTUALIZATION TECHNOLOGY

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Abstract The benefits of virtualization cannot be overemphasized. It is an innovative technology that helps businesses save huge amounts of money and increase efficiency by performing more with less effort. The objective of this paper is to review the business benefit of adopting virtualization technology and highlights factors to carefully consider before switching to virtualization

Keywords Virtualization, Business Continuity, Virtual Machines, Network Infrastructure

Introduction/ Background

An excellent research area in computing is the virtualization technology. This technology was introduced and developed by IBM Corporation during the 1960s. In that period, IBM created a few virtual machines (VM) which can run on a single physical mainframe. IBM intends to maximally use system's resources. Virtualization is a simple technique that logically apportions system resources provided by a mainframe computer into different applications. This innovation provides the same services just like the real machine. In other words, through virtualization, multiple applications that traditionally reside on their servers can be brought together to run on a single physical server. A point to note is that the applications can run dissimilar operating systems (OS) (Dell, 2011). An important function of VM is to run multiple operating systems on the same physical computer and each operating system running separately, not coinciding with one another on the host machine (Chen and Noble, 2001).

To fully grasp the functionality of virtual machines, it is important to know what hypervisor is all about. A hypervisor (or virtual machine monitor) controls and manages the virtual machine. The diagram of a virtual machine monitor (VMM) is shown in fig. 1. A VMM is a program installed on top of hardware machine that creates virtualization layer, manages the guest OS and their storage areas, memory and other resources that are being shared among the different operating systems (Chen and Noble 2001). In simple term, VMM hosts VMs

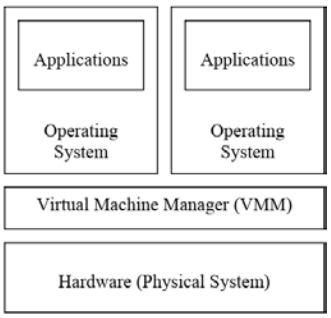

Fig. 1. Virtual Machine Monitor (VMM). Adapted from (Chen and Noble 2001).

Hypervisors can either exist as type 1 or type 2 hypervisors shown in fig. 2 and fig. 3. A type 1 hypervisor also called Bare Metal Hypervisor runs directly on the hardware. While a type 2 hypervisor also called Hosted Hypervisor runs within OS.

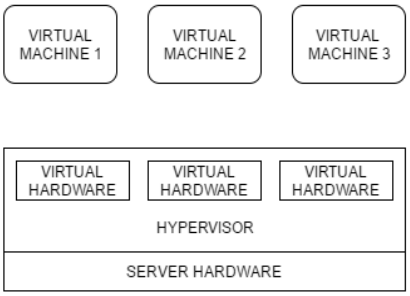

Fig. 2. Type 1 hypervisor. Adapted from (Chen and Noble 2001)

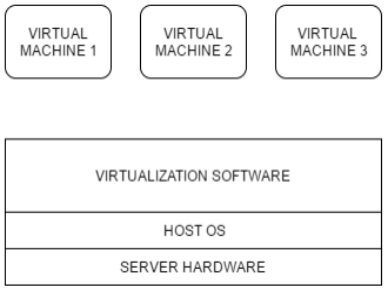

Fig. 3. Type 2 hypervisor. Adapted from (Chen and Noble 2001)

Today, there is an increased business competition which has made companies strive to produce more quality, cheaper and faster (Ercan, 2010) and they can leverage the benefits that the innovation of virtualization provides. It can help with business continuity and complete data protection so companies can achieve continuous application availability and automated disaster recovery across physical sites. With virtualization, businesses can simplify backup and recovery of data and systems and increase responsiveness through improved efficiency and flexibility (Vmware, 2011).

Research by Spiceworks to determine the adoption rate of virtualization technology showed that 92% of businesses use server virtualization. Following server virtualization, the most common is storage virtualization with an adoption rate of 40%, next by application virtualization at 39% and virtual desktop infrastructure (VDI) technology at 32%. Similarly, network virtualization and data virtualization each share a 30% adoption rate (Spiceworks, 2019).

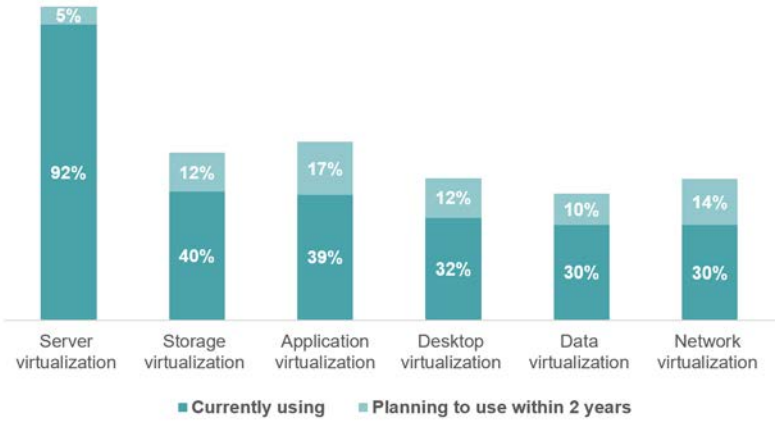

Fig. 4. Business Adoption of Virtualization Technology. Adapted from (Spiceworks, 2019)

Also, the research indicates more than half of businesses plan to use storage virtualization and application virtualization by 2021. Application virtualization is expected to experience the most growth among virtualization technologies with adoption expected to grow from 39% today to 56% by 2021. We also expect double-digit growth in the use of desktop, data, and network virtualization technologies within the next two years (Spiceworks, 2019).

Virtualization Approach

Several virtualization approaches are depending on the hardware capabilities of the host and guest operating system (OS).

i. Full virtualization

This technique offers a complete replica of the physical machine and makes a whole virtual system so the guest operating system and its applications will run on. Everything about the virtual system is segregated from each other and managed by virtualization layer or hypervisor, that controls the flow of instruction between the guest OS and physical machines like centralized server, disk storage and memory. The capacity of virtual machine features to provide hardware interface like those provided by the real physical machine is provided by the unmodified guest operating system. Accordingly, the visitor OS or application isn't aware of the virtualized

conditions and can execute on VM even as they'd on a physical framework (Ondrej, 2011). This provides a high sense of security for virtual machines.

Different operating systems run on this approach. Examples include Windows and Linux. Microsoft virtual server and VMware ESX Server. One potential deficiency of full virtualization is its performance as application typically run fairly slower on the virtualized system. This is because the computing power of a physical server and related resources are reserved for the virtual machine manager that needs data processing (Ondrej, 2011)

ii. Paravirtualization

A technique where each virtual machine is provided with a similar abstraction of the hardware but not the same as the underlying physical hardware is the paravirtualization. It requires modifications to the guest operating systems to work with the commands of the virtual machine (Sampathkumar, 2013). As a result, the guest operating systems are aware that they are executing on virtual machines. This provides several benefits such as less complex virtualization layer and more opportunities for optimizing as OS is aware of its environment. However, one potential downside of this technology is that the modified guest operating system cannot be migrated back to run on physical hardware (Singh and Singh, 2018).

One of the best-known systems which implement paravirtualization is the Xen (Praveen, 2011). The potential disadvantage of paravirtualization is erased with the new virtualization innovation from Intel and AMD permitting the guest operating system to run without altering it. A special privilege called the root mode is introduced in this level. The root mode allows one to install an unmodified guest operating system.

iii. Operating system-level virtualization

The operating-system-level virtualization architecture offers some advantages where the entire containers are installed on top of a single OS. Such advantages include low overhead that assists to maximize efficient use of server resources that are available to the applications running in the containers. It is profitable and convenient as patches or modifications can easily be made to the host server that could be instantly applied to all the containers. However, this approach typically restricts the operating system choice as every guest operating system must be identical or similar to the host in terms of version number and patch level. Example of implementation of virtualization on operating system level includes OpenVZ, FreeBSD Jails (Neda, 2017).

How Virtualization Reduce Costs and Improve Efficiencies?

The following point is how businesses can use virtualization to reduce costs and improve efficiencies (Vmware, 2011):

i. Reduce Costs

Virtualization can help minimize hardware and maintenance costs and lower the organization's energy bill.

a. Reduce expenses. With virtualization, the server infrastructure cost is reduced. Another issue for many businesses is power consumption. Virtualization can help lower energy costs and lessen the organization's CO_2 emissions.
b. Consolidate hardware. If your business currently uses one server per application, you can save on expensive floor space and help eliminate server sprawl by bringing together multiple applications onto a single server. This can reduce hardware and maintenance costs by as much as 50 per cent.

ii. Increase Efficiency and Business Continuity

a. Improve productivity. With virtualization, there are fewer technical issues to manage. This will give employees to focus on strategic projects, such as improving customer service or developing a new product or service. 73 per cent of small to midsize businesses that have implemented virtualization reported seeing significant improvements on time spent on routine administrative tasks.
b. Protect your business from downtime and disaster. Many small to midsize businesses cannot afford the expensive and complex nature of traditional business continuity solutions. With virtualization, companies can achieve faster and easier backup and recovery of key application data and workloads.
c. Improve business responsiveness. Managing a virtual infrastructure allows IT professionals to quickly connect and manage resources to meet ever-changing business needs, providing them with more flexibility in systems and applications and having more time to look at strategic initiatives. Instead of being viewed as a cost line item, IT can improve response time and help develop and drive new business initiatives.

d. Secure company assets. Rather than securing hardware, businesses are securing data, no matter where it resides on the network. Virtualization can enhance a company's ability to increase security because the IT staff can apply security patches and move applications between virtual machines to avoid downtime. Your business is less vulnerable to security attacks because virtual machines reduce your server count.

iii. An adaptive workspace with virtualized desktops and applications

The idea behind every modern computing environment is to provide users with an easy-to-use, secure, and cost-effective desktop experience that can deliver the personalized applications and data they need, on any device they are likely to use, from any location they happen to be. You're probably familiar with traditional desktop virtualization products, but consider the relevance of the following desktop virtualization advancements as you think about your own organization's challenges (Freeform, 2018):

a. Demand modelling: Using new graphics virtualization technologies, specialized processors can be dedicated to virtual Windows desktops, enabling fleet managers and cargo capacity analysts to run sophisticated modelling applications on-demand, on any device.
b. Access systems from anywhere: Multifactor authentication, resource authorization policies, and connection authorization policies control access to IT resources and sensitive data located within your business, enhancing security, compliance, and mobility.
c. Pre-configured, pre-integrated, pre-tested: Vendors and system integrators are taking the pain out of deploying the servers, storage, network connectivity, and software required for on-premise desktop virtualization initiatives. And when cloud services make sense, modern remote desktop infrastructure is available here too, including Desktop-as-a-Service (DaaS).

iv. Increase Scalability and Availability in the Education Sector

With virtualization technologies, such as virtual desktop infrastructure (VDI) and remote desktops, educational organizations can scale both computer and networking capabilities without expensive hardware. There is no longer need to worry planning for expansion; virtualization increases both scalability and availability.

Additionally, it's easy for IT administrators to control and monitor thousands of virtual machines (VMs) from a single central computer dashboard. Virtualization also encourages a bring-your-own-device (BYOD) culture where students can bring their device and access personalized content directly (Yfantis, 2020).

v. Improve Storage Demands in the Healthcare Sector

One challenge healthcare providers face is the storage of healthcare records. To meet the evolving needs of patients and industry regulations, IT solutions need to be both secure and flexible enough. With storage virtualization, healthcare companies can design solutions based on their needs rather than the hardware. For instance, if you have a server for electronic healthcare records that is running out of space, you could use software to pool leftover space from other servers and workstations to create one huge virtual drive.
With more efficient resource distribution, you can keep sensitive documents stored on site without investing in expensive hardware upgrades (Pronto, 2018).

Points to Consider Before Making The Switch to Virtualization

Before making the switch to virtualization, an in-depth investigation of the current organization environments is better for the organization. An important aspect to consider should include network infrastructure, sufficient server capacity, CPU, sufficient storage and memory. Another aspect to consider include cost, business model, budget, software and vendors' licensing, and qualified personnel. Virtualization requires a thorough understanding, well thought out plan on the major components of your infrastructure to achieve adequate redundancy and avoid downtime. Furthermore, some applications are compatible with virtualization, they include mobile, media-rich, some security apps, and apps that require specific peripherals (Berry, 2020).

Conclusion

Virtualization is an innovative technology that helps companies and organizations save huge amounts of money and operates with better efficiency. This technology offers substantial benefits to several businesses. It will increase staff performance which will, in turn, increase the company's competitiveness in the market. While there are no real downsides to virtualization, there are factors to carefully consider before making a switch.

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