

ICE Systems Pty Ltd

White Paper Series

Business Value of Virtualisation

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The Business Value of Virtualisation in the small to medium enterprise (SME)

The current economic climate is seeing a number of small to medium enterprises facing considerable challenges to meet company profit targets. In this climate the Australian small to medium enterprise (SME) has been under significant pressure to reduce costs, increase operational efficiency and to extend their allocated IT budget.

In such pressurised times analysts have observed that many IT managers are reluctant to move to new technologies and undertake a different IT strategy. However, case studies have shown that this is precisely the time to make this transition.

Virtualisation is an established technology which is forming the basis of a new strategic direction for IT departments of all business sizes which can meet these challenges.

There are a number of key business values in moving towards a virtualised infrastructure. I will elaborate on these later although they include, costs saving, decreased administration, lower power utilisation, efficient resource usage, application and server high availability. All of these at lower cost and keep the mission critical applications functioning so the business can focus driving sales and increasing profits.

What is Virtualisation?

There are several different types of virtualisation and it can sometimes feel like the categories are shifting and changing. To make sense of this, I will explain each category of virtualisation according to current industry standards.

In summary the categories include:

- Server Virtualisation
- Client Virtualisation
- Presentation Virtualisation
- Desktop Virtualisation
- Application Virtualisation

These separate technologies can be effectively combined to develop a complete virtualisation strategy. Detailed below is a summary of each of these categories followed by a brief example of a Virtualisation design for an SME company which incorporates all of these technologies into a cost effective and efficient IT strategy.

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Server Virtualisation

The term virtualisation was coined in the 1960's and the technology was first used by IBM in their mainframes from the 1970's. This paradigm for computing was updated in the PC age and the first virtualisation software was released commercially by VMware in the late 1990's.

The first and most pertinent category to SME businesses is that of Platform Virtualisation, also known as Server Virtualisation.

In Server Virtualisation a piece of software know as a 'hypervisor' runs on the hardware and provides a simulated hardware computing environment which allows for multiple operating systems to run on a single server. The server is known as the host and the operating systems or guests are known as virtual machines.

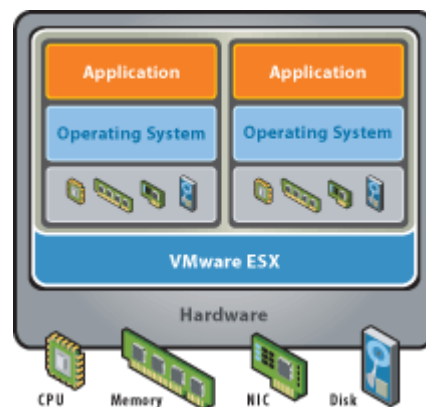


Fig 1. Logical Illustration of Server Virtualisation provided by VMware

There are two types of server virtualisation:

Type 1: Also know as native or bare-metal hypervisors which are software that runs directly on the host's hardware as a hardware control and guest operating system monitor. The guest operating system thus runs on the level above the hypervisor.

This is the most common type of server virtualisation and it's now moving from the large enterprise datacentre's to SME offices for it adds significant value to the business especially when used with a virtual server management suite.

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The vendors who supply this software include the industry leading VMware with their ESX hypervisor, followed by Citrix with their XenServer5.5, then Microsoft with Hyper-V and a number of other vendors including Oracle VM, Red Hat KVM, Virtual Iron, Parallels Server and Sun's Logical Domains.

A critical differentiator between these hypervisors as we shall see later is the management suite which is used to control them and the type of additional features which have been built into this management functionality.

Type 2: Also known as host based hypervisors. They run the hypervisor software on existing operating systems and the guest virtual machines run as a third layer on top of the hypervisor.

The structure creates a significant amount of resource overhead and performance degradation for guest operating systems and consequently it is not often used these days in production environments. It is certainly not recommended.

Type 2 hypervisors are often seen in development, testing and training environments for which performance and availability are not critical issues.

Examples of this type of Hypervisor include Microsoft Virtual Server and Workstation, VMware Server, Workstation and Fusion, Parallels Workstation and Virtual Box.

Microsoft has also just released an advanced operating system integrated form of Type 2 virtualisation in their Windows 7 client. It is called Windows XP mode and this technology will run a Windows XP virtual machine using the workstation hypervisor. However, what differentiates this from the above solutions is that it is tightly integrated into the client operating system and user profile enabling the user to run applications from the virtual XP machine seamlessly (no additional desktop window) and the application resides in the users Windows 7 start menu. It also has extensive support for peripheral devices such as USB and printer connections.

Client Virtualisation

As the name suggests Client Virtualisation occurs when the hypervisor software runs on the desktop or laptop hardware; the clients.

This is a very new type of virtualisation and has only become possible through the hardware based virtualisation instruction set extensions built into the modern Intel VT and AMD-V CPU's. These extensions address the parts of x86 that are difficult or inefficient to virtualise, providing additional support to the hypervisor. This enables simpler virtualisation code and a higher performance for full virtualisation.

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Whilst these extensions have benefitted server virtualisation; it is a recent update, namely the Intel vPro™ chipset by Intel which has made true client side virtualisation viable.

In client virtualisation the Type 1 (Bare Metal) hypervisor runs directly on the client hardware. The client operating systems run on this virtualisation layer.

The new Intel vPro™ chipset allows for the hypervisor layer to be very thin, thus any requests by the guest operating systems to use hardware resources have near direct access to the CPU and memory. This results in resource efficient, high performance virtual machines. Importantly for a desktop environment this allows for near direct access to the GPU (Graphics Processing Unit) which enables rich graphics to be provided to the user. An example would be the ability to run AutoCAD in a guest virtual machine which runs the corporate Standard Operating Environment (SOE) and DirectX Games such as Call of Duty in a separate guest which runs an operating system for personal use.

The client hypervisor allows staff to run the corporate SOE outside their local network so they are offline and still have access to all the required business applications. An example would be an executive opening his laptop and working on a plane and still having all of his SOE applications.

The separation between work, personal and development operating systems allows for increased security, less helpdesk calls, greater performances and a lower administrative overhead.

Citrix is leading the way with this technology and has been working closely with Intel to integrate its client optimised Xen Hypervisor known as the Citrix XenClient into the new Intel vPro™ desktops. This collaboration between Citrix and Intel will enable PC manufacturers to include 'built-in' client-side virtualisation with new desktop and laptop computing systems for the first time ever.

The Citrix Solutions also enables virtual machines to be 'streamed' to corporate clients using their provisioning server when the user is on the office network. This combined with the Citrix profile management solution allows for a consistent and up to date desktop SOE with the latest corporate applications and patches. The updates occur from a single gold (master) image on the server.

This is the only virtual machine that needs to be updated thus creating a very efficient means of upgrading or adding applications and patch management. This is a full desktop management solution which allows the virtual corporate SOE to be used offline.

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There are other types of less advanced client virtualisation solutions such as VMware ACE technology which packages a virtual machine and will install the image onto the client or run from a USB drive. This is not a true Type 1 client hypervisor. VMware are currently in the process of updating their client virtualisation solution.

Client virtualisation can be integrated with Server, Application and Presentation Virtualisation to create a complete solution which shall be demonstrated later in the article.

Presentation Virtualisation

Presentation Virtualisation is technology that presents a screen image and mouse clicks to the end user of a desktop or application which is running on a central server.

This form of virtualisation is dominated by Citrix with their XenApp product. However, there have been other vendors such as Microsoft with their Terminal Services (now Remote Desktop services) and to a lesser extent Tarantella.

The paradigm originated from the mainframe computing idea of centralised computing resources with thin (dumb) terminals which only run a small client application which connects to the central servers. In the late 1980's Citrix was the first company to release a commercial product to utilise this paradigm for the PC era.

Citrix developed the ICA protocol which contains 32 thin wire channels from which audio, mouse clicks, printing, and desktop images to name a few travel from the server to the remote client. It is a very efficient protocol and only requires *approximately* 20kbs of bandwidth for a user session.

It was first released with IBM's OS/2 Operating System in 1989 and then in the early 1990's Citrix licensed the use of the NT Operating System source code from which Winframe was developed. This product evolved into Metaframe then Presentation Server and finally XenApp which is in use by 99% of Fortune 500 companies worldwide.

Presentation Virtualisation is able to occur through the use of a Microsoft Operating system which has been modified to allow for multiple concurrent user sessions. It presents as their own personal computer. However, resources are shared with other users on the same server. This differs from both Server and Client virtualisation which create a virtual hardware layer which the guest operating system references to create multiple instances of a logically separate virtual machine on a single server.

High levels of efficiency and cost saving can be achieved by running Citrix XenApp server as virtual machines on a type 1 hypervisor such as XenServer or ESX. Studies have indicated the XenServer in particular allows for more than double the user session count in a virtual server environment than on VMware ESX.

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Application Virtualisation

Application Virtualisation is a technology which separates an application from the underlying operating system. An application runs in its own isolated environment believing that it is directly interfacing with the original operating system and all the resources managed by it, when in reality it is not. It references its own dll's, executables, registry entries, etc which reside in an isolated folder on the host operating system. Application virtualisation differs from Server Virtualisation in that in the latter case, the whole operating system is virtualised rather than only specific applications. A hypervisor is not required, just a small client application which manages the delivery and initialisation of applications in this virtual environment.

This technology is very useful when a customer has aging applications that are not compatible with newer operating systems. An example would be running an aging application developed for Windows 2000 on windows Vista or alternately running two applications which are both using a different version of a Microsoft Access database.

This technology increases the efficiency of managing applications for they can be stored in a central file share and only this single instance of the application is updated and then it can be automatically pushed out to the clients. It also is very useful when migrating to new operating systems and SOE's.

There are a number of competing vendors which provide very similar applications virtualisation solutions. The industry leader is Citrix with their Application Streaming product followed by VMware with their newly purchased ThinApp product. Microsoft also has an application virtualisation product called App-V as does Symantec and Novell.

Desktop Virtualisation

In recent times there has been a great deal of industry hype surrounding desktop virtualisation. Both well respected industry analysts Gartner and Forrester believe that Desktop Virtualisation, otherwise known as Virtual Desktop Infrastructure (VDI) will become the dominant method of delivery for desktops in the next five years.

Desktop virtualisation is similar to presentation virtualisation in that images, mouse clicks, audio, etc are transferred over remote protocols such as ICA, RDP or PCoverIP. The key difference is that instead of connecting to a session on a single shared Windows operating system the end user connects directly to their own dedicated client operating system. The operating system can reside on physical hardware such as a blade although the most common method is to utilise a Virtual Server environment such as ESX or XenServer to create client virtual machines that the end users will connect to, through a VDI session broker.

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Desktop virtualisation encapsulates and delivers either the entire operating system environment to a remote device. The remote device has a small client which established and manages this connection. The VDI software client can be installed on a traditional thin client which has limited inbuilt resources or a full desktop client which has its own operating system.

There are a number of major vendors who provide this solution. The undisputed leader of VDI is currently Citrix with their XenDesktop Product. It leverages its established ICA protocol and newly developed High Definition Experience (HDX) clients to provide a superior performance over its competitors including VMware View and Microsoft Med-V. There are also smaller vendors such as Ericom's PowerTerm WebConnect and there are also emerging open source Desktop Virtualisation solutions.

It is apparent that whilst there a number of vendors who offer virtualisation solutions there are only two who can be considered end-to- end virtualisation providers. They are VMware and Citrix. Microsoft is very close to providing an end- to- end solution although they currently require Citrix to complete the solution. To illustrate this point Microsoft uses the Citrix XenDesktop virtual desktop broker to manage guest operating systems in it Med-V VDI solution.

A virtual desktop solution especially when using a virtual server backend infrastructure and thin clients provides easier management, lower hardware and power costs, increased security and a viable means of creating an effective business continuity plan with disaster recovery.

There are several return on investment (ROI) calculators included below from different vendors all providing examples of how this solution can save a business a considerable amount on their IT expenditure.

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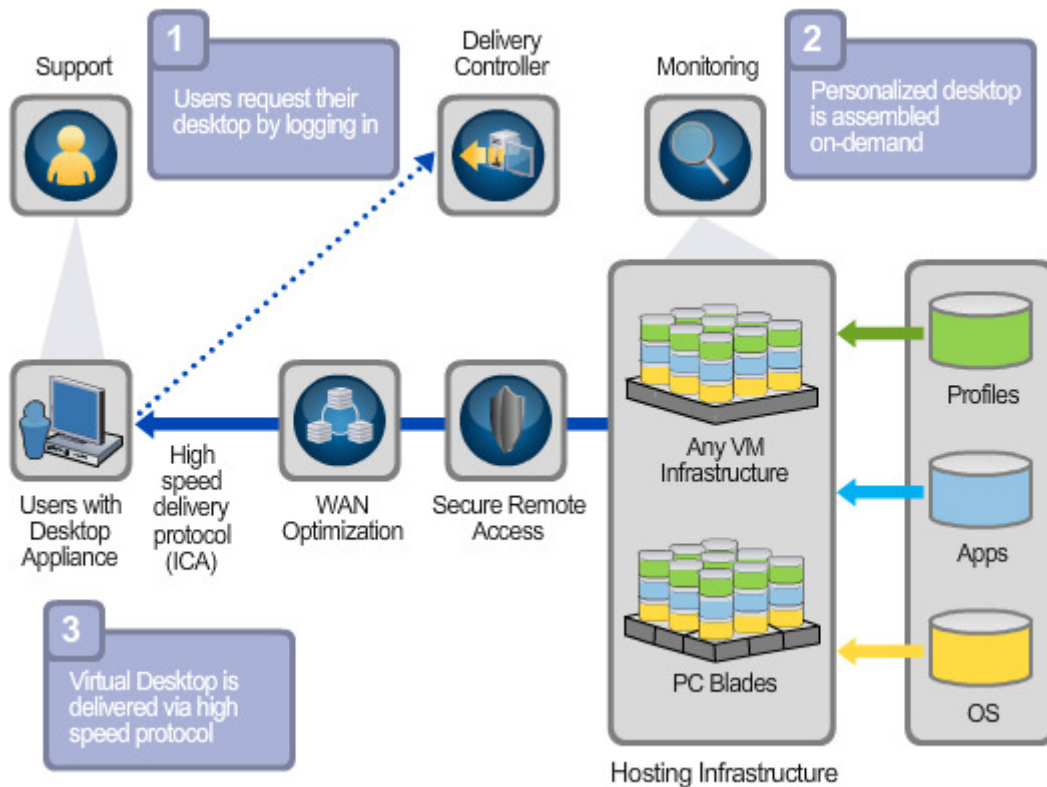


Fig 2. Logical Illustration of Desktop Virtualisation from Citrix

This diagram provided by Citrix is an illustration of how Desktop Virtualisation functions in a standard SME environment. VMware have a similar feature set and with their own illustration.

In the example above the user turns on their local device whether it is a thin client or a desktop with the (Desktop Receiver) ICA client on it. They connect to the Delivery Controller (Desktop Broker) either through a local network connection or if required a secure remote VPN connection which can be WAN optimised. The Delivery Controller will, after authenticating to Active Directory, provide a personalised desktop from the hosting infrastructure. This can be from a physical device or virtual machine. If Citrix is used, the Delivery Controller can also choose a terminal server or XenApp session (Presentation Virtualisation) and deliver this to specific user groups.

To save space on the storage infrastructure, a single virtual machine can be used as the 'master' image from which virtual desktops are delivered. Profile Management software with roaming profiles and group policies combine with this virtual desktop to provide the personalised user experience with only a fraction of the tradition amount of resources used.

This saves a considerable amount in hardware costs, power costs and administration. As data is centralised it is more secure than traditional methods and data backup is simplified

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How an SME can benefit from virtualising their infrastructure

There are a number of ways that businesses can benefit from virtualisation; some of which have been briefly touched upon above, including addressing the problems with underutilised and difficult-to-manage hardware, excessive power consumption, efficient administration and the expense of housing servers in datacentres and branch offices.

By addressing these issues there are considerable savings in IT expenditure. The first and most visible occurs from server consolidation.

Server Consolidation

Server Virtualisation allows organisations to undertake a physical to virtual (P2V) conversion of their existing servers. This results in the same number of servers running on less physical server hardware. As there is less physical server hardware customers have reduced costs throughout the entire hardware lifecycle from provisioning servers, to managing them and removing them from the infrastructure.

Capacity planning tools such as those from Novell Platespin or VMware are used to determine how many virtual servers will reside on a single physical server. This typically will result in 60-80% utilisation rates for servers, which is significantly higher than the standard 5-15% utilisation rates seen in current environment only using physical servers.

By running multiple virtual machines on fewer physical servers, customers are drastically cutting hardware requirements and easing server management. This can be observed in a number of case studies provided by all vendors, for example, Microsoft through several case studies which use Windows Server 2008 Hyper-V demonstrate the saving using server virtualisation. Indiana University Auxiliary IT Department went from 152 to just 32 servers, which it expects will save US\$85,000 annually and Maximum ASP reduced its servers from 40 to 5, saving US\$7,000 every year. Additional details are freely available from the Microsoft website.

VMware has calculated cost savings of more than \$3,000 annually for every workload virtualised. VMware clearly outline these saving on their website <http://www.vmware.com/solutions/cost-savings>. It is not only the virtualisation providers who are able to illustrate the cost savings using virtualisation. All of the major IT analysts including Forrester, Gartner and IDC each provide articles demonstrating the return on investment and reduced total cost of ownership achieved when using virtualisation technologies.

Space Savings

Every business regardless of size has to house their physical servers in a secure, cool and accessible location. Many SME companies use their own server room or rent co location space in one of the many large datacentres. The result

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is that expanding server farms can also be expensive to house virtualisation addresses this issue by consolidating servers. This provides additional valuable space in your datacentre and branch offices and will provide significant savings in infrastructure housing costs. The most obvious savings are observed when less rack space needs to be rented from the datacentre provider. However, there are other situations. An example is an Australian Oil company who had run out of space in their server room. They were looking at knocking down walls and expanding until they undertook a server consolidation program using VMware and were able to significantly reduce the number of physical servers located in their server room thus negating the need for an expensive reconstruction project.

Power Savings and Green Initiatives

An increasing issue in organisations is the cost of power. This is an important issue as it costs companies a great deal to run power into server rooms, air conditioning in the rooms to keep them cool and the constant availability of UPS services to keep them running in the event of a black or brown out. This is a particularly important benefit in today's climate of volatile power prices. Many customers have realised dramatic electrical savings as a result of server consolidation. Microsoft provides the case study of how TALX expects to save approximately 50% in annual power and cooling costs by consolidating its server environment with their Hyper-V server virtualisation.

The amount of power a company is required to use has a direct impact on the level of carbon emissions they contribute to the global ecosystem. As independent environmental research has noted, server virtualisation can have a tremendous impact on green initiatives. By improving capacity utilisation by consolidating underutilised servers, server virtualisation not only lessens cooling requirements and kilowatts of power used, it reduces the environmental footprint for organisations. The website <http://www.hyper-green.com> helps organisations calculate how much energy they will save and the environmental impact of those savings.

Administration Savings

An important area where savings can be achieved is from the reduced administrative overhead associated with using virtualisation solutions. This can be difficult to quantify. However, many organisations have reported that after undertaking server consolidation and implementing virtualisation management tools such as VMware vCentre, Citrix XenCenter or Microsoft's SCVMM they have seen an improvement in the server to admin ratio. The result is lower personnel costs including outside consultants.

It also improves the performance of the existing IT departments as they are able to complete their tasks more efficiently and provide better support to end users. This of course leads to happier staff and subsequently better productivity.

The management suite enables new servers and applications to be deployed in minutes instead of days. They allow for high availability of applications as virtual machines will fall over and restart on another virtual host such as

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XenServer in the event of an outage. There is also new lockstep technology which provides fault tolerance i.e.: 100% uptime. This occurs as two virtual machines on two or more separate hosts are running identical transactions at the same time. If one host goes down the other continues without any interruption and is able to service client request. Marathon technologies <http://www.marathontechnologies.com> first developed this form of fault tolerance and VMware are now including their own version in their new vSphere 4 suite.

There is inbuilt patching, lab management, live motion for no downtime host maintenance, snapshots, advanced storage management and granular automated scheduling of tasks, just to name few of the inbuilt administrative features which save an administrator time and an organisation costs.

Disaster Recovery

Another important benefit of virtualisation is the ability for smaller organisations to create a financially viable Business Continuity Plan (BCP) which has a functional Disaster Recovery (DR) solution.

A common methodology is to have a main site with several virtual server hosts connected to a storage area network (SAN). The virtual machines on the SAN are replicated to another SAN at a DR site or quite often a geographically separate office. Products such as VMware's Site Recovery Manager will automate the staged restart of backup virtual machines at the DR site in the event of an outage at the head office.

Citrix takes this solution further by integrating their XenApp server and NetScaler appliance into the end-to-end virtualisation solution. The combination of XenServer, XenApp and NetScaler with its inbuilt Global Load Balancing service enables a fully automated DR solution. The NetScaler will redirect all client requests to the remaining functioning site and the run anywhere Citrix clients will enable users to log on from home, branch offices or internet cafes and continue to work even if their local office workstations are no longer available.

The impact of outages of hardware within head office environments can be negated through the use of high availability and fault tolerance solutions mentioned above and through the use of snapshots. A snapshot is a copy that is made of the virtual machine at given points in time.

The virtual machine can easily be restored to this point in time by restoring the snapshot. Full backups to offsite locations for security and compliance reasons is achieved using 3rd party backup software such as Backups Exec and the virtual consolidated backup services provided by the major hypervisor vendors.

Gartner studies have indicated that virtualisation will increase availability of hardware and applications for improved business continuity and will provide an 85% improvement in recovery time from unplanned downtime

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Security and compliance

There are a number of security benefits to using Virtualisation. The easiest to imagine relates to the centralised storage of data. It can be easily managed and access can be restricted when required. Backups are simplified as there is no longer the need to be concerned about data in branch offices and in many situations the entire virtual machine can be backed up without having to resort to file level backups.

In a centralised virtual environment logging and journaling of data movement is also simplified thus assisting with Sobanes-Oxley and PCI compliance.

Licensing Savings

Through virtualisation infrastructure, significant licensing savings can be realised. This can be seen with software products such as databases which are licensed on a per socket basis. When this type of server application is running in a virtual environment a single or dual socket license can be used, however, it potentially has access to a number of CPU cores and CPU availability by being a part of a resource pool in a virtual server farm. This is a server farm of virtual server hosts such as XenServer or VMware which load balance virtual machines across the physical hosts for optimal performance.

Microsoft is also proving licensing benefits through utilising their Hyper-V virtualisation solution. For example a company can run Windows Server 2008 Enterprise Edition which gives them the right to run four virtual operating systems per physical server or with Datacentre Edition you license Windows by the processors on the physical server and get unlimited Windows server operating system rights for the virtual machines.

There are numerous other benefits seen through virtualising your companies IT infrastructure. Instead of extending this section further the most descriptive way to demonstrate the benefits and cost savings from virtualisation is to design a virtualisation solution for a fictional SME with a very common existing infrastructure and then run the TCO and ROI calculators on this fictional organisation to determine the savings they will achieve by undertaking the migration to a fully virtualised infrastructure.

TCO and ROI Calculators

There are numerous ROI and TCO calculators which will provide an estimate of the commercial benefits to virtualising your infrastructure.

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These online calculators ask a series of sample questions about your organisation and will create a report outlining the projected savings by implementing the recommended solution. In the following section an example of an ROI calculation will be used on a fictitious organisation that reflects the standard SME infrastructure.

Below are links to online ROI and TCO Calculators:

Microsoft Hyper-V

<https://roianalyst.alinean.com/msft/AutoLogin.do?d=307025591178580657>

VMware vSphere

<http://www.vmware.com/go/calculator>

Citrix XenServer

<http://community.citrix.com/citrixready>

How it all works together

A company will see greater benefits to running a complete virtualised infrastructure over and above a basic implementation of a virtual server environment.

In our fictional example I will describe how an SME company which owns 40 servers and 200 clients in a distributed environment can migrate to a fully virtualised infrastructure. The ROI and TCO saving will be calculated.

The solution will move from servers at each of the three sites and a full desktop PC environment for 200 users to a VMware solution which consolidates and virtualises all the servers to the head office and delivers virtual desktops to users with their VMware View 3 VDI suite.

This is an example only of the savings seen by migrating to this VMware solution. However, independent research has shown that Citrix is a more effective virtual desktop solution and when combined with a company that already has XenApp (as many do) then the savings are considerably more as the company is able to leverage this existing investment.

The IT Infrastructure of the fictitious company reflects the standard IT environment seen in many Australian SME companies. The company is called FictitiousHealth and as the name suggests is part of the Health Industry.

After running the questionnaire and inputting very conservative answers in the VMware online ROI calculator the results seen in the following diagram indicate that through server consolidation there is a 6.7:1 server consolidation ratio. This is achieved by a reduction in the number of physical servers from 40 to 6. Through virtualising desktops

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there is a 61% saving in desktop capital and operating expenses. There is also a calculated total power saving of 72,000 kWatts per year.

VMware TCO Analysis

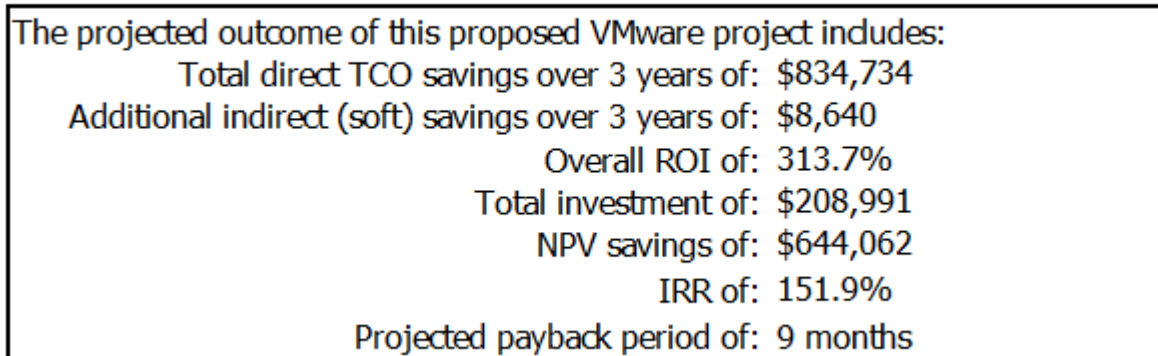


Fig 3. ROI and TCO calculation for FictitiousHealth provided by VMware

Conclusion

It can be seen that a fully virtualised environment can save an organisation a considerable amount in IT expenditure and in tough economic times it is clear that this is an important technology for all organisations especially small to medium enterprises to start adopting. Should you wish to discuss options for your specific environment then please call ICE Systems on +61-2-9906 1592 or click http://www.icesystems.com.au/contact_us.html to contact us.

About the Author

Damon Wells is a Solutions Architect with ICE Systems. The majority of his working career has been in IT with the last 10 years spent in senior engineering and design roles. He is a specialist in the field of virtualisation and has many certifications in the field such as the CCIA from Citrix, the security CISSP and an MCSE, CCNA and a BSc from Macquarie University.