White Paper
Fujitsu vShape

The flexible and scalable vShape solution combines all aspects of a virtual environment, based on reliable technologies and best practice solutions, with simple implementation and operation.

Content

1. Introduction

Today organisations are challenged with unpredictable and explosive data growth, while still having dependences on applications and services running in silo IT configurations. IT effectiveness is increasingly affected by the expansion of underutilised hardware, isolated management tools, and high demand on resourcing operations. The inefficiency associated with IT complexity affects small, midsize and enterprise organisations alike. Some businesses have already begun to move away from inflexible IT silos towards a shared, virtualised IT architecture that is helping to improve responsiveness, lower costs, and drive business innovation. Organisations with limited resource and tight IT budgets need an affordable solution that can help them build an IT infrastructure that is simple to deploy and manage, flexible enough to operate with their current needs, and can be easily scaled for future growth.

Common challenges surrounding virtualisation

- Level of IT skills competency
- Myriad of technologies
- Skilled resource required for designing, implementing and integrating virtualisation

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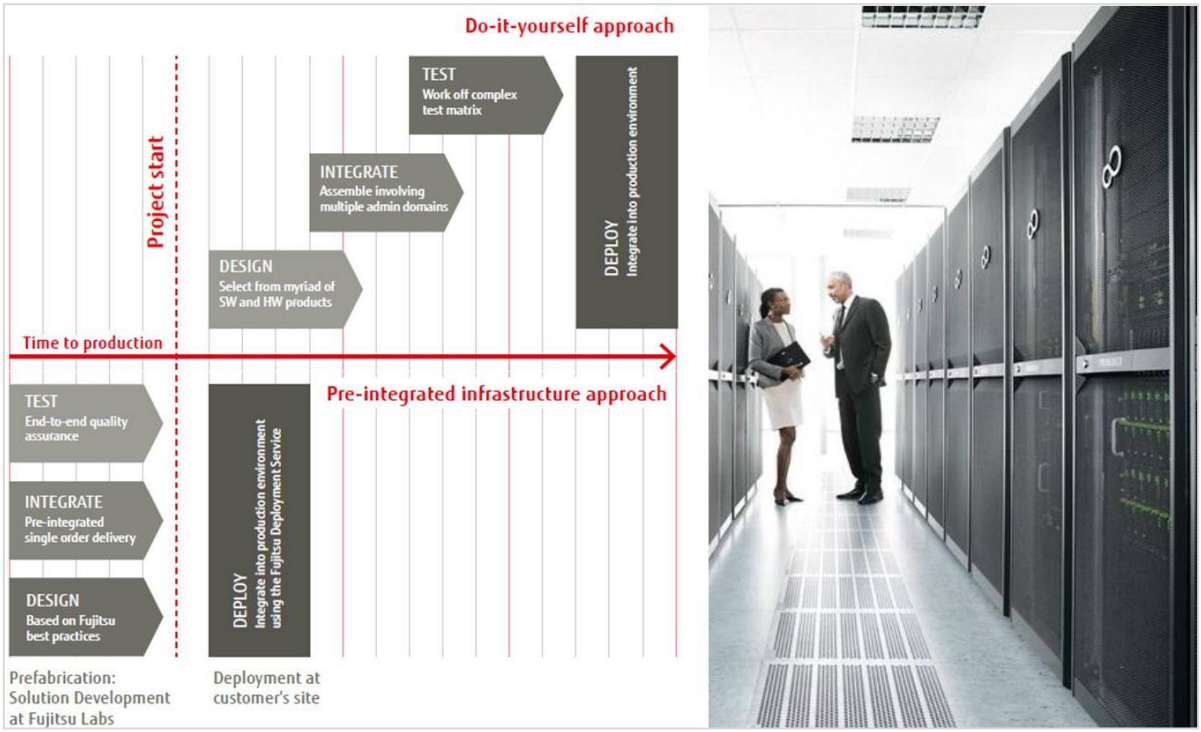


In today's market there is a clear trend and requirement for organisations to move away from conventional do-it-yourself deployments towards virtualisation and the cloud. The above image demonstrates the advantages that organisations can benefit from following a solution lead approach.

Current customer demands

- More flexible and simplified infrastructures fitting around the current and future requirements of the business processes
- Pre-integrated software and hardware infrastructures
- Simplified high availability without requiring knowledge of complex cluster solutions
- Faster provision of new applications through simple creation and configuration of virtual machines
- Greater efficiency through automatic distribution of workloads
- Cost savings through consolidation leading to significant reductions in investment and operating costs

How to cope with this challenge?

The flexible and scalable vShape solution combines all aspects of a virtual environment, based on robust technologies and best-practice. Organisations benefit from the peace of mind that their validated vShape Solutions are simple to implement and use for a more streamlined experience, all from a single provider with a single maintenance contract. Fujitsu vShape accommodates a variety of validated designs that can be customised to specific environments and can easily be scaled as needs and demand change. vShape consists of NetApp FAS storage, Brocade IP switches and leading VMware virtualisation technology, running on Fujitsu PRIMERGY servers designed and optimised for virtualisation. These IT infrastructures are based on industry standards and prevent single vendor lock-ins. With vShape, organisations are able to benefit from multidimensional scaling, continuous operations, and automated management which will enable them to effectively deal with massive data growth - all in a single, feature-rich solution.

Advantages - in Summary

1. Validated:
    a. Optimised for virtualisation, with excellent performance & availability
    b. Proven & validated architectures
    c. Industry leading technologies

2. Flexible:
    a. Standardised components
    b. Flexible configurations
    c. Highly scalable capacity, performance & functionality

3. Fast:
    a. Reduced design risk & implementation
    b. Single part number & price
    c. Single point of contact for the maintenance of the complete solution

Why is server virtualisation so Important for small & medium enterprises?

The continued increase in performance of ISS servers (Industry Standard Servers with x86 processor technology) has impacted SMEs. The servers used in this sector of the market are usually equipped with multi-core processors. This means that a physical processor contains several logical computing cores. The resulting computing performance can hardly be used efficiently with conventional software architectures. That is why it makes sense to run several independent services 'separately' on a single system, thereby making more efficient use of computing performance. The number of virtual machines (VMs) that can be hosted by a server depends not only on the CPU performance of the physical server, but also the individual resource demand of memory, network bandwidth, IO throughput and disk capacity of the applications encapsulated in the VMs.

Capacity planning is key

In order to realise the full benefits of virtualisation, it is important to match hardware capabilities with server requirements. In practice, this comes down to fitting the greatest number of virtual servers onto a physical server without reducing the performance of those servers. In addition, server virtualisation means that much more flexible architectures can be established.

- Older operating systems can be run on the latest hardware
- Applications can be started on any hardware due to the flexibility of server virtualisation
- Software management is made easier and can be largely automated
- Better availability can be achieved, something that would be too complex and expensive for most SMEs using conventional approaches

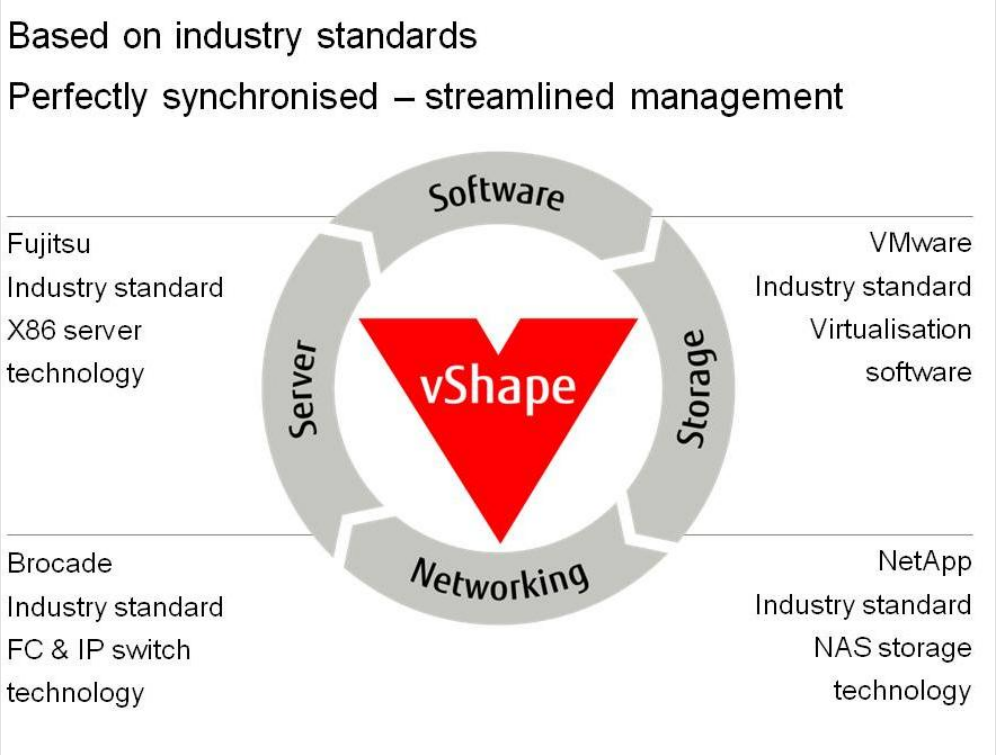
More efficient, flexible and highly available infrastructures are indispensable competitive factors, particularly for SMEs.

2. Why VMware, NetApp and Brocade?

The advantages of vShape at a glance

Reduce your investment and operating costs and improve your control over your IT infrastructure, whilst still maintaining flexibility in your choice of operating systems, applications and hardware.

- Focus on business critical projects instead of spending too much time on resource intensive tasks
- Use your existing IT resources more efficiently and reduce your data center investment costs
- Reduce your energy consumption and space requirements and the associated costs



Profiting from market leading VMware technology

Fujitsu and VMware are leaders in virtualisation and cloud infrastructure solutions, enabling organisations of all sizes to lower costs and increase business agility. As a Strategic Technology Partner, Fujitsu is able to provide solutions for every size of customer and can deliver both 1st and 2nd line support services for all OEM VMware products.

- Server virtualisation
- Data center solutions
- Private and hybrid cloud computing
- Desktop virtualisation
- End user computing

vShape features Fujitsu PRIMERGY rack servers which have been designed to support VMware's latest, vSphere 5.1, server virtualisation technology. The strong alliance and continued product development between both companies' guarantees that all certified PRIMERGY servers from Fujitsu are optimised to deliver industry leading results in performance, efficiency and reliability for the latest virtualised computing platform. vSphere 5.1 allows high performance across all virtualised applications and is the most proven, trusted and widely deployed server virtualisation software in the market. This provides a solid foundation for all virtualisation and consolidation projects.

Taking advantage of NetApp storage

As Fujitsu's strategic storage partner, NetApp has an outstanding reputation as a manufacturer of innovative, extremely cost-effective storage and data management solutions, and is one of the fastest growing storage providers worldwide. NetApp storage systems enable organisations to utilise their storage capacities with more efficiency. Furthermore, Fujitsu and NetApp have combined their expertise and this has enabled them to integrate server, storage systems, network and virtualisation technologies in complete infrastructure solutions that offer flexible use of IT resources and scalability. For customers the strategic partnership means that they will get the optimal storage solution for their particular requirements, and that they can implement their IT strategy holistically and consistently. Many enterprises already benefit from this strong alliance, especially when it comes to optimising business-critical application environments, realising virtualisation projects and implementing cloud strategies.

In a partnership spanning almost 15 years, NetApp and Fujitsu are setting new standards for the optimisation of complete IT infrastructures. The Fujitsu and NetApp strategic alliance is based on a common understanding that an overarching and cross-functional storage infrastructure requires more than just a series of components that are simply "strung together." This mutual approach is the basis for the development of more flexible, more scalable and more cost-effective storage infrastructures in a dynamic data centre. Regardless of whether you need to consolidate your storage infrastructure, improve storage capacity utilisation, or provide more performance and failure resiliency for database and application environments, with Fujitsu at your side, you will find the optimal solution for your enterprise.

The joint highlights of the Fujitsu and NetApp product families include:
- Seamless family concepts with standardised management and high scalability across all models
- Homogeneous architectures within the product families reduce operating costs and the cost of migration when responding to growing capacity and performance requirements
- Highly developed functions for maximum storage efficiency

Service for every requirement: Fujitsu offers consulting, integration services, maintenance and support as well as managed services for the entire portfolio. This is all from a single source – including service, support and maintenance. The combination of expertise and mutual experience that is the foundation of this alliance results in solutions and services that address the specific needs of every customer.

Working in partnership with Brocade

Fujitsu and Brocade provide end-to-end solutions to assist customers in evolving their data-centers to support anytime and anywhere application requirements. Brocade is Fujitsu's preferred networking provider and allows organisations to transition smoothly to a world where information and applications reside anywhere.

- Leader in Ethernet Fabrics
- Leader in Storage Networking

With innovative networking technologies from Brocade and integrated solutions from Fujitsu, data center operators can benefit from higher agility to serve new business requirements.

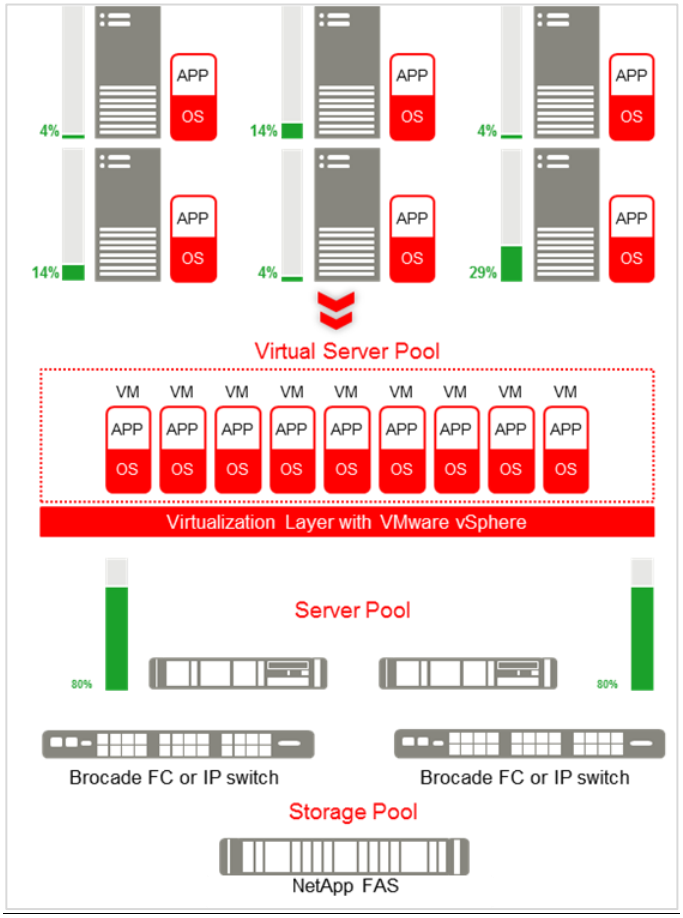
Fujitsu's vShape solutions contain Brocade's Ethernet switches, providing industry leading switching technology with simplified management via Brocade Network Advisor (BNA). The switches can also be managed using an industry standard CLI (Command Line Interface), meaning customers can use the same management commands that they would with other manufacturers' switches. Brocade's Ethernet switch provides wire-speed and non-blocking 1 GbE.

3. vShape Solutions

VMware vSphere

The tried and tested datacenter solutions from VMware, which are based on the industry's leading virtualisation platform, lead to greater flexibility because the business infrastructure is simplified. This results in a more dynamic and flexible datacenter.

vSphere is a virtualisation layer (called ESXi) that is also available as a free downloadable version ("ESXi Standalone"). Different editions are available with different ranges of functions, both for smaller, medium-sized and large businesses. Management is provided by the vCenter, which is available in two editions.
Within the vShape Solutions we decided for the Essentials Plus edition, where vCenter Foundation is already included. If customers should have requirements towards advanced fault tolerance, they should go for the Enterprise or Enterprise Plus edition of vSphere.



Tables with a subset of the features which are particularly important to differentiate the various solutions

	vSphere Editions			
	Essentials Plus	Standard	Enterprise	Enterprise Plus
High availability	x	x	x	x
Data Recovery	x	x	x	x
VMotion	x	x	x	x
Fault Tolerance			x	x
vCenter Foundation included	x			

	vCenter Editions	
	Foundation	Standard
# managed nodes	Max. 3	unlimited

	Site Recovery Manager (SRM) Editions	
	Standard	Enterprise
# secured virtual machines	Max. 75	unlimited

VMware vSphere 5.1

- **Essentials Plus** offers a comprehensive solution for small offices in order to enable many application workloads to be consolidated and administered, this keeps initial investment low and reducing hardware and operating costs. In addition, it also offers a high level of application availability and data security in a complete solution.
- **Standard** offers fundamental consolidation of applications to reduce hardware costs and simultaneously speed up the provision of applications.
- **Enterprise** minimises downtimes, protects data and offers automated resource management.
- **Enterprise Plus** offers all the benefits of VMware vSphere and also transforms your IT infrastructure into the next generation of flexible, reliable IT services.

VMware vCenter Server

All solutions include a vCenter license; partly as an integral component of a product (e.g. Acceleration Kit or Essentials Plus) or explicitly ordered as an add-on. The vCenter is operated in the solutions as a VM. vCenter is part of the product pallet and enables a large number of features. This includes a unique pallet of virtualisation-based functions that make your virtual environment more responsive, more available and easier to maintain than a physical IT environment. When managing a virtualised IT environment of any size, you can use VMware vCenter to achieve maximum efficiency, automation, simplicity and security. vCenter enables you to provide virtual machines quickly and to monitor the performance of physical servers and virtual machines.

vCenter optimises resources in an intelligent way, ensures high levels of availability for all applications on virtual machines and makes your IT environment more responsive: this is thanks to virtualisation-based distributed services, such as VMware DRS, VMware High Availability (HA) and VMware VMotion. vCenter requires a Windows operating system and a database. The operating system used is Windows Server 2008 R2. With every vCenter license also a Microsoft SQL Server 2005 Express license is included. VMware supports up to 5 nodes with SQL Server 2005 Express. Always if you use more than 5 nodes at one vCenter you have to obtain an additional database or use a separate instance of an existing, vCenter supported database to operate vCenter.

SQL Server 2005 Express

As stated under the 'VMware vCenter Server' section, with every vCenter license a Microsoft SQL Server 2005 Express license is included which is sufficient for up to 5 nodes. That is why we have not configured a different SQL database. Note: Please be aware that if you extend the number of PRIMERGY servers and use more than 5 nodes, SQL Server 2005 Express is no longer sufficient for this purpose and the customer has to obtain an additional database license or use a separate instance of an existing, vCenter supported, database to operate vCenter.

vCenter Site Recovery Manager

The automation of recovery enables VMware vCenter Site Recovery Manager to avoid manual steps which are susceptible to error, and ensures that recovery procedures are executed as intended and in a consistent way. VMware vCenter Site Recovery Manager also simplifies uninterruptible tests on recovery plans within an isolated team environment, so that you can ensure that these are up-to-date and can be executed successfully. Moreover SRM also supports automatic fall back after the disaster is remedied. It is licensed per protected virtual machine and we use it within our XL configuration only. To use SRM it is mandatory to have a vCenter Standard license at all sites that run virtual machines which should be protected.

The key components of the vShape 50 Solution is listed below. The way these components interact dictates the functionality of the relevant configuration.

	vShape 50
Servers	PRIMERGY RX300S7 2 nodes 2 CPUs each
Storage Protocol	IP – 1 / 10 GbE
Storage System	NetApp FAS2240
Workloads	50 – 70 VMs Sized for 72 VMs
Virtualisation	VMware vSphere 5 Essentials plus

When creating the validated vShape Solutions, less attention was paid to pure performance, such as the mapping of as many virtual machines as possible. Instead, the focus was on needed functionality in relation to the actual business requirements. This offers an excellent overview of the interplay between the different components used in daily activities. The individually required number of virtual machines can be easily achieved by making minor adjustments of the configuration. Our vShape Solutions focus on performance and scalability and offer good data availability, automation and come with redundant components. Moreover, customers have not only the choice between vShape Solutions but also the flexibility to get a solution which fits to their actual needs. They can be expanded or adjusted without difficulty in order to cover the individual customer requirements.

Based on the validated vShape Solution of 50 virtual machines we have created two additional defined configurations for the following sizing's:

- A 25 VM configuration contains all components included in the 50VM vShape Solutions, but with half the capacity, half the server memory – but without trade-offs in redundancy.
- 100 VM configurations contain double the number of servers with the same amount of memory as the 50VM reference design plus an additional disk shelf with 24 disks.

Notes about the vShape Solutions

The following points are covered in the vShape Solutions and are not explicitly described or mentioned in this document.

- **Redundant server, storage and network components**
  All servers are equipped with redundant power supply units, fans, network adapters and/or host/bus adapters.
  All storage systems are equipped with redundant power supply units, controllers and hard disks (RAID DP).
  All network components of the LAN and SAN in the sample configurations are designed for redundancy. This applies to adapters, switches and controllers. The only exception is the management interface in the servers (iRMC).

- **iRMC included and ODD-drives excluded**
  All servers have an integrated remote management iRMC (integrated Remote Management Controller) in addition the solution includes the advance license which provides full video redirection and remote media. The servers do not contain any optical disk drive like DVD or Blu-Ray drives. These drives can optionally be added.

- **FC Multipath, LAN Teaming / Load balancing**
  Multipath software and virtual (LAN) switches are integral parts of ESXi. Teaming and load balancing are features of virtual switches.

- **ESXi Embedded**
  We chose the UFM-device option to save time during the setup of the configuration at the customer site.

- **Warranty, service and support**
  The solution comes with a 3 year 4 hour response warranty included.

- **User rights for operating systems and applications**
  Unless otherwise indicated, the sample configurations are generally configured without the operating system and without applications.

- **UPS**
  Customers have often already taken precautions or may wish to deal with the issue at a later point, so the sample configurations are designed without UPS (uninterruptible power supply).

We generally recommend that uninterruptible power supplies should be used. This will secure overall operations in the event of short-term power failures and, if normal power supply fails for a longer period, secure closedown of servers and the securing of data. If no precautions against a power failure have yet been taken, this topic should be included in conversations and the configuration can be expanded to include UPSs.

Background to the sizing used

Different methods for optimum sizing are described in another section at the end of this document. The background to the "guideline values" used in the defined configurations is explained below.

Guide Values

Various recommendations from different manufacturers exist, from virtualisation solutions for the average size of virtual machines. These are often theoretical considerations, some of which have also been optimised from a marketing perspective - the more VMs that can be operated the better. The following general parameters are based on our empirical values from numerous projects and a conservative analysis. If real-time analysis of resource requirements is not possible, the following reference virtual machine will help.

- **2/3** core per virtual machine
  The starting point is 2/3 core per virtual machine on up-to-date CPUs. For example: if it is assumed that Quadcore CPUs are used, 8 VMs share one CPU (socket), and each VM requires 1/8 CPU.
- **3.5 GB** main memory
- **159.5 GB** disk capacity (net) (dependent on system chosen)
- **150-160 IOPS**

The memory requirement of the hypervisor was ignored.

Disk Storage Requirements

A further 20% should be reserved for snapshots and the size of the main memory (swap area) should be taken into account. This means that each VM would have 130 GB of usable capacity. Calculated of 159.5 GB per VM (20% of 130 GB = 26 GB + 3.5 GB (main memory) + 130 GB (disk capacity, net)). We also assume that we shall provide enough disk space to enable ALL VMs to run on ALL nodes. The storage system should also provide the necessary resources in this case too.

IOPS

In addition to the space requirement, which generally is not a limiting criterion, the performance (IOPS) of the storage system must be taken into account. This always requires a load profile (your technical architect will request this to validate the final design). The following general rule of thumb applies in virtualised environments;

The more spindles (disks) there are and the faster these rotate, the better or more effective is the overall solution. Load profiles vary between customers, these sample configurations are based on an empirical value as a compromise.
All calculations are based on 2.5" SAS disks with 10k rpm because the IOPS deviates to an acceptable degree, the price is more attractive and the required storage space is smaller. 2.5" SAS disks have an output of approx 150 IOPS.
Nevertheless I is also be possible to use 3.5" SAS disks with 15k rpm for high IOPS requirements, but because of the more attractive pricing and less space requirement most customers use 2.5" SAS disks today.

IOPS v. disk storage

On the one hand, there must be sufficient disk-capacity, while on the other hand sufficient spindles must be available to cover the required IOPS. With the current disk sizes it always has to be figured out what the driving parameter is.
You will find the comparison-calculation to figure out the needed number of disks at each solution.
With the 25,100 and 200 vShape designs, 600GB 10K drives have been used to provide both capacity and IOPS. For the vShape 50 we configured 450GB 10K drives to ensure an acceptable capacity and IOPS yet still remain cost effective.

Spare disks

Two spare drives are provided per vShape System

RAID

RAID DP is used as the Raid level. The RAID level can be ignored in the IOPS analyses. The disk specification in IOPS already takes account of the RAID level.

Software

The vShape systems have been configured with NetApp full software bundle, this includes;
DATA ONTAP, Sync Mirror, SnapLock Compliance, SnapLock Enterprise, Snap Restore, Snap Mirror, Snap Vault, Flex Clone, Snap Drive for Unix and Snap Manager for; Exchange, SQL, SharePoint, Oracle, VI, SAP, Hyper V and SMBR

Protocols

The vShape systems have been licenses for the following protocols;
NFS, CIFS, iSCSI, FCP

Bandwidth

The capacity of a 1 Gb/s line is fully utilised with approx. 100 MB/s. 100 MB/s is approx. 80% of the maximum (theoretical) available bandwidth of 128 MB/s. If a VM would use transmits blocks of 64 KB size this would result in approx. 1600 IOPS (100 MB/s * 1024 / 64 KB = 1600 IOPS). Therefore there is no bottleneck on the available bandwidth expected, because usually the block size in virtual environments is less than 64 KB, which in turn provides an even higher IOPS rate. The similar procedure in calculation also applies to FC 8 Gb. The capacity of a FC 8 Gb line is fully utilised with approx. 800 MB/s. This takes us to approx. 12800 IOPS with transmits blocks of 64 KB size – as stated above with lower block sizes the IOPS rate would be even higher.

These conservatively determined empirical values cannot replace customer-specific planning and the resulting adaptation of the configuration!

4. Configuration Details

Positioning

vShape is tailored towards customers who are taking an easy and pragmatic approach to virtualisation. Their main concern is the effort and complexity associated with setting up virtualised IT environments. Practice shows that many customers provide their own Ethernet infrastructure or have already set up most of it - this applies both to switches and wiring. Our vShape Solutions focus on performance and scalability and offer good data availability, automation as well as component redundancy.

Selected infrastructure components

PRIMERGY RX servers

The PRIMERGY rack server generation provides best-in-class energy efficiency levels and delivers up to 73% more performance per watt compared to the previous generation. Together with the new modular concept, the excellent expandability of up to 768GB RAM and the outstanding performance of the Intel® Xeon® E5-2600 product family make the RX S7 generation an efficient and powerful foundation for virtualisation.

Fujitsu PRIMERGY RX200 or RX300 S7 Dual-Socket Rack Servers

- Designed for virtualisation: optimal balance of processor performance, memory and I/O capabilities
- Always in top positions of VMware benchmarks
- Two of the world's most energy-efficient rack servers leading to a lower TCO

NetApp FAS storage systems

NetApp FAS provides a high-performance unified storage platform that slashes capacity use with built-in de-duplication and thin provisioning as well as space-efficient backup and cloning. NetApp systems enhance operational efficiency with automated storage management, data protection, and security plus optimised performance with 10GbE. NetApp delivers highly flexible storage for virtualised environments, a key component for consolidating and optimising IT infrastructure.

NetApp FAS2220 or FAS2240 storage systems

- Unified 10 GE fabric across storage, computing and networking resources can be achieved
- Scalable cost effective performance and capacity of up to 374 TB
- Use 50% less storage in virtual server environments

Brocade switches

Brocade's Ethernet switches are included in the vShape solution, providing leading switching technology with simplified management via Brocade Network Advisor (BNA). Brocade's Ethernet switch provides wire-speed and non-blocking 1 GbE, provide best-in-class power efficiency, leading to a lower TCO.

Brocade FastIron WS648G

- Offers 48 ports with 1 GbE for connectivity
- Multilevel access security with IronShield Advanced

5. Sizing

The sample Storage configuration is based on the following key values:

	vShape 25	vShape 50	vShape 100	vShape 200
Total Marketed RAW	7.2	10.8	20.8	57.6
Total Storage per vShape	3.85	6.46	19.23	40.37
Storage Per VM	154GB	130GB	192GB	200GB
Total IOPS per vShape	3750	8000	16000	30000
IOPS per VM	150	160	160	150

These figures represent the basic systems configured for a single part number in Fujitsu's System Architect. If modelling is required or capacity requirements change these can be amended.
IOPS Figures have been provided by NetApp using the following assumptions; NFS protocol used 60% Random, 65% Read

Migration of physical systems

After the solution has been installed, the 'old' physical world must be adapted/converted to the new virtual world, enabling it to be put to productive use. A variety of aids are available for this. The following are recommended:

- VMware Converter
- Novell PlateSpin Migrate

It is possible to generate the 'new' virtual machine while the 'old' server is still running; this results in a very easy switch from physical to virtual: just shut down the old server and start the new virtual machine which contains all tasks and settings.

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