

Hyper-V

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A hypervisor or virtual machine monitor (VMM) is computer software, firmware, or hardware, that creates and runs virtual machines. Microsoft Hyper-V Server is the hypervisor-based server virtualization product that allows users to consolidate workloads onto a single physical server [1]. Hyper-V has advantages of being scalable, secure and flexible.

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<https://github.com/cloudmesh/sp17-i524/tree/master/paper2/report.pdf>

1. INTRODUCTION

Cloud computing is a booming field and with that, the need for virtualization is also growing. Microsoft has long back stepped into the field of virtualization and is improving in the sector. It brought Microsoft Hyper-V, also codenamed as Viridian and formerly as Windows Server Virtualization to compete with VMware vSphere [2] [3]. It is a native hypervisor which can be used to create virtual machines on x86-64 systems running Windows.

With the release of Windows 8, Hyper-V overtook Windows Virtual-PC as the hardware virtualization component of the client editions of Windows NT. Hyper-V is also available on the Xbox One, in which it would launch both Xbox OS and Windows 10 [2]. Hyper-V supports Windows XP, Vista, Windows 7, Windows 8-8.1, Windows 10, Windows Server 2003-2016, CentOS 5.5-7.0, Red Hat Enterprise Linux 5.5-7.0, Ubuntu 12.04-14.04 among others [3].

2. ARCHITECTURE

Hyper-V maintains isolation of virtual machines in terms of a partition [2]. A partition is a logical unit of isolation in which each guest OS executes. A Hyper-V instance needs to have at least one parent partition, running a supported version of Windows Server (2008 and later). The virtualization stack runs in the parent partition and has direct access to the hardware devices. The child partitions, which host the guest operating systems, are created on parent partitions. A child partition is created by parent partition using the hypercall API, which is the application programming interface exposed by Hyper-V [4].

A child partition does not have direct access to the physical processor. A child partition doesn't even handle its real interrupts. It has a virtual view of the processor and runs in a guest virtual address. Depending on virtual machine configuration,

Hyper-V may allow access to a subset of the processors to each partition. The hypervisor handles the interrupts to the processor, and redirects them to the respective partition. Hyper-V can hardware accelerate the address translation of guest virtual address-spaces by using second level address translation provided by the CPU [1].

Direct access to hardware resources is not allowed to the child partitions, but they are allowed have a virtual view of the resources, in terms of virtual devices [4]. Any request to the virtual devices is redirected to the devices in the parent partition, which then manages the requests [4]. The VMBus is a logical channel which enables inter-partition communication. The request and response are redirected via the VMBus [4]. If the devices in the parent partition are also virtual devices, it will be redirected further until it reaches the parent partition, where it will gain access to the physical devices.

3. PREREQUISITES

To install Hyper-V we need to have an x64 based processor with a minimum of 1.4GHz clock speed. We also need to enable hardware-assisted virtualization, this feature is available in processors that include an inbuilt virtualization option specifically, Intel Virtualization Technology or AMD Virtualization. It also requires hardware-enforced Data Execution Prevention (DEP). Specifically, Intel XD bit (execute disable bit) or AMD NX bit (no execute bit) must be enabled [3]. The processor should also support second level address translation. Minimum 2 GB memory with error correcting code or similar technology is required, realistically much more memory is required as each virtual machine requires its own memory. The installation also requires a minimum of 32GB disk space. Apart from the above mentioned requirements, there are other requirements which are not mandatory but required to enable certain features [2].

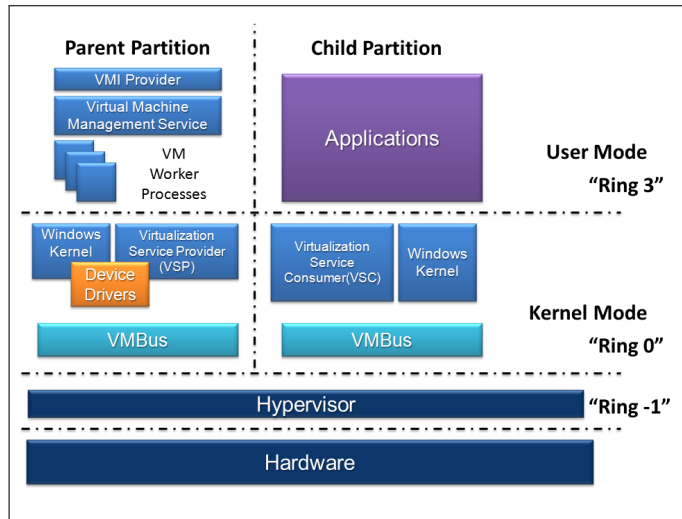


Fig. 1. Hyper-V architecture [2].

4. INSTALLATION

Installation of Hyper-V needs you to install Windows Server 2012 R2, for which you need a bootable device having the same and boot the device using it. Select the operating system you need to install i.e. standard/datacenter. Accept the terms and select install windows and select the drive you want to install the operating system on, we need a minimum of 32GB space for the installation. Set the username and password and then login. After logging on change the host name by going under my computer system properties. Open the server manager and configure according to the requirements which include selecting the roles and feature as required. Select the server name and click next and wait for the installation to complete [3]. Once Hyper-V is installed you can install create virtual networks and create virtual machines on which you can then install the operating system.

5. ADVANTAGES AND FEATURES

With Windows Server 2012, Hyper-V supports network virtualization, multi-tenancy, vhd disk format supporting virtual hard disks as large as 64TB, offloaded data transfer, cross-premises connectivity and Hyper-V replica. And with Windows Server 2012 R2 also supports shared virtual hard disk, storage quality of services, enhances session mode [2]. Multiple physical servers can be easily consolidated into comparatively fewer servers by implementing virtualization with Hyper-V. Consolidation accommodates the full use of deployed hardware resources. Hyper-V also helps in ease of administration as consolidation and centralization of resources simplifies administration and scale-up or scale-out can be accommodated with much greater ease. With Hyper-V and with virtualization, in general, there are significant cost savings. As separate physical machines are not required for every host and multiple virtual machines can be easily setup on a single physical machine. Hyper-V can be easily managed and a comprehensive Hyper-V management solution is available with System Center Virtual Machine Manager. Additional processing power, network bandwidth, and storage capacity can be accomplished quickly and easily by assigning additional resources from the host computer to the guest virtual machines [5].

6. LIMITATIONS

Hyper-V does not virtualize audio hardware. It does not support the host/root operating system's optical drives to pass-through guest VMs, as a result, burning to disks are not supported. In Windows Server 2008, Hyper-V does not support live migration of guest VMs where live migration is maintaining network connections and uninterrupted services during VM migration between physical hosts. Although Hyper-V doesn't provide live migration but it tries to eliminate the limitation by having quick migration feature. Also, when Hyper-V is installed it uses VT-x x86 virtualization feature making it unavailable for other solutions due to which software which requires VT-x support can't be installed in parallel [2]. One of the major operating system that is still unsupported includes Fedora 8 and 9 [2].

7. MANAGEMENT

Hyper-V servers can be managed using Windows PowerShell either locally or remotely [6]. By running server manager on a remote computer, a server running in server core mode can be connected. It can also be connected using Microsoft Management Console (MMC) snap-in or by using another computer running Windows, the user can use Remote Desktop Services to run scripts and tools on a server [6]. Server can be switched to graphical user interface mode to use the usual user interface tools to accomplish the tasks and then switch back to server core mode [6].

Hyper-V hosts can be managed using Hyper-V manager where the manager lets you manage a small number of Hyper-V hosts, both remote and local. It's gets installed with the installation of Hyper-V Management Tools, which can be installed through a full Hyper-V installation or a tools-only installation [6].

8. COMPARISON BETWEEN HYPER-V AND VSPHERE

Windows Server 2012 R2, VMware vSphere Hypervisor and VMware vSphere 5.5 Enterprise Plus all support 320 logical processors, 4TB of physical memory, 1TB of memory per virtual machine. While Hyper-V and vSphere Enterprise edition both support 64 virtual CPUs per virtual machine, vSphere Hypervisor only support 8. In Hyper-V there can be 1,024 active VMs per host while this is limited to 512 in vSphere. It is interesting to know that Hyper-V supports up to 64 nodes and up to 8,000 virtual machines per in a cluster while vSphere Enterprise plus supports 32 and 4,000 respectively [1].

Both VMware vSphere Hypervisor and Hyper-V are free standalone hypervisors, however enterprise edition of vSphere is not. The above information shows that Hyper-V has a number of advantages from a scalability perspective, especially when it comes to comparison with the vSphere Hypervisor [1]. VMware vSphere 5.5 brought a number of scalability increases for vSphere environments, doubling the number of host logical processors supported from 160 to 320, and doubling the host physical memory from 2TB to 4TB, but this still only brings vSphere up to the level that Hyper-V has been offering since September 2012 [1]. Hyper-V also supports double the number of active virtual machines per host, than both the vSphere Hypervisor and vSphere 5.5 Enterprise Plus.

9. CONCLUSION

Hyper-V is a powerful hypervisor introduced by Microsoft with features such as high availability, scalability, reliability, flexibility.

It also supports resource monitoring that helps user track historical data on the use of virtual machines and gain insight into the resource use of specific servers. Hyper-V sees competition from many other supervisors such as vSphere, Qemu, KVM, VirtualBox and provides a tough competition. Hyper-V requires hardware assisted virtualization support from processors and it can only be used with x86-64 processors. In spite of its limitations it's a popular choice because of the features it provides. The customization options available in Hyper-V provides the user with lot of options to manage the virtual machines as he would like. Hyper-V and Hyper-V hosts can be easily managed using Windows PowerShell and Hyper-V manager tool locally or remotely.

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