FUJITSU

Desktop Virtualization with Citrix

Desktop virtualization has initiated intensive discussion concerning the best methods for delivery and management of IT workplaces. Many organizations have taken advantage of virtualization technologies in their data centers and naturally consider the advantages that virtualization could bring to the desktop environment, too. Citrix is the leader in server-based computing and a pioneer in the virtualization of applications and desktops. Fujitsu is known for best-in-class infrastructure products and services across all project and lifecycle phases. Based on market leading virtualization technology from Citrix, Fujitsu offers end-to-end desktop virtualization solutions, designed to assist customers in improving service quality whilst reducing cost and delivering a great end user experience at the user's device.

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Challenges with the operation of IT workplace infrastructures

IT manager are exposed to various requirements which are difficult to balance. Executive management wants IT to be flexible in order to respond quickly and effectively to ever changing business needs. Budget managers are looking for more efficiency. This includes lower costs and minimized risks. And of course, the end users demand systems that are easy to use and always work, which is the absolute prerequisite for high end user productivity and satisfaction.

But how does reality look like? Lifecycle management of IT workplaces has proved to become increasingly complex. The deployment of new PC workplaces including the preparation of images for various platforms and the application compatibility tests to identify application conflicts may end up in a cumbersome and time-consuming task. PC hardware is distributed across the enterprise; there are more and more remote and mobile users who are not always connected to the network, but still require software updates and patches on a regular basis. Besides, protection of applications and data from loss and theft according to the company's security policy, end user support and recovery from failure are on the IT manager's agenda. Due to the short lifecycles of hardware and software, the activities involved in a refresh recur quite frequently. All these management tasks cause high efforts and costs.

Based on calculations from customer environments, analysts show that on average companies spend 4 times more on PC operation and management than on the purchase of a PC. The analysts also state, that by optimizing the workplace infrastructure and its management, the operating costs can be reduced by 40% or even more.

Virtual Client Computing

How can organizations manage desktops more efficiently? How can company data on desktops and notebooks be protected from theft and loss? Which solution is ideally suited to be implemented in remote offices? Are there any alternatives for traditional PC architectures? These are typical questions expressed by organizations seeking to provide optimized client infrastructures.

Virtual client computing represents the approach answering these questions. By breaking the tight coupling between the components that make a PC, such as hardware, operating system, applications and user personality, management can be simplified tremendously. Managing single instances of components instead of many unique monolithic desktops reduces complexity, accelerates deployment, updates and patches, improves service quality, increases business continuity and finally reduces costs.

Virtualization makes the components and their lifecycles independent from each other, and thus expands the individual lifecycles, too.
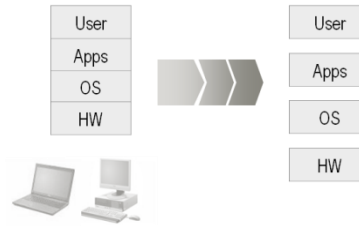
Depending on where virtualization happens, we speak of user virtualization, application virtualization, operating system image virtualization or device virtualization. In combination they enable a dynamic and fast assembly of IT workplaces on demand, be it for new users or with recovery after failure.

Workplace delivery options

Separating workplace components from the user's device enables you to move these components into the data center and access them flexibly from any device.

This is exactly what Citrix promoted already in the 1990s with the first wave of server-based computing. This concept is realized by the Citrix XenApp technology, and is also denoted as **Hosted Shared Desktop.** It provides a locked down, streamlined and standardized environment with a core set of applications, ideally suited for task workers where personalization is not needed or allowed.

Analysts state that more than 90% of Fortune 1,000 companies have successfully deployed server-based computing, but they use it only across less than 10% of their installed desktops. This underlines the restrictions of this concept, which are mainly the multi-user capability of the applications and the limited level of personality. The **Hosted Virtual Desktop,** also known as **Virtual Desktop Infrastructure (VDI),** offers a personalized desktop, typically needed by office or knowledge workers. VDI is in principle identical with server virtualization, with the difference that instead of a server operating system a desktop operating system like Windows XP or Windows 7 runs in the virtual machine. In addition to a hypervisor and the virtualization management known from server virtualization, a connection broker is needed, that amongst others, manages the connection between the virtual desktops and the access device of the requesting end user.

Hosted Virtual Desktops can be dedicated or permanently assigned to the respective end users have who then have full control to customize them to suit their needs. Any change by the user is stored within the assigned virtual desktop, and will have a permanent effect

In order to save datacenter resources and cost, a pool of virtual desktops can be created whose size is equal to the maximum number of simultaneously active users. At logon time, an available virtual desktop from the pool will be selected, supplied with a standard image, allocated to the end user and personalized. At logoff, the virtual desktop will be returned to the pool again.
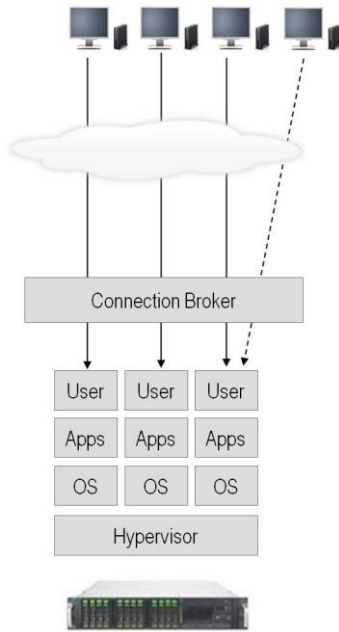
Especially to meet the demands of power users, physical workstations can be moved into the data center, instead of using virtual desktops. In this case we speak of the concept of the **Central Hosted Desktop**.

In contrast to this, the **Local Streamed Desktop** leverages the local processing power of rich clients, while providing centralized single-image management of the desktop. At the beginning of your desktop session, the entire image will be streamed to the local device and run on it, i.e. the desktop boots from the central image. These types of desktops are often used in computer labs and training facilities, and when users require local processing for certain applications or peripherals.

The concept of the **Local Virtual Desktop** enables mobile users to be involved in a centralized management. It delivers one or more centrally managed desktop images to physical endpoint devices allowing the user operate them also disconnected from the network.

With these workplace delivery options, you will always find the optimum solution for each type of user and his requirements.

Virtualization from Citrix - the market leader in server-based computing and desktop delivery

As the leader in server-based computing and the pioneer in the virtualization of applications and desktops, Citrix offers the most comprehensive and mature portfolio covering all delivery options for desktops and applications. Subsequently, we are going to take a more detailed look at the most relevant Citrix products and technologies.

Citrix XenServer

XenServer is a complete virtual infrastructure solution that includes a 64-bit hypervisor with live migration, full management console, automation capabilities and the tools needed to move applications, desktops, and servers from a physical to a virtual environment. Based on the open-source design of Xen, XenServer is a highly reliable, available, and secure virtualization platform that provides near native application performance and unmatched virtual machine density.

XenServer with base functionality is offered free of charge to any user for unlimited production deployment. There are premium editions available that extend XenServer base functionality especially in the area of manageability, high availability and flexibility.

The hypervisor was originally developed at Cambridge University and initially available under the rules of the open source community. XenSource, a company founded by developers of that university, then took charge of further development. Citrix acquired XenSource in 2008 and has since then marketed it under the name of XenServer.

In the last couple of years, XenServer has gained market momentum and is recognized as a mature platform for business-critical applications. The integration with other Citrix products makes it the hypervisor of choice for Citrix-based desktop virtualization solutions. As Citrix owns the source code, XenServer can be optimally aligned with other Citrix products. It is worth mentioning that XenServer was positioned by Gartner. in the leaders quadrant of the "2011 Magic Quadrant for x86 Server Virtualization Infrastructure" report.

ICA (Independent Computing Architecture) Protocol – A bit of history

One of Citrix's success factors with server-based computing in the past was the ICA (Independent Computing Architecture) Protocol, which consists of server- and client-side technology that allows graphical user interfaces to be transmitted securely over any network, and displayed on almost any client device. ICA allows applications and desktops to run on a central server enabling centralized management of applications, desktops, end-users, servers, licenses and other system components for greater efficiency and lower cost. ICA enhances information security by minimizing or eliminating data from traveling across the network by sending and receiving encrypted representation of screen pixels, keystrokes and mouse clicks. ICA is uniquely designed to consume minimal network bandwidth and resist to network latency, which allows virtual desktops and applications to be used over LANs, WANs, WiFi and 3G connections.

HDX (High Definition User Experience)

HDX leverages the ICA protocol and is a family of innovative technologies that optimize the end-to-end user experience in virtual desktop and virtual application environments.

HDX Broadcast ensures high-performance of virtual desktops and applications over any network, including high-latency and low-bandwidth environments. **HDX IntelliCache** optimizes performance by caching bandwidth intensive data and graphics and delivering them from the most efficient location. **HDX MediaStream** accelerates multimedia performance by sending compressed streams to endpoints and playing them locally. **HDX RealTime** enhances real-time voice and video using advanced encoding and streaming to ensure a no compromise end-user experience. **HDX 3D** optimizes the performance of everything from graphics-intensive 2D environments to advanced 3D geospatial applications using software and hardware based rendering in the datacenter and on the device. **HDX Plug-n-Play** enables simple connectivity for all local devices in a virtualized environment, including USB, multi-monitor, printers and peripherals.

The Adaptive Orchestration function dynamically adjusts HDX capabilities to adapt to specific device, network and application scenarios for an optimal user experience.

Citrix XenApp

XenApp is an on-demand application delivery solution that enables any Windows application to be virtualized, centralized, and managed in the datacenter and instantly delivered to users anywhere on any device. XenApp delivers applications in two ways, hosted and streamed.

Hosted applications run on a central server using HDX technologies to securely transmit the application's user experience to the endpoint device. The application streaming function enables XenApp to deliver virtual applications to client devices, where they run locally in an isolated sandbox environment. Moreover, this enables you to run even incompatible applications causing application conflicts on the same device.

XenApp is used by over 100 million users worldwide.

Citrix XenDesktop

Analysts state that more than 90% of Fortune 1,000 companies have successfully deployed server-based computing, the great majority certainly using, Citrix XenApp, but they use it across less than 10% of their installed desktops. Citrix XenDesktop will address the remaining 90% of the desktops in these companies. XenDesktop is a fully integrated desktop virtualization system that that delivers Windows desktops as an on-demand service to any type of user and any type of device. This is achieved by Flexcast, a unique delivery technology, which basically supports any workplace delivery option, such as Hosted Shared Desktop, Hosted Virtual Desktop, Hosted Central Desktop, Local Virtual Desktop, and Local Streamed Desktop. Virtual desktops can be hosted in the datacenter or run locally at the endpoint, wherever costs, security or mobility is optimal. FlexCast technology dramatically improves customers' return on their investment and makes desktop virtualization a practical reality for broad, enterprise-wide deployments.

The Desktop Delivery Controller (DDC) is the connection broker within XenDesktop. It looks after user authentication and connects users to their virtual desktops, hosted applications, or even physical workstations in the data center.

Due to the integrated Provisioning Services, XenApp functions and the Profile Manager, IT can manage single instances of operating systems, applications and user profiles to greatly simplify desktop management.

Due to its open architecture, XenDesktop works with various hypervisors, such as XenServer, Microsoft Hyper-V and VMware vSphere, and with a multitude of storage systems. XenDesktop does also closely integrate with Microsoft App-V and System Center for application management.

With technologies like IntelliCache as part of XenServer, Citrix further demonstrates high optimization of their own XenServer hypervisor for XenDesktop. IntelliCache is an emerging technology that can reduce storage I/O utilization for virtual desktops by up to 95%

The close collaboration with Microsoft makes XenDesktop an attractive supplement in Microsoft-based infrastructure environments. Even Microsoft recommends XenDesktop as the desktop virtualization solution for the enterprise.

The fact that basically any type of access device can be used opens up more choice for the end user device. Thus, even the trend of employee-owned devices is supported without compromising security.

There are organizations encouraging their employees to purchase their own device, which will then be also used for private purposes. Such a concept not only increases the motivation of employees in using computer technology; typically the user handles a "private" device with more care, so that outages of such devices are reduced.

Citrix Receiver

Citrix Receiver the client side of XenApp and XenDesktop. It is available as a free download from citrix.com supporting numerous types of client devices, amongst others even iPhone, iPad, Android devices, and of course any Windows, Linux and web platform. Citrix Receiver uses the Citrix HDX technologies to communicate with XenApp and XenDesktop. Furthermore it integrates with 3rd party solutions, such as Microsoft App-V for instance.
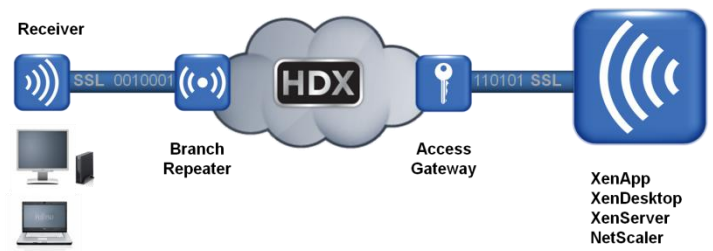
Citrix XenClient

Users, who are not connected to the data center, can only be involved in a virtual desktop infrastructure concept, if their virtual desktop can be made available on their mobile working device for offline usage.

Citrix XenClient is a high-performance bare-metal client hypervisor that enables mobile users to run their virtual environment directly on a client device hardware, e.g. a notebook, dividing up the resources of the machine and enabling multiple operating systems to run side by side in complete isolation.

While working, no connection to the data center is necessary. Thus the user can continue working while he is offline. Once connected with the data center, again collected changes are synchronized back to the virtual desktop in the data center while updates and patches become effective on the client device.

The encryption of the virtual disk on the local storage device, restricting the use of the local virtual desktop to specified time periods, and other policies for the offline operation ensure that "offline" virtual desktops do not compromise the company's security policies.

XenClient is part of the XenDesktop license. A free version XenClient is available as a download on citrix.com.

Citrix NetScaler

Citrix NetScaler is an all-in-one Web application delivery controller that makes applications run five times faster by application accelerator methods such as HTTP compression and caching, ensuring application availability through advanced L4-7 load balancer and content switching methods, increasing application security with an integrated application firewall and substantially lowering costs by offloading servers for server consolidation. It optimizes the user experience and makes sure that applications are always available. NetScaler is deployed in front of web servers as a physical network device or virtualized appliance.

Citrix Branch Repeater

The Citrix Branch Repeater delivers applications at a local area network-like performance over the wide area network to branch office and home office users. This is achieved by local caching and de-duplication across multiple XenDesktop or XenApp user sessions and local staging of XenApp streamed applications.

Branch Repeater is available as both a physical and a virtual appliance.

Citrix Access Gateway

Citrix Access Gateway is an SSL / VPN that securely delivers applications with policy-based access control. Thus, organizations can cost effectively extend access to datacenter resources from outside the office.

When a user attempts to connect to corporate resources, Access Gateway collects and verifies information including client device configuration, user identity, and network location to ensure compliance with security policies and to optimize the user experience. Access Gateway establishes an encrypted connection between the client and datacenter to ensure desktops, applications, e-mail, and other resources are securely accessed from anywhere.

Access Gateway also works with Branch Repeater to accelerate each connection and deliver a high-performance experience. Once a session is established, information collected about the connecting device, user, and location dynamically adapts the level of access and available actions. This ensures that the data needed is delivered to users in the most secure manner according to their particular access scenarios.

Access Gateway monitors active connections in real time to detect when a user roams between networks or moves between devices. When this occurs, Access Gateway transparently reconnects the session and dynamically adapts access and available actions to ensure security as the user's access scenario changes.

Citrix XenDesktop editions and licensing

XenDesktop is available in several editions. The Express Edition is offered as a free download to allow IT professionals to conduct no-cost trials. The VDI Edition is designed for virtual desktop projects that only require the hosted virtual machine method of desktop delivery. The Enterprise and Platinum Editions include all our major virtual desktop delivery models in one integrated package, and also the capabilities of Citrix XenApp for delivering on-demand applications into virtual or physical desktops.

Each edition comes with user profile management and provisioning services to stream a single desktop image, on-demand, to multiple servers in the datacenter. All editions feature licensing for both Citrix XenServer and Microsoft Hyper-V virtualization infrastructure.

The subsequent table shows the functions included in the individual editions:

Product Components	Platinum	Enterprise	VDI	Express
Desktop Delivery Controller	✓	✓	✓	✓*
XenServer	✓	✓	✓	✓
XenServer Enterprise	✓	✓	✓	
Provisioning Services	✓	✓	✓***	
StorageLink	✓	✓	✓	
Workflow Studio	✓	✓	✓	
Profile Management	✓	✓	✓	
XenClient	✓	✓		
XenApp Enterprise		✓		
XenApp Platinum	✓			
HDX WAN Optimization	✓			
EdgeSight for Virtual Desktops	✓			
Access Gateway Universal license	✓	**	**	
Single sign-on	✓			

*   Limited to 10 virtual desktops
**   Access Gateway platform licenses included in every Access Gateway appliance provide secure remote access for VDI and Enterprise editions
***   Supports provisioning hosted virtual desktops and virtual servers on server systems that are part of the Citrix-provided XenDesktop deployment

The licensing model of XenDesktop is rather flexible. Customers have the choice between user-based, device-based, and concurrent user licenses. The user-based model enables the licensed user to access any desktop environment from an unlimited number of devices. This is in particular attractive for users who alternately use their business PC, their home PC or any other device while being on the move. The device-based model enables any user and any number of users to access any desktop environment from a licensed device. This model is especially attractive for access devices in travel agencies, banks or training centers which are used alternately by a large plenty of people.

In addition to the user-based and device-based license model, all editions can also be licensed on a concurrent user basis.

Licenses can be re-assigned after a period of 90 days. The re-assignment option also allows automatic switching from device-based to user-based licenses and vice versa.

The perpetual licenses are combined at the initial purchase with a Subscription Advantage for 1 (optionally also 2 or 3 years) which is good for all software updates and upgrades during the validity timeframe, and after the initial period, members are encouraged to renew their membership for another year in order to continue receiving all of the benefits of the program.

Infrastructure products from Fujitsu –
The sound basis for Citrix virtualization software

Desktop virtualization solutions not only require virtualization software, they require also infrastructure products at the front-end and in the data center. Fujitsu has a long track record in providing robust servers and storage systems which have proven in innumerous virtualization projects. The same is basically true for the front-end. Fujitsu's portfolio comprises particular access devices for virtual workplace infrastructures, such as stationary and mobile thin clients, as well as ultra-thin and Smart Zero Clients. And in those cases where rich clients, such as notebooks, tablets, desktop products or workstations are needed, Fujitsu can also help.

Fujitsu PRIMERGY – Ideal server platform for desktop virtualization

Fujitsu PRIMERGY servers convince through their rock-solid reliability, independently proven leading price performance and energy-efficiency, and are thus also the ideal platform for virtual client computing. They are based on latest industry standard Intel processor technology and fully supported by Intel's enhanced virtualization feature set, boosting virtualization software and application performance.

Whatever industry you're in, and whatever your operational requirements are, there is a Fujitsu PRIMERGY server solution that fits your needs. The PRIMERGY product line includes blade systems, cloud servers, rack-mountable servers and stand-alone tower servers. Thus customers can choose the most adequate system for their specific use case. The broad range includes products from one up to eight processors with up to 10 cores per CPU.

CPU performance is a good foundation for an efficient operation. But it is always important that main memory size and I/O throughput are aligned to it. This applies absolutely to Fujitsu PRIMERGY servers. They feature a maximum memory capacity of up to 4 TB. Highest processor performance is only useful in combination with tailored I/O throughput. For this demands Fujitsu offers a wide range of different connection possibilities to address current and next-generation I/O requirements for standards-based Ethernet, Fibre Channel and InfiniBand networks.

As a result, in a virtual desktop infrastructure, you achieve a very high ratio of virtual desktop machines per server.

The market-leading overall performance of Fujitsu PRIMERGY servers has been regularly confirmed for many years by top results in the most important system performance benchmarks.

Lowest MTBF figures of the individual components, the redundancy of all components and the hot-plug capability of the most important components contribute to high reliability and systems availability. Availability is increased even more due to the holistic server management which also eases administration.

A particular feature of Fujitsu's **ServerView Suite** for the management of physical and virtual server infrastructures is the ServerView Power Management, which provides a real customer benefit with virtual desktop infrastructures. As a rule, virtual desktop users are not active 24 hours a day, because they need some sleep. If the infrastructure solution does not cover several time zones, utilization will decline. This is the moment, when ServerView Power Management engages in order to maximally increase your energy efficiency by throttling or switching of power consuming components.

The energy efficiency throughout the entire family disburdens cooling in the data center. The proven Cool-safe™ technology ensures that up to 25% more air can be "inhaled" than in comparable products. This reduces the risk associated with heat failures and doubles the lifetime of electronically components

PRIMERGY servers are rigorously tested with XenServer and certified for its latest version.

Citrix XenServer is perfectly integrated with ServerView, Fujitsu's management suite for PRIMERGY servers. For this purpose special agents for XenServer were developed, which are steadily maintained with full quality assurance. Due to these agents, all server management functions are also available in a XenServer environment.

Unified management of physical and virtual environments

Hypervisor based virtualization software today is able to control everything in a fully virtualized environment. But sometimes not everything is virtualized in a datacenter. For this use case, Fujitsu provides the ServerView Resource Orchestrator Virtual Edition (ROR VE) for the easy management of mixed environments consisting of physical and virtualized servers, taking of course also Citrix XenServer into consideration.

Fujitsu ETERNUS DX –The flexible data safe

Basically, virtual desktops are files which reside on an online storage system, which need to be always rapidly available. Therefore the storage system has to provide highest performance enabling fast I/O transfers even for a larger number of virtual desktops, and to ensure highest levels of data integrity and availability. Fujitsu ETERNUS DX online storage systems perfectly meet these requirements.

ETERNUS DX is designed as a highly reliable mainframe class system with built-in high availability. All main components are redundant, hot-pluggable and hot-swappable, firmware can be updated without stopping operations, data paths are redundant, and all relevant RAID levels are supported, giving you even the flexibility to find the right balance between the level of data safety, access speed and cost.

In addition to RAID, redundant data copies can be generated within the same storage system. Thus a failed disk drive can be rebuilt much faster compared to the lengthy rebuild from a RAID configuration. The longer it takes to rebuild a failed disk, the greater is the risk that another disk will fail during recovery. Data replication can also be a means to accelerate the parallel access to the same data (e.g. the master image or virtual application instances) by many virtual desktop users.

In order to protect data against disasters, data can also be replicated to multiple sites, even with different Fujitsu ETERNUS DX models. With distances up to 100 km, mirroring can happen synchronously at reasonable cost; asynchronous data replication can be applied to global distances between the sites over a wide area network.

For performance reasons, online storage systems are equipped with ever-increasing cache systems, whose volatile content often means a risk of data loss. The Cache Protector function ensures that data in the caches is written to a non-volatile flash memory after power outage and safely stored there, no matter how long the power outage lasts.

Fujitsu ETERNUS DX can be expanded up to 1000s of TB, i.e. basically any number of virtual desktops in real-life projects can be stored. It is extremely important for us, that I/O performance can keep pace with the large data capacities of. This is taken into account with the number of host connections and by using I/O controllers providing the highest speed in the market. For years, Fujitsu ETERNUS DX systems have held the top ranking in the SPC-1 benchmark of the Storage Performance Council, as far as IOPS performance and price performance ratio ($ / IOPS) is concerned.

If besides high availability and performance, flexibility and efficiency are of relevance for you, Fujitsu ETERNUS DX will be the right answer for you, too.

SAS and Nearline SAS hard disk drives as well as Enterprise SSD drives are supported, even mixed in one enclosure. Thus, you can select the medium suiting best to your particular requirements, be it speed, access time, lifespan, or cost. SSD drives might be a perfect fit for master images with highest IOPS demands, in order to avoid the well-known boot storms. Besides high performance, SSD drives stand out due to extremely low power consumption, long lifetime and high MTBF values, because there are no moving parts. For the virtual disks and the user data, SAS disks are the more cost-effective alternative. Especially for backup and archiving purposes, Nearline SAS is recommended.

RAID migration allows moving logical volumes dynamically between different RAID groups and drives without interrupting operations. Thus data can be easily moved to the most appropriate RAID level depending on access frequency, importance and cost aspects. This can even happen automated according to previously defined rules and threshold monitoring. Hence, Fujitsu ETERNUS DX represents an automated tiered storage solution in a box.

Due to the support of Fiber Channel (FC), iSCSI and Fiber Channel over Ethernet (FCoE) which combines the advantages of Fiber Channel and Ethernet, you have also the choice, as far as connectivity is concerned.

Let us now discuss some aspects which underline efficiency of Fujitsu ETERNUS DX. With its modular architecture, ETERNUS DX is designed for scalability and prepared for storage growth. You may start with an entry level system, and by adding resources you will end up with a midrange or even high-end system. When upgrading to a larger system model, all what is required is an update of the system controller. Hard disks and data, or even complete disk shelves, can be retained if so desired. This means investment protection for any customer.

Using storage virtualization technologies, such as Thin Provisioning, storage utilization can be optimized. You define the logical capacities, e.g. of the virtual disks of your virtual desktops, covering already future requirements, whilst the physical capacity in total only has to match current requirements.

In order to reduce the size of data copies for backup, snapshots can be generated. Data will only be replicated before being updated. Another benefit of snapshots is the fast restore process.

MAID (Massive Array of Idle Disks), a technology designed for "Write Once, Read Occasionally" (e.g. backup disks) takes care of less frequently used disks being shut down. This reduces power consumption and heat dissipation. Another contribution to less energy consumption is the 2.5" disks which, except to this, also allow greater capacities at less space requirements.

Finally, Fujitsu ETERNUS DX is easy to manage. This is the merit of Fujitsu ETERNUS SF, a management suite for the entire Fujitsu ETERNUS DX family, from entry-level to enterprise-level systems. This also means: if you know one model, you will basically know the whole family.

The models are of course certified and compatible with Citrix XenServer.

The access to Fujitsu ETERNUS DX is block protocol based. In combination with NetApp V-Series, Fujitsu ETERNUS DX turns into a unified storage system additionally supporting file protocol based access. Furthermore, all software functions which are implemented on NetApp storage systems, e.g. data de-duplication or the transparent failover in the event of a disaster are then usable on Fujitsu ETERNUS DX, too.

Flash memory optimizes VDI performance and storage

While the I/O load for an average user is typically 5 to 8 I/Os per second (IOPS), peak loads can range from 20 to 100 IOPS or even more. With hundreds of users on centralized storage, even a small percentage near peak load can impact performance. To keep performance high during peak I/O load times, such as login in the morning, logoff in the evening, antivirus checks or image patching, the storage system should be able to handle the peak load for all users at the same time while producing little to no negative performance effects for users.

Therefore it can be very useful to separate VDI storage from other enterprise storage and use flash instead of hard disks. A dedicated flash memory array offers a very high (6- to 7-digit) number of IOPS with low latency, and thus solves the storage I/O issue. Storing the desktop images, respectively the master image and its clones, as well as the paging files of the virtual desktops on this flash memory array, provides consistent performance, even under heavy load.

If a single flash memory array is not sufficient, just add another one – there won't be a limit in terms of scalability.

Fujitsu uses Flash Memory Array technology from its partner Violin. In order to ensure long-term data integrity and retention, and prevent any single point of failure from causing data loss, RAID is implemented across flash modules, not just within a module. Another highlight is the distributed garbage collection implemented in hardware – the reason why the write performance is some 40 times higher compared to most solid-state devices.

The subsequent real-life example shows what can be saved in a 10,000 virtual desktops deployment.

	Traditional storage	All Flash Memory	Reduction
Rack Space [HU]	299	12	95,99%
Racks	7,1	0,29	95,92%
# disks (HDD or SSD)	950	0	
Capacity [TB]	521	64	87,72%
Power [kW / year]	411,861	68,538	83,36%
Carbon [Tons / year]	177,18	29,47	83,37%

Fujitsu ETERNUS CS – The outstanding data protection appliance

In addition to making your virtual client computing environment rapidly and anytime available, a basic requirement is the protection of the virtual desktops including the data of the end users. There are still organizations in which various islands of backup solutions for various applications, and where dedicated solutions are used for long-term archiving in parallel, which makes the management of data protection extremely complex, difficult and expensive. Adding dedicated solutions for virtual client computing would make the situation even worse.

This brings Fujitsu's virtual tape appliance ETERNUS CS into the game, which represents a virtualization layer between the server world and the storage world, and can be used for any backup / restore and any long-term archiving purpose. Servers write data rapidly to the hard disks of the Fujitsu ETERNUS CS. Organizations always have the option to decide, whether the data will remain on the disks, whether it is written to one or several tape libraries, or whether it should even reside on disks and tape in parallel. This will keep the speed of backup and restore in balance with the costs of media, and support flexible service level agreements. Having once written the data to the hard disks of the Fujitsu ETERNUS CS, the ETERNUS CS appliance automatically looks after the entire information lifecycle management.

Except to industry standard servers, which will most frequently be used for virtual client computing environments, Fujitsu ETERNUS CS supports UNIX systems and mainframes. Due to universal tape interfaces, Fujitsu ETERNUS CS is compatible with all market-leading libraries. As a result, Fujitsu ETERNUS CS is a single solution for any heterogeneous environment. This simplifies management and reduces operational costs.

Moreover, it works seamlessly together with data protection software products from the leading market players, such as Fujitsu's partners Symantec and CommVault and many more. Thus it can be easily integrated into existing data protection environments, which means maximum investment protection for the customer.

And finally, the appliance approach accelerates deployment while reducing maintenance and operational effort.

Fujitsu FUTRO Thin Clients for server-based computing and virtual desktop infrastructures

Thin clients are the typical access device for traditional server-based computing and virtual desktop infrastructures. They feature high security, high system stability, extremely low energy consumption, simple management, long lifecycles, and correspondingly minimized costs.

Fujitsu's FUTRO thin client product line includes various models to meet different requirements. These models are all certified for Citrix XenDesktop. Likewise, all models feature the backpack solution, meaning the thin client can be mounted behind the screen, reducing the need for cables and space. This modular approach plays to the fact that the lifecycles of the thin client device and the screen are different.

Fujitsu FUTRO thin clients are high quality products manufactured in the heart of Europe with mainboard developed by Fujitsu itself. Their compliance to EPEAT and Energy Star 5.0 makes FUTRO thin clients a green IT product. Integrated PCI basically gives you the flexibility to attach any peripheral device, without the need to install additional PCI extension boxes. An integrated smart card reader combines security with ease of use. Power-over-Ethernet supports you in using only one cable for both, electric power and connection to the network.

Furthermore, if there is anything specific a customer needs, be it pre-installations of customer-specific images, be it laser marking on the devices, or be it anything else: Fujitsu's customizing program made4you is the answer.

If you need more performance and flexibility than a classical thin client can offer, a powerful Fujitsu ESPRIMO desktop PC can be configured to customer needs. A thin client upgrade kit turns the ESPRIMO into a thin client with all its advantages. The upgrade kit can also be useful when migrating from a distributed PC infrastructure to server-based computing or VDI. Thus, customers expand the lifecycle of their former PCs.

And if mobile thin client usage is required, the thin client upgrade kit will also help. Just use it in a Fujitsu LIFEBOOK, Fujitsu's notebook product line, and you have got your mobile thin client.

The operating systems offered for Fujitsu FUTRO are eLux (an embedded Linux derivative especially designed for thin clients), Windows Embedded CE and Windows Embedded Standard.

Especially in the area of system management, Fujitsu FUTRO solutions from Fujitsu feature a clear differentiator. SCOUT Enterprise management software enables an easy preparation, change or adjustment of local images from a central console. After plugging the thin client to the corporate network, it will be deployed automatically. So a fully automated rollout is possible with no action required onsite.

A much beloved detail is worth mentioning, this is the inheritance of licenses. Customers purchase a license once for a certain device. But when once this device is replaced, the license will be transferred to the new one. This license model is true for SCOUT and for eLux. SCOUT is for sure the perfect management tool for Fujitsu FUTRO thin clients with eLux, but can be used for Windows CE and Windows Embedded Standard, too.

Fujitsu FUTRO ultra-thin and Smart Zero Clients for dedicated use cases

A Fujitsu FUTRO Thin Client can be configured for any use case. No matter, if devices for remote access in desktop virtualization environments, UNIX terminals, SAP terminals, web terminals or terminals for any proprietary computer system are needed, Fujitsu FUTRO Thin Clients are the right choice.

If the use case of a Fujitsu FUTRO thin client changes during its lifecycle, you just reconfigure the device using the SCOUT management tool, and it can immediately be used for another purpose. This flexibility means investment protection and further cost savings at the end of the day.

However, if there is only a single use case for thin clients in an organization, the flexible usage option of the thin client will not be needed. A device without embedded operating system whose flash just incorporates the protocol required for the communication with the central infrastructure, for instance HDX, would be sufficient.

Such devices are denoted as Ultra-Thin Clients. As the management of these devices is limited to firmware updates and therefore close to zero, some vendors call this type of device a Zero Client or Smart Zero Client.

The Fujitsu FUTRO product family includes ultra-thin clients / Smart Zero Clients for dedicated use in Citrix environments with hardware-based protocol acceleration. An outstanding feature is the easy upgrade option to fully managed thin clients.

Services and support for Virtual Client Computing

A desktop virtualization solution includes servers and virtualization software, storage systems, network components and access devices, possibly even various types of them. Selecting the right technologies according to business requirements and economic aspects, an optimum design and sizing of the future infrastructure, its implementation and the migration from the existing world into the new one, is a huge challenge for the customer. Uncertain project duration and a multitude of risks can be the consequence.

Fujitsu's approach is concerned with taking out the complexity, reducing the customer's work effort, and reducing the overall risk in putting all the pieces together, with the goal of making things simple and helping customers overcome the many hurdles in realizing a successful solution. Exactly this is reflected in Fujitsu's virtual client computing service offering across all project and lifecycle phases.

Workplace Assessment

Before thinking deeper about virtual client computing, organizations should know the status of their existing IT workplace environment including hardware, software, as well as user types and user behavior. Understanding the current situation is essential to identify cost savings and performance improvements. These are the main objectives of a standardized Fujitsu service offering in the consulting phase, the Workplace Assessment.

Based on the results, Fujitsu will define jointly with the customer the workplace strategy, which optimally meets business requirements. Likewise, technologies are selected, which are ideally suited for specific objectives. This helps customers reduce complexity and the time required to evaluate various technologies, and thus accelerates decisions.

The Workplace Assessment is an effective consulting package making use of standardized methods based on Fujitsu's extensive project experience. As other OPTIMIZATION Services from Fujitsu, it is offered at an attractive fixed price, and requires only very low effort by the customer.

IT Investment Decision Support™

If the customer wants to go a step further and determine the ROI of a drafted infrastructure, Fujitsu will deliver an ROI analysis for IT investment decision support. This service is based on a proven methodology which has been successfully used in many infrastructure projects. Depending on the maturity level of the project, the financial impact is estimated or even bindingly predicted.

No project without a Proof-of-Concept (PoC)

Before designing an optimum future IT infrastructure, it is extremely important to exactly know the business needs and the business goals a customer wants to achieve. These key prerequisites are elaborated in a joint strategy workshop with the customer, either in conjunction with the Workplace Assessment or independent from it. Based on this information, business goals are aligned to technology goals, and the design criteria for the future infrastructure are formulated.

User experience is an essential element for a successful project, Therefore Fujitsu always recommends a proof-of-concept. It will show by means of a prototype installation, how the future solution will meet the requirements concerning necessary IT functions, user experience, ease of use, performance, availability etc. Thus the impact of new technical concepts can be better assessed, making difficult IT decisions easier.

Fujitsu supports its customers in designing the test infrastructure, and defining the test scenarios and the project plan for the proof-of-concept. Moreover, if required, Fujitsu delivers and installs the test infrastructure, supports the customer in executing the test plan and in documenting and analyzing the test results.

In a final workshop, the test results are presented and jointly discussed, and recommendations are derived. Next steps are agreed; usually this will end up in a project then with infrastructure design in detail, followed by implementation and migration.

Migration support

Migrating personal settings to a new system can be time consuming and annoying. Therefore Fujitsu developed a tool, which migrates your personal settings and deleting the data on the hard disk drive is just a matter of a few clicks: DeskView Advanced Migration.

Currently Windows XP, Windows Vista and Windows 7 are supported. It does not matter if you migrate from a physical device to another physical device (P2P), from a physical device to a virtual machine (P2V) or between different virtual environments (V2V). Even the migration from virtual environment back to a physical device (V2P) is supported.

Taking it one step further, you can create with just a few simple steps a complete virtual snapshot of your current computer. Virtual infrastructure environments are able to run the snapshot and you may continue work with full access to your initial data and programs without the actual physical computer hardware. You can use this feature to build your own virtual infrastructure environment.

Another convenient way to transfer all data from an old hard drive is to clone single logical drives into virtual drives. In addition, DeskView Advanced Migration ensures a secure and audit-proof deletion of data from physical hard disk drives.

DeskView Advanced Migration supports the end user in accelerating the use of new systems. It makes the move to virtual environments completely transparent, thus increasing end user satisfaction. IT organization take advantage from simplified and fast rollouts, reduced administration efforts and reduced migration costs. It is ready to run from a CD and does not require any installation. With its self explaining user interface it is totally easy to use.

Financing options

Not every customer has budget available to invest in virtual client computing upfront, despite wanting to take advantage from the benefits it provides.

Fujitsu has a multitude of solutions that can help overcome initial capital expenditure blocking points. By shifting fixed costs into variable costs, we allow our customers to maximize their operating budgets. This increases their flexibility, and allows them to maneuver within their budgets.

Integrated support concept

For sure, in a first step every customer who is going for virtual client computing is longing for a successful introduction of his new infrastructure solution. However, we should not ignore the fact that during operation there will be situations in which the customer needs support. And often in such a situation when certain things don't work as they should, the question will come up, what the reason for this situation is.

- Is it server hardware or the virtualization software?
- Is it the storage system?
- Is it the access devices or the network between access devices and the data center?
- Or is it just the software running on the thin client?
- Which provider is the one who can solve my problem?

These are a lot of questions which make a professional support concept extremely important for the customer. Otherwise you will end up in the typical finger-pointing, where none of the involved parties want to take responsibility.

Having Fujitsu as a support partner, organizations need not worry about this. Our end-to-end support concept covers the entire solution including all infrastructure aspects, no matter whom the technology originally comes from.

In order to increase support and service capabilities, we created a formalized process for the support levels 1-4 where the support organizations of both, Fujitsu and Citrix, are tightly coupled. On level 1 Fujitsu looks after call acceptance. On level 2, Fujitsu has got support engineers with profound Citrix knowledge and skills, which in most cases makes the involvement of the 3rd level at Citrix superfluous. Basically level 3 is only involved for fixing software errors and respecting patch delivery. If issues with drivers or ServerView are identified, these will be forwarded to engineering level 4 at Fujitsu. The result of this process is faster and better service delivery and problem resolution.

Managed Services

If IT organizations want to concentrate rather on their core business and strategic projects than daily routine tasks, Fujitsu will operate the customer's virtual desktop infrastructure, based on standardized and optimized processes, either on the customer's premises or off-premise in one of Fujitsu's data centers. Customers take advantage from scale effects, the simple opportunity to alleviate shortages in resources and skills, flexible customer-specific and business-related service levels, and cost reductions. The "price-per-seat" charging model eliminates investment risks and ensures highest cost transparency. At the same time, customers keep their IT infrastructure fully under control.

Workplace as a Service

Even more agility can be achieved by sourcing IT workplaces as a service from a trusted Fujitsu cloud, with a standardized service level agreement, as easily as electricity from the socket or water from the tap. A "pay-as-you-use" model is the basis for billing, minimizing capital expenditure.

Fujitsu and Citrix – together since the beginning

As a Citrix worldwide OEM partner, Fujitsu has offered Citrix desktop technologies (starting with WinFrame, followed by MetaFrame and Presentation Server) in its infrastructure solutions from the very beginning. There is a huge joint customer base with a considerable number of attractive use cases and success stories.

Both companies are working closely together to deliver value-add infrastructure solutions and services. Fujitsu uses Citrix virtualization technologies in its "Managed Workplace" and "Workplace as a Service" offering, which are both key building blocks of Fujitsu's Dynamic Infrastructures strategy.

When Citrix expanded its portfolio from a pure application delivery (XenApp) to a full desktop virtualization solution (XenDesktop), it was quite natural for Fujitsu having a full portfolio of infrastructure products to expand the existing collaboration to Citrix's XenDesktop technology. As a core component of its desktop virtualization solutions, Fujitsu offers XenDesktop to customers, who want to extend the benefits experienced with server-based computing to a broader group of end users.

In addition, Fujitsu makes sure that the XenServer hypervisor is integrated with its own ServerView tools for managing its PRIMERGY x86 industry standard servers.

What's the value of the joint desktop virtualization solution?

Organizations deciding for the joint desktop virtualization from Fujitsu and Citrix can count on market-leading virtualization technologies, best-in-class and proven infrastructure products, as well as end-to-end services based on a profound knowledge and experience. Fujitsu's infrastructure products are optimally harmonized with Citrix's virtualization software, thoroughly tested and certified. The overall solution is custom-tailored to optimally meet the customer's business demand. The foregone proof-of-concept ensures that everything will run perfectly.

As a one-stop shop for desktop virtualization, Fujitsu provides hardware, software and services, all from a single source. This simplifies the introduction, accelerates project time, reduces risks and costs, and enables a faster return on investment.

Furthermore, Fujitsu gives customers every choice to select the appropriate sourcing model. IT managers can opt for a self-managed approach, just calling on Fujitsu's support to design and implement the overall infrastructure solution and to maintain it thereafter. If IT staff has to focus on business applications and process innovation, Fujitsu will operate the virtual desktop infrastructure or provide IT workplaces as a service. The offerings interact with each other and give customers the flexibility to combine them as needed. Thus, you have always the option to align IT to actual business needs, which is the CIO's top priority.

Total cost of virtual desktop infrastructures

Implementing Citrix XenDesktop including all the previously discussed technologies and infrastructure products from Fujitsu has a very positive impact on the costs of managing desktops.

Analysts like Gartner, Forrester or IDC have developed direct and indirect cost models, which allow a neutral comparison between various solutions.

Basically in all cost models, there are initial acquisition costs, which can be in many cases easily calculated. But there are also operational costs, which are significantly higher than acquisition costs. Exactly these high operational costs are reduced in a virtual desktop infrastructure.

Besides acquisition and operational costs, organizations will also benefit in increased agility and flexibility of virtual desktops. Running a desktop virtualization solution, the integration of infrastructures after mergers and acquisitions, establishing new offices or expanding the workforce are no longer complex projects; virtual desktops will enable a quick, secure and efficient implementation. And virtual desktops enable an easy path to changing the sourcing model or to "employee owned devices".

It's also worth mentioning that the initial cost of implementing a virtual desktop infrastructure can be higher compared with the cost of continuing the usual desktop / notebook refresh. However, those initial costs should not be an inhibitor for starting a desktop virtualization project. With Fujitsu's attractive financing options, every customer has got the option to finance the project over a longer time period. What is more, the additional investment can be compensated with the ongoing operational savings achieved.

For a quick comparison, Citrix offers a **TCO Calculator**. This online tool can be used by Citrix partners and is available at https://roianalyst.alinean.com/citrix/xendesktop. Citrix partners should contact their local Citrix partner manager for access. The tool uses data from Gartner and IDC studies, as well as industry averages and results from real life projects.

The TCO calculator is a quick and easy start for evaluation possible cost savings when using Citrix XenDesktop. In addition, Fujitsu provides its ROI consulting services which determine the financial impact of desktop virtualization for a customer-specific situation, as already mentioned.

Conclusion

There are many reasons, why customers change their infrastructure. By migrating to a desktop virtualization solution from Fujitsu and Citrix, customers improve service quality, increase agility and security and reduce costs.

IT administration will benefit in many areas. Virtual desktops are more stable, more secure and better available compared with traditional desktops and notebooks. Virtual desktops are faster deployed, can be accessed from a broad diversity of devices and will significantly decrease the required storage capacity. Key management tasks, such as backup and patch management, are centralized and operated with increased efficiency and control inside the data center. And operational costs decrease over time.

However the advantages of virtual desktops are not restricted to IT administration. Every user will immediately recognize the increased flexibility of a virtual desktop. They are, for the first time, able to use their private notebook inside the company without violating any security policy. They may benefit from more desk space and less clutter by using the Fujitsu Zero Client to connect to a virtual desktop. Or they may work offline – with an encrypted, timely limited, offline available virtual desktop. Especially in this use case, the virtual desktop demonstrates many advantages compared with a traditional notebook. A broken notebook, for example, can be simply replaced without complex data migration or application installation.

Fujitsu and Citrix jointly deliver the leading virtual client computing solution. All software and hardware components are tested and well integrated for ensuring a fast and seamless implementation and operation. Customers benefit from the peace of mind that the close cooperation between Citrix and Fujitsu brings.

Moreover, customers can realize additional advantages from Fujitsu's flexible service offerings covering consulting, design, implementation, migration, operation and maintenance. And Fujitsu's financial services let you benefit from all virtual desktop advantages without any pre-investment.

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