

WHITE PAPER

VIRTUALISATION





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VIRTUALISATION – A WHITE PAPER

1 WHITE PAPER OVERVIEW

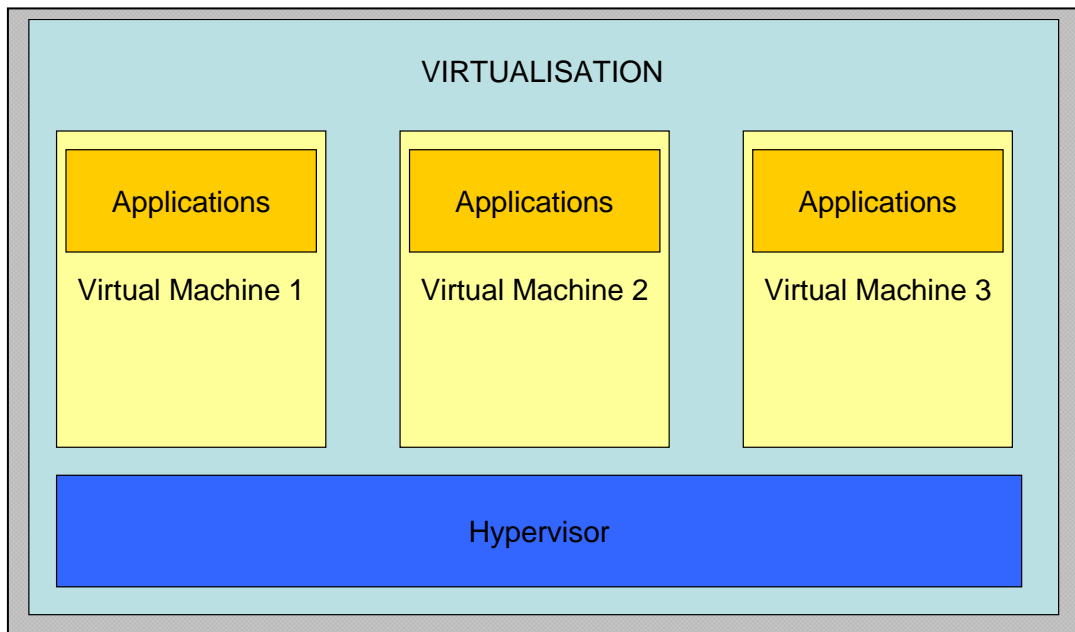
This White Paper aims to give an overview of Virtualisation technology and usage. The areas covered are:

- an introduction to the technology,
- the main benefits of the technology,
- some of the problems associated with Virtualisation, as well as how these might be overcome,
- some real world examples of the use of the technology,
- Virtualisation from MDS Technologies perspective,
- a conclusion on Virtualisation.

2 AN INTRODUCTION TO VIRTUALISATION

2.1 WHAT IS VIRTUALISATION?

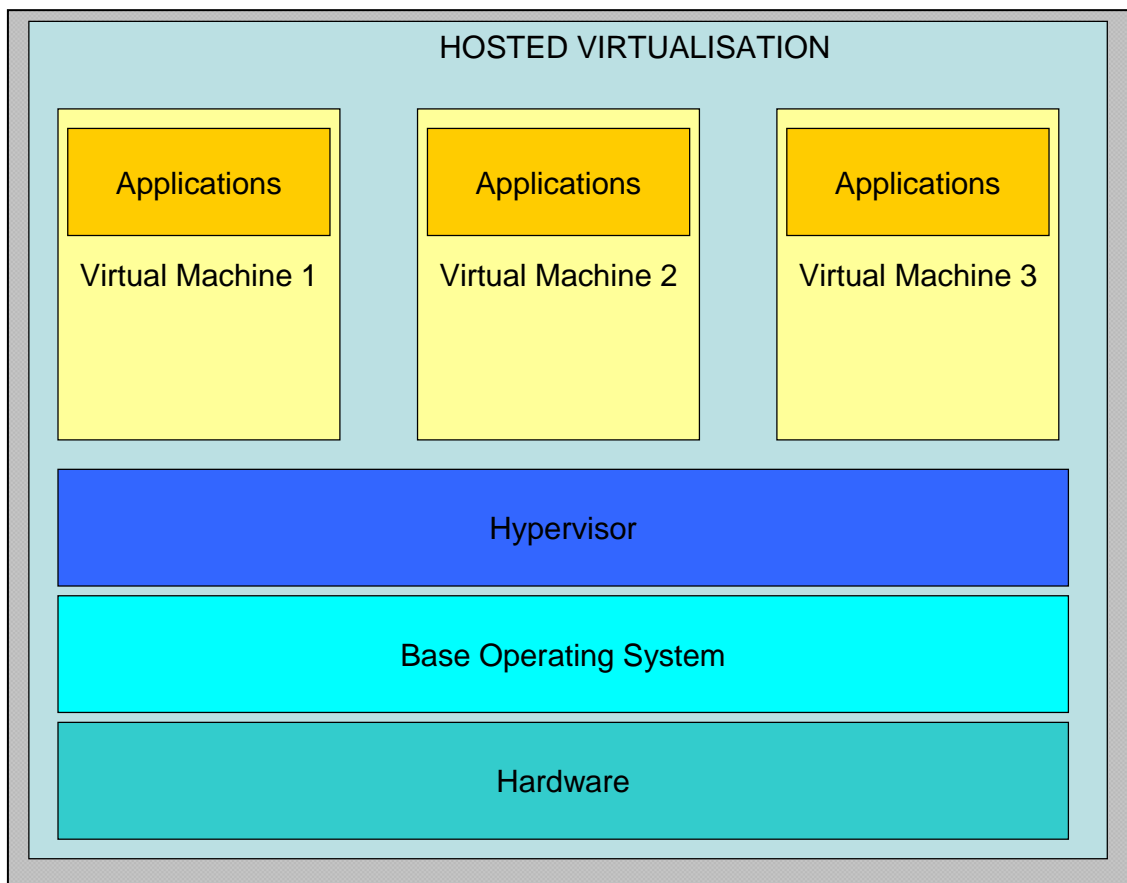
Over recent years, Virtualisation has become an increasingly ‘hot topic’. It is now a technology commonly promoted within the IT industry, from chip manufacturers to storage vendors, Data Centre providers to hosting providers. It is seen as a leap-forward in the way server hardware is utilised, allowing for major increases in efficiency (including resource, hardware-use, energy, physical space and financial efficiency).



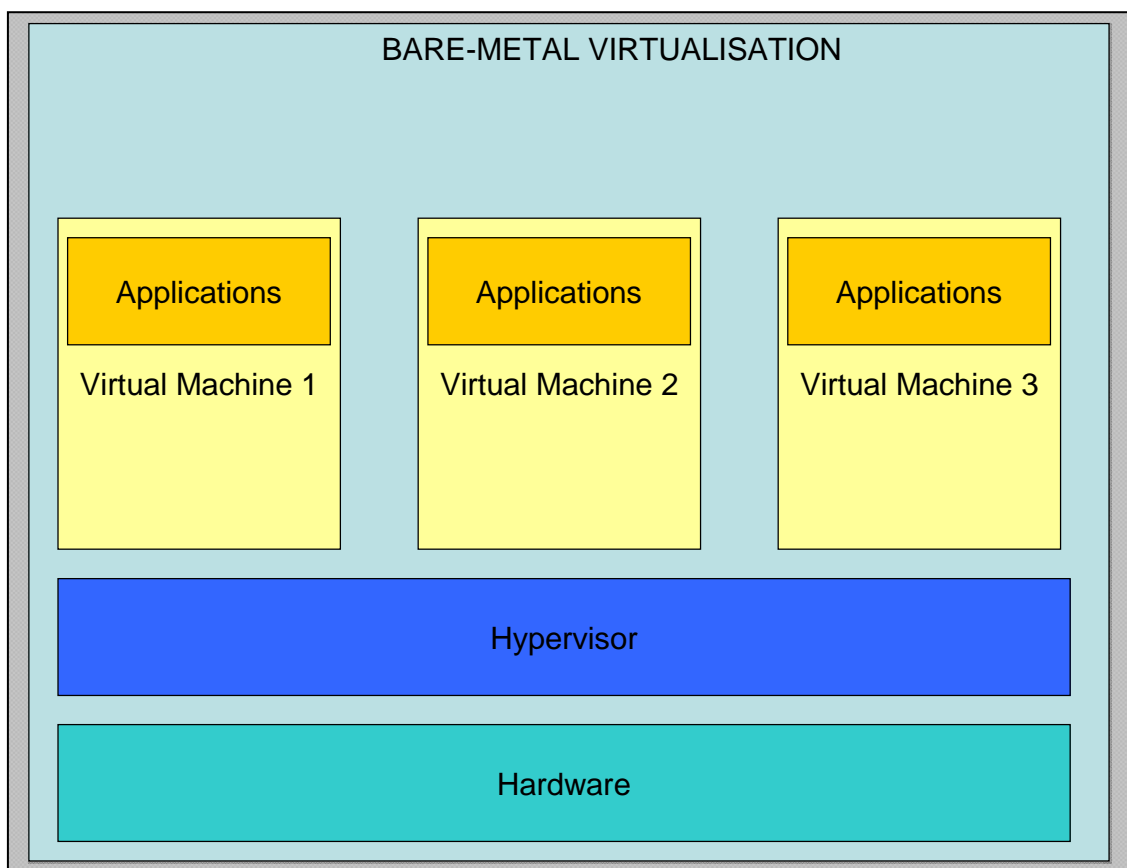
Essentially, Virtualisation allows one computer to run multiple processes at the same time, in separated compartments. Virtualisation creates a ‘layer’ between the operating system and the physical hardware, allowing multiple processes to access the hardware at the same time, but without interacting or conflicting with each other. These ‘Virtual Machines’ are typically managed by a hypervisor, a software and or hardware platform. The hypervisor creates the ‘layer’ between the hardware and the Virtualised environment, allocating the hardware resources where necessary. The main advantage of Virtualisation is that one physical machine can be used to perform several functions. Each function can be performed by one instance of a Virtual Operating System (OS),

for example, ensuring there is no possibility of conflict between the functions being performed. This can ensure that the machine is not being under utilised and is thus very cost effective. Therefore fewer Machines are needed in total and those that are used will be used in the most efficient way. This, in theory, helps to significantly reduce hardware costs, whilst at the same time significantly increase efficient hardware utilisation.

There are two types of Virtualisation architecture. The first is Hosted Virtualisation, in which a 'base' OS is installed on the hardware. A hypervisor then sits on top of the OS and allows users to run various Virtual Machines. These Machines access the hardware's resources through the hypervisor via the base OS. Hosted Virtualisation architecture is beneficial in that it is easy to install and configure and can be run on a wide variety of hardware with little to no configuration required. However, since the Virtual Machines must access the resources through the base OS, performance can be degraded.



The second type of Virtualisation architecture is Bare-Metal, where the hypervisor is installed directly onto the hardware, with no need to install a 'base' OS. The hypervisor communicates directly with the hardware resources and allows the Virtual Machines to access the hardware without the need for a base OS. This architecture allows for improved I/O performance as the hardware can be accessed by the Virtual Machines more directly. It allows both real-time and general purpose OS to work in parallel on the same hardware. However, Bare-Metal architectures need hardware drivers to be included with the hypervisor and they are generally more difficult to install and configure.



In general, organisations tend to use Virtualisation to cost-effectively and physically-efficiently boost the capacity of their IT infrastructure.

There are a number of technologies that underpin Virtualisation technology. Three such technologies are listed below:

- Binary Translation – where the hypervisor dynamically alters the code that is being executed by the Virtual Machine so that it does not affect the system state, for example code that accesses an I/O device would be changed by the hypervisor using binary translation to redirect the I/O request so it doesn't not cause conflicts with other Virtual Machines,
- Hardware Assist – this makes use of special processor technology such as Intel's Intel-VT and AMD's AMD-V to avoid changing the system state if it receives a privileged instruction,
- Paravirtualisation – in which an OS is explicitly modified so that it is aware that it has been Virtualised and calls the hypervisor when it needs to, these called are offered referred to as hypercalls.

2.2 HOW POPULAR IS VIRTUALISATION?

The use of Virtualisation technology is on the increase. In 2008, Gartner found that 12% of organisations would be using Virtualisation by the end of the year. In 2009, Gartner found that that figure had jumped to 20%. Furthermore, a survey by silicon.com's CIO Agenda found that more than half of all CIO's questioned planned to focus on Virtualisation technology during 2009.

Meanwhile a survey by Forrester Research in early 2009 found that 53% of SMEs in the US and Europe had already implemented server Virtualisation or where planning to within a year. At that time, SMEs had Virtualised 36% of their OS instances and planned to have Virtualised 61% of their OS instances within two years. An IDC survey found that 16.5% of all servers shipped in Q2 2009 were Virtualised, up from 14.5 % in Q2 2008.

A study by Computerworld in January 2010 found that 64% of organisations were likely or very likely to Virtualise more servers in 2010. Gartner estimates that 55% of all new workloads will be deployed on Virtual servers in 2010, up from 40% in 2009, whilst 24% of *all* workloads will be running Virtually.

Regardless of whether Virtualisation is popular or not, there is a growing need for it. A survey conducted by Gartner in 2008 found that 15% of Data Centre Managers reported that their Data Centres were at full capacity and they would have to either build new sites or refurbish existing ones within the next 12 months.

2.3 WHO ARE THE MAIN PROVIDERS?

There are a few leading providers of Virtualisation technology. One of the most important is the EMC subsidiary, VMware, which provides a range of Virtualisation solutions, from standalone programs for end-users to large industrial-scale commercial Virtualisation tools. VMware's main business is in Virtualising servers, allowing for the consolidation of many Machines onto just a few. Other providers of Virtualisation technology include Citrix, Red Hat, Oracle (via Sun) and Microsoft.

According to IDC, in 2008, the five main Virtualisation solutions were:

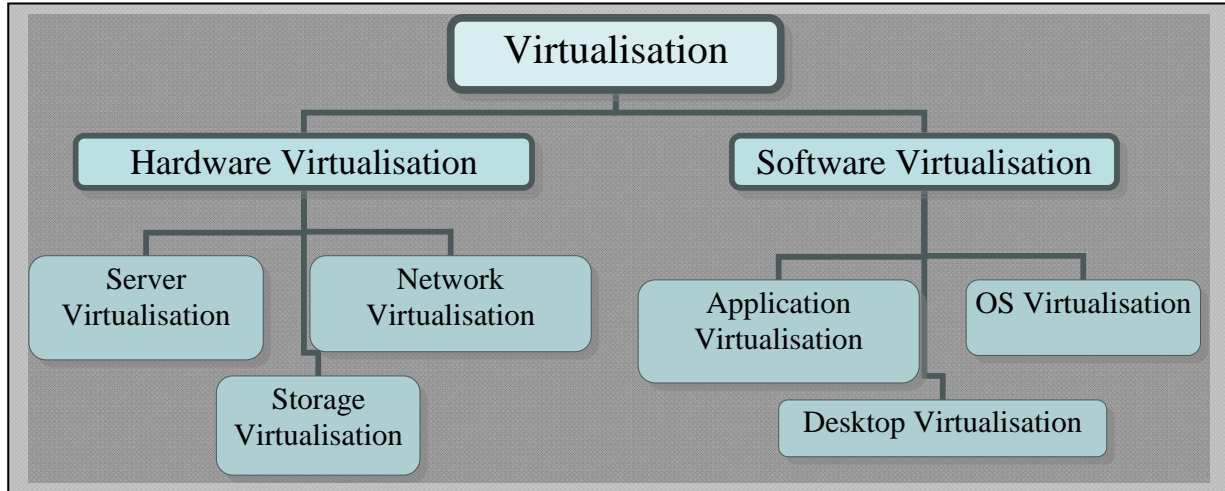
1. VMware's VMware ESX,
2. VMware's VMware Server,
3. Microsoft's Virtual Server 2005
4. Microsoft's Hyper-V
5. Parallels' Virtuozzo.

Interestingly, all showed a decline in sales during 2008, but this was put down to an effect of the global economic slowdown.

Citrix XenServer, meanwhile, although not in the top five, experienced a revenue increase of 108% in 2008, attributed to it moving to offer XenServer as an Open Source Virtualisation option. Many experts saw this move as an attempt to increase market share and help it to compete against the industry leaders.

There are a number of Open Source Virtualisation solutions available, including Qemu and Sun's Virtualbox, alongside XenServer. The typical Open Source Virtualisation business model is to encourage uptake and market share by making a hypervisor freely available. Premium support, maintenance and customisation services are then sold to users. Gartner estimated in 2009 that Open Source had only a 5% market share of the overall server Virtualisation revenue. However, it estimated that this would increase to 10% by 2012. Open Source has some advantages, in that users can customise the solution to fit their needs, whilst, with a strong user base, it can benefit from continued development by the community. However, if it does not have a strong enough user base, then development typically lags behind competing commercial products and its market share shrinks concurrently.

2.4 WHAT ARE THE DIFFERENT TYPES OF VIRTUALISATION?



There are a number of different types of Virtualisation, which are briefly summarised below:

- Server Virtualisation: the most often cited type, in which servers, for example mail, file or web servers, are Virtualised, allowing one physical machine to perform multiple tasks. This can be achieved via three basic methods:
 - Emulation: the hypervisor emulates the hardware it is installed on, typically called full Virtualisation, allowing each Virtual machine to run any operating system supported by the underlying hardware.
 - Partitioning: also sometimes called Operating System-Level Virtualisation, is where servers are Virtualised on a kernel layer. The term partitioning is used, because a single physical server is partitioned, or sliced, into many smaller portions, where each portion operates like a stand-alone server. Various terms can be used to describe each portion, including Virtual Environment, Virtual Private Server, a guest or a zone.
 - Clustering: this method uses Cloud Computing-based technologies, in which many resources are aggregated together to appear as one large resource. An example might be the aggregation of multiple mail servers so that they appear as one single mail server, whereas in reality the mail server functions are shared between the servers.

- Storage Virtualisation: data from multiple devices is pooled onto one Virtual storage device, managed from a central console, allowing disk space to be fully utilised without wastage.
- Application Virtualisation: allows multiple applications to be run on a single machine or a reduced number of servers, the applications share resources (OS, memory and processing power) and workloads are balanced to ensure optimal performance.
- Network Virtualisation: the creation of a secure Virtualised network, allowing delivery of multiple discreet services across a shared platform, essentially permitting more efficient usage of network bandwidth and resources.
- Desktop Virtualisation: similar to the familiar concept of thin clients, in which a user's OS and applications are stored on a central server, allowing the user to access multiple OS from one machine. Gartner estimates that by 2013, 40% of all corporate desktops will be Virtual, with the market worth \$1.8 billion by 2012.
- Operating System Virtualisation: more commonly used by the consumer, allowing one OS to be run within another, mainly for testing purposes. This approach can be used by developers to test for cross-platform compatibility, for example.
- There are also many other types of Virtualisation-related technologies (it is important to note that some experts argue that the difference between some of the types listed below is merely down to definition):
 - Platform Virtualisation (separates an OS from the underlying platform),
 - Partial Virtualisation (for specific applications),
 - Para-Virtualisation (software interfaces are provided to the Virtual Machine),
 - Virtualisation-aware Operating Systems (an OS that is aware when it is hosted in a Virtualised environment and changes the way it functions appropriately),
 - Cross-platform Virtualisation (allows software designed for one system to be run on another unmodified),

- Virtual Appliance (a Virtual Machine image designed to be run on a Virtual platform),
- Portable Application (software that runs from a storage device and that is not installed on the host system),
- Virtual Memory (allows addressing of physically separate memory as if it is one),
- Memory Virtualisation (aggregation of RAM from networked systems into one memory pool),
- Database Virtualisation (removing the database layer that lies between storage and applications).

2.5 FUTURE APPLICATIONS

As with many technologies, some IT industry commentators have great expectations for Virtualisation technology.

VMware, for example, believes that Virtualisation could be the saviour of the IT department, creating harmony between an individual user's computer preference and their employee's corporate IT requirements. Called 'employee-owned-IT', Virtualisation would allow users to put a corporate-managed Virtual Machine on their home computer. This Virtual Machine would be configured remotely and would run only those applications that have been approved by the corporation, with a reduced risk of any potentially dangerous programs being run by employees on their personal OS interacting with the corporation's IT networks.

VMware is also looking into the possibility of running Virtualisation software on mobile phones, allowing one OS to be run on top of another, or allowing the phone to boot into two separate OS. VMware has already demonstrated a mobile phone that is able to boot into both Windows Mobile and Google's Android OS.

Vendors are also looking into growing the use of Virtualisation technology in the Data Centre, allowing for a more flexible service to be provided. One possible idea is moving Virtual Machines from hardware that is at maximum capacity to idle Machines during peak times, and then moving them back again, allowing the idle hardware to be shut down with commensurate power-saving benefits. This process could be completely automated, governed by pre-defined rules.

Virtualisation will also play a big role in acting as the catalyst for Cloud Computing (since it is one of the key underlying technologies). One idea is that organisations could utilise third party data centre hardware when needed, simply by transferring over copies of their Virtual Machines. In fact, an organisation's entire Data Centre could be run as Virtual Machines, allowing additional hardware resources from third party providers to be utilised only when necessary.

In general, as more organisations and suppliers get involved in the technology and deliver their own solutions, users will be able to benefit from Virtualisation as the competition amongst providers helps to decrease costs and increase functionality.

3 THE BENEFITS OF VIRTUALISATION

There are many reasons an organisation may decide to make use of Virtualisation technology. Some are inter-related; others are distinct and justifiable purely on their own. All of them demonstrate the true power of the technology and the advantages it offers.

3.1 INCREASED FLEXIBILITY

In terms of functionality, one of the great advantages of Virtualisation is that it allows an IT department to be much more flexible. Virtual Machines can be shifted from one server to another, depending on server load; ensuring system-critical business functions always have adequate resources. It also allows server configurations to be changed in minutes rather than weeks, so new applications and services can be introduced much more quickly.

Virtualisation makes it easier to host and run legacy applications and older OS on modern hardware, removing the need to manage and maintain antiquated hardware to provide legacy functions.

3.2 INCREASED DATA SECURITY

Another potential benefit of Virtualisation, particularly in the case of Desktop Virtualisation, is increased data security. By storing a user's entire system on a central server, it is much easier to backup and replicate that system and the associated physical risks of data security are reduced. Thus, if the user experiences hardware failure or loss (in the event of a laptop for example), no data is actually lost, as it is all stored on a separate central server. All that needs to be done is to repair or replace the physical hardware and reinstall the Virtualisation client subsystem and the user can once again access their system.

3.3 LIVE MIGRATION

One of the most anticipated features of Virtualisation is live migration; the ability to move a Virtual Machine from one physical host to another, whilst the Machine

remains in-use and un-interrupted. This allows systems to be brought down for maintenance, or to prevent hardware failure, with no impact on business systems or services. This would bring an end to scheduled maintenance and down-time and allow for a more reactive and pro-active IT support function. A number of Virtualisation solutions already include implementations of this feature, such as:

- Citrix's XenServer,
- Oracle's Oracle VM,
- VMware's VMware ESX,
- Microsoft's Hyper-V Server 2008 R2.

3.4 REDUCING THE RISKS OF BUSINESS CONTINUITY

Virtualisation plays a key role in reducing the cost of Disaster Recovery. If an organisation's systems are fully Virtualised, the risks of business continuity and the associated need to completely replicate the physical hardware offsite in order to achieve a full Disaster Recovery set up is reduced. Instead, a Data Centre provider merely needs to hosts the Virtual Machines on its servers, ready to be activated if required. In the meantime, the physical hardware on which those Virtual Machines would be run can be used to provide other services, until they are needed. This drastically reduces the cost of a Disaster Recovery solution. Forrester Research has indicated that this can cut the cost of a Disaster Recovery solution by up to a half.

3.5 VIRTUALISATION IS GREENER

One of the clear and obvious benefits of Virtualisation technology is that it is better for the environment. By allowing an organisation to reduce the number of physical servers it runs, it can reduce its electricity demands and cooling requirements. This means that the organisation's carbon footprint is lowered, as it uses less energy and thus less carbon dioxide is produced.

These decreased power requirements obviously also have the added benefit in that an organisation's utility costs are reduced, since it requires and uses less energy.

3.6 IMPROVED RETURN ON INVESTMENT

Another clear advantage of Virtualisation technology is that it allows organisations to make the most efficient use of their hardware and resources. By Virtualising their server infrastructure and applications, an organisation can ensure that the available hardware resources are optimised between all servers and applications. When needed, additional processing power and resources can be given to particular functions and then can be re-assigned when the requirement is no longer there. As a result, an organisation can make full use of the resources it has available and remove excess and unused hardware.

If an organisation has irregular high-demand periods, in between long periods of average demand, an organisation can make use of Virtualisation and Cloud Computing services and hardware on-demand, to bolster its existing capacity to meet those periods of high demand. As a result, it needn't invest in hardware that lies unused for long periods of time.

4 ISSUES WITH VIRTUALISATION

As with all new technologies, there are inevitably problems associated with it. Below are some of the more common complaints and criticisms of the Virtualisation technology, alongside, where relevant, potential solutions to these problems.

4.1 INCREASED COMPLEXITY

One of the major criticisms of Virtualisation is that it massively increases the complexity of an organisation's IT landscape. Whilst it may reduce and consolidate its physical hardware, an organisation suddenly has a huge number of Virtual Machines that it must now manage. Because it is no longer restricted by physical and spatial limitations, it is thus possible for the number of Virtual Machines to grow considerably. Each of these Machines still needed to be treated as a separate server, with the provision of security patches, updates and server maintenance that this entails. Each Machine also needs to be managed and monitored.

However, it is this management and monitoring that helps to resolve this problem. Through the use of Virtualisation management software and services, the day-to-day management of Virtual Machines can be automated and controlled from one control centre.

It is important to note that whatever solution is chosen, the Virtualisation of an IT system is a complex and complicated task and requires an IT department to define and then implement strategies that will allow it to manage and control the new IT infrastructure.

4.2 INCREASED SECURITY RISKS

Some industry experts warn that companies need to understand the potential security risks involved with Virtualisation technology. A survey conducted by YouGov in 2008 found that more than 40% of IT directors believed security was built in to server Virtualisation solutions and didn't have to be addressed separately. The main area of concern is that the hypervisor itself could be the target for attack. Consequently, since Virtualisation is used to run numerous systems on one piece of hardware, if the

hypervisor is compromised, an attacker could in theory gain access to not just one server or system, but to all the servers running on that hardware.

Whilst this is a justifiable concern, it is the same concern that can be voiced against any software technology. So long as an organisation takes the obvious and necessary precautions that it would with all IT systems, these risks are no more significant than with any technology.

In fact, it has been argued that Virtualisation can actually increase security, by adding an extra security layer between the user and the attacker. For example, Google is using Virtualisation-based technology in both its Chrome browser and ChromeOS OS. In each case, processes are run in separate 'sandboxes' and system 'jails' preventing them from directly accessing the hardware or other system services. Thus, if one part of the system is compromised, the compromised system is contained and the remainder of the system remains secure.

VMware also offers its own solution, VMsafe, a set of APIs that allow third party developers to build trusted Virtual appliances. These can sit between the hypervisor and all the Virtual Machines. This allows, for example, one copy of an anti-virus system to protect all the Virtual Machines on one piece of hardware, saving resources and reducing management complexity.

A separate, but related, issue is also that of physical security. With the use of Virtualisation, monitoring where an application is physically being run becomes more complex. An organisation must ensure that the hardware on which all its Virtual Machines are run complies with all the necessary requirements for all the possible applications that may be run on it.

This also highlights the legal problems that exist as a result of Virtualisation. If Virtual Machines are moved from server to server as resource demands require, careful attention must be paid as to whether the processes that that physical device is running can be legally run in that server's physical location. Once again, the use of a Virtualisation monitoring and management system that covers these areas can help to reduce these problems.

4.3 SOFTWARE LICENCE COMPLEXITY

One inevitable area of confusion is software licensing. In many cases, software is licensed based on the number of processors on the machine on which the software is

installed. However, in the case of Virtualisation, this becomes irrelevant, as the machine on which the software is installed can vary. Virtualisation also makes it much less clear at which point the software is being accessed and by whom.

Software producers are gradually updating their licensing options to cater for a Virtualised environment. For example, Microsoft announced in 2009 that one licence for its Windows Server 2008 Enterprise Edition would allow you to run one host OS and up to four Virtual OS, whilst the Datacenter and Itanium Editions allow unlimited number of Virtual OS to be run (providing all physical processors are licensed). However, it is very unlikely that an organisation's existing licences will cover use in a Virtualised environment, and as a result, new licences will have to be acquired or existing ones re-negotiated. Whilst this is never an easy process, it can be viewed as an opportunity to consolidate ones existing licensing infrastructure and as a chance to negotiate a better deal that is more suited to an organisation's current requirements.

An additional problem is the danger of vendor lock-in. At the time of writing there was limited interoperability between competing Virtualisation solutions and it is possible for an organisation that relies heavily on one vendor to find that it has very little flexibility when it comes to integrating competing solutions or even OS. This, however, is likely to be a problem that decreases in significance over time. By way of example, in late 2009, Microsoft and Red Hat announced that they had completed interoperability testing and validation between the two companies Virtualisation and OS solutions.

4.4 DECREASED HARDWARE EFFICIENCY

Some experts argue that Virtualisation, particularly in the case of Virtual Machines, is much less efficient than a real machine, because hardware is accessed indirectly and in the case of a Virtual Machine, is being run on top of an existing system. This problem is most obvious when one Machine is run within another, as in the case of using solutions such as VMware Player, to run one OS within another. Some experts have even used Amdahl's law when arguing that Virtualisation can only have a finite improvement effect. Amdahl's law is used to find the maximum expected improvement to an overall system process when only part of the system is improved.

The main goal of Virtualisation is to allow for effective management of numerous Virtual Machines on the available hardware. Thus Virtualisation really comes into its own when it is managed properly. Clearly using a single server to run only one Virtual Machine is very inefficient. If more Virtual Machines are run on that one server and are managed correctly, such that the available resources are directed to those Machines

that need them at any one time, it can clearly be seen that Virtualisation makes that server more efficient. The perceived lack of efficiency is quickly overcome as more Machines are run on the same device (providing of course that the device is not overloaded). Therefore, Amdahl's law doesn't strictly apply to Virtualisation because Virtualisation does not aim to improve a particular system; it aims to improve the *efficient use* of that system. It will not make a process run any faster, but it will allow more processes to be run on the same hardware and it will share the available resources between those processes in the most efficient manner. With a hypervisor that also allows for load balancing and resource monitoring, efficiency is further increased.

4.5 INCREASED NETWORK LOAD AND COMPLEXITY

When an IT infrastructure is moved over to a Virtualised environment, additional strain is put on the underlying network infrastructure. Virtual servers each require a Virtual network card, which must all be routed through the physical cards available on the hardware on which the Virtual Machines reside. This, coupled with the increasing use of technology such as VMware's VMotion, allows Virtual Machines to be moved from physical server to physical server in real time results in increased network traffic. In order to combat this, the network infrastructure must be upgraded, allowing it to be dynamically configurable.

However, new standards and technologies are being developed to aid this increased complexity. One such example is the Virtual Ethernet Port Aggregator (VEPA) a standard that both HP and Cisco are developing to aid network traffic flow.

It is also possible to make use of advanced network switches, which take some of the load off the Virtual switch in the hypervisor. Regardless of these technologies, a level of expertise and experience is needed when tackling the network problems that a Virtualised environment can cause.

5 EXAMPLES OF THE CORPORATE USE OF VIRTUALISATION

5.1 TESCO

In the Spring of 2008, the UK-based grocery and merchandising retail chain completed the Virtualisation of 1,500 Windows-based servers. The main aim was to boost efficiency and cut carbon emissions. The solution was based on technology from Citrix. As a result of the Virtualisation roll out, Tesco was able to reduce its Data Centre size by a factor of ten and its carbon emissions by 20%.

5.2 NHS

The UK's National Health Service announced in 2009 that it would be using Virtualisation as a central component of its plan to cut its carbon emission by 10% by 2015 and by 80% by 2050.

5.3 ALSTOM

Alstom is a France-based organisation working in the fields of power generation and transport. It has been using Virtualisation technology from VMware since 2003 to help lower its IT costs by consolidating its servers. It has Virtualised its Windows Active Directory, Alteris patch management server, Lotus Notes email and some of its SAP servers. It is also planning to use VMware to Virtualise its disaster recovery solution.

5.4 ASSOCIATION OF TEACHERS AND LECTURERS

The Association of Teachers and Lecturers (ATL) is a UK-based Trade Union, representing educators from primary school to further education. It is using Virtualisation to both recover quickly from system failure and cut hardware costs.

ATL utilises VMware's ESX Server and VMotion solutions to move Virtual Machines from one server to another, whilst ESX Server maintains a Virtual Machine's network identity. Use of the technology has cut its server count from 22 to 11, giving it a single

view of all of its system resources. The system is also backed up to servers, rather than to tapes, allowing a back-up to be up and running in minutes.

5.5 HBOS

UK-based banking group HBOS began its Virtualisation strategy in 2003, with an aim to Virtualise its local networks, application servers and over 1.7 petabytes of storage. The strategy was driven by a desire to support business growth and to reduce and control IT costs.

It first Virtualised its wide and local area networks, then used Microsoft Virtual Server to Virtualise its IBM Aix mainframe and HP windows servers.

5.6 ROYAL LONDON ASSET MANAGEMENT

Royal London Asset Management (RLAM) is a fund management company based in the UK. It believes it will save up to £75,000 over five years and achieve a ROI in three years as a result of using Virtualisation technology.

RLAM has 180 end-users and 35 physical servers in two server rooms. It was facing capacity issues and was rapidly running out of server space. It worked with Kelway, a reseller and VMware ESX software to Virtualise its servers, allowing it to reduce its server numbers from 35 down to eight. RLAM also implemented a Storage Area Network, allowing it to store five terabytes of data on a single physical device.

As a result, it was able to be considerably more flexible in the provisioning of its IT infrastructure, future-proof its systems and provide ample growth capacity.

5.7 OTHER EXAMPLES

Other companies that already have or are planning to use Virtualisation technology in one form or another include:

- Aviva,
- Virgin Atlantic,

- London 2012 Olympic Games,
- Pret a Manager – using Virtualisation and Cloud Computing to lower the cost of its disaster recovery,
- HMRC – using Virtualisation to test and develop up to 600 applications for a Citrix thin-client system in a secure development environment that does not impact on the running of its everyday systems.

6 MDS TECHNOLOGIES CASE STUDIES

Below are a range of examples from one typical Data Centre operator, in this case MDS Technologies (MDS). MDS has a wealth of experience with Virtualisation technologies and technologies related to Virtualisation, having provided solutions to its customers for a number of years.

6.1 TRAPEZE UK

Trapeze UK is a supplier of online journey planning systems, based in the UK. It provides a 24/7 service to enable travellers to plan door-to-door journeys using public transport. As a result, it demands upmost reliability and the most efficient service.

MDS runs several co-located racks for Trapeze UK, hosting the servers that process millions of queries each year, delivering the essential passenger transport data that allows passengers to plan their entire journey online. The flexibility of the service, coupled with the technical expertise of MDS support team has given Trapeze UK the confidence that its reputation and that of its clients are in safe hands.

6.2 NAVMAN

Navman is Europe's leading supplier of Vehicle Tracking Services and has been a long-standing MDS customer. Between 2007 and 2009 the two companies have worked together to transform Navman's server and storage infrastructure into a Virtualised environment. Navman has grown rapidly since its inception and, as is typically the case, added new servers, storage and back-up facilities (all run by MDS) as new services were added and data storage requirements developed. As Virtualisation technologies developed, Navman approached MDS to review its installation to see if moving to a fully Virtualised environment would not only be easier to manage but would also reduce costs and overheads.

Navman use an exclusively Windows-based computing environment which made the choice of Virtualisation environment a simple one. They chose Parallels Virtuozzo on a cost and functionality basis and have seen the following benefits:

- reduced hardware overheads,

- 3 machines now doing what 10 were needed for previously,
- savings in OS licensing,
- hosting costs reduced as less power and space needed,
- increased resilience:
 - the ability to take hardware down without affecting service,
 - options for failover without downtime in the event of failure,
- increased manageability,
 - Windows updates only needed for hardware nodes,
 - centralised allocation of resources,
- improved service and uptime for users and customers.

6.3 VODAFONE VAS

Since 2002, MDS has delivered a range of services to the global mobile telecommunications supplier, Vodafone and runs a number of mission-critical strategic solutions. The Vodafone Applications Service (VAS) enhances the efficiency and productivity of core business activities for mobile workers. It enables mobile users to interact remotely with their business applications (for example, Siebel, Oracle, Remedy, salesforce.com and SAP) from their BlackBerry, Pocket PC or Symbian device. MDS has hosted VAS services for Vodafone since 2006 and also works directly with several third party providers, such as Dexterra, who deliver products under VAS to Vodafone customers.

MDS provides both back-up infrastructure and storage solutions to support the service, from its Corsham Data Centre. In the past, a new VAS service may well have required the implementation of at least one additional server and associated storage and back-up. By introducing a Virtual environment and sharing facilities across a range of services, greater use of the existing server and storage infrastructure has been achieved. This has increased efficiency and reduced cost, not only in terms of basic hardware, but also in terms of space, cooling and associated power costs.

6.4 TIBBOH INTERNET

tibboh approached MDS in 2007 with a view to developing a new mobile Internet solution for the Education sector. The solution envisaged creating a 3G access portal to allow access to the internet, and associated content providers, but filtered and restricted to ensure that content was suitable to the age of the person attempting to gain access. Five access levels are currently permitted – U, PG, 12, 15 and 18 – ensuring that access and content are suitable to that specific age range. Delivered via a Vodafone 3G mobile dongle, the software/communications applications have been created by MDS using bespoke application development (Open Source, Java, Apache/Tomcat etc) running in a fully Virtualised environment. Currently some 500 children are registered on the system as tibboh bring on content providers and finalise go-to-market provision with a high street retailer for a major launch early in 2010.

MDS manages three separate environments for tibboh – a Test environment with approximately 10 fully Virtualised servers, a Development environment with 6 servers and a Live environment with around 30 servers. Service is delivered by two completely separate network links and the whole system is monitored by MDS monitoring and security systems. Scalability has been an inherent part of the design and will support the nationwide launch in early 2010.

6.5 IKON OFFICE SOLUTIONS

Ikon Office Solutions is the world's largest independent distributor of office equipment and document management services. MDS hosts IKON's In-Touch application at its secure Corsham I Data Centre facility. This ensures that IKON can always rely on In Touch to allow it to communicate with, and despatch jobs to, a 400-strong team of mobile engineers across the UK.

In Touch is not only a messaging system, it provides an up-to-the-minute flow of information between IKON's head office and its mobile team. Engineers can be sent to and complete jobs quicker, making the company more efficient and productive. It also integrates with IKON's Customer Relationship Management system, giving their technicians instant access to vital central resources when they are out with customers.

As the mobile system's wireless performance relies on a solid and dependable connection, MDS' strong links with mobile service provider Vodafone play a crucial role in the day-to-day operation of the service. MDS' servers provide the gateway for the flow of all the information sent using In Touch, communicating with both IKON's mobile devices and their backend servers. The strong relationship with Vodafone

ensures downtime is kept to a minimum and MDS' engineers are able to sort out any issues usually before IKON is even aware of them.

IKON is extremely happy with its relationship with MDS and says the fact they need only minimal contact with MDS highlights the quality and reliability of the service provided.

CONCLUSION

From this brief introduction into Virtualisation it is clear that the technology has great potential, however, it requires a reliable infrastructure in terms of Data Centre, power and bandwidth. It is a complicated and complex technology that requires sophisticated management solutions, common sense, a clear strategy and careful planning and project management. If just one of these areas is overlooked then a Virtualisation strategy could fall flat and all the benefits of the technology lost.

To make the most of Virtualisation, corporations should work with a partner that has experience in all these areas and can provide the solutions and services necessary to help ensure a successful Virtualisation rollout. MDS Technology is one such solutions provider and its customers can be confident that the Virtualisation path they choose is the most sensible and appropriate to their individual requirements.