White Paper
Desktop Virtualization.

The future of the corporate desktop.

T Systems

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1. Introduction.

Costs, security and employee motivation on the one hand, and the capabilities of the software on the other: the working environment is a crucial commercial factor for businesses for various reasons. The leaner and more maintenance-free it is, the faster it can act and react in a competitive world.

Desktop virtualization makes a complete separation between terminals and applications. This offers many companies the ideal solution for their workstation PCs. The central location of applications and data in the data center, to be retrieved over the network, allows the user to access his or her PC from anywhere. According to Forrester Research, this offers "decisive advantages, including improved security, ease of use and access to desktop applications in a mobile working environment".[1] The International Data Corporation (IDC) expects virtualized infrastructures to account for more than 10% of the German PC market by 2011.[2]

But in all the euphoria, the key issues relating to "desktop virtualization" can easily be forgotten:

- Is desktop virtualization a technology to be taken seriously, and one that keeps its promises to the customer? Or is it just a by-product of virtualization in the server field, offering no discernible benefits?
- What new opportunities does desktop virtualization create for future work, and under what conditions?

The sections below address these and other questions. They also put the T-Systems Dynamic Desktop virtualization solution to the test.

[1] Source: Forrester Research, David Friedlander and Simon Yates, January 5, 2006, Desktop Virtualization Is The Future Of The Corporate PC.

[2] Source: IDC, Viewpoint Details, Dr. Thomas Reuner, November 2007.

2. History - development from the terminal server to the PC and "back".

"Mr. Watson, come here - I want to see you." Was it these groundbreaking words spoken by Alexander Graham Bell in 1876 at Boston University in the first-ever telephone call that laid the foundations for the digital age, or was it the Z3 developed by Konrad Zuse in 1941? Both answers would be right; while Bell started the development of telecommunications, the first working computer was like the invention of the wheel for information technology.

End of the 20th century: the triumph of the PC.
In the earliest decades, computers were giant calculating machines that had to be operated by hordes of engineers. Later, terminals - initially connected locally, then via a network - opened up new possibilities for "end-users" too.

In the 1970s, a new species conquered the world of computers, the microcomputer. This was made possible by the invention of the micoroprocessor, which increasingly offered the power of a traditional mainframe "in the home". With its host of different uses, the number of machines increased just as prices dropped. Now much cheaper, computers found their way into the world of work as well as private households. By the end of the last century, the personal computer had established itself almost everywhere. It also forced out existing solutions with terminals accessing central computer infrastructures.

DSL combines voice and data for the first time.
In telecommunications, meanwhile, there were at first mainly analog lines. With the development of ISDN (the Integrated Services Digital Network) in 1989, multiple telephone channels and a separate data stream could be carried over one line. Today, DSL (Digital Subscriber Line technology, running at up to 210 mbps) is more or less universally available, and both private and commercial computers everywhere are connected via the Internet or intranets.

21st century: from IT and telecommunications comes ICT.
The boundaries between telecommunications and information technology are increasingly disappearing. So-called ICT solutions (information and communications technologies) combine both worlds. At the same time, the rate at which innovations hit the market is constantly increasing. This means that companies are faced with a growing challenge if they are to keep up with the technology.

Dynamic Desktop: the answer to today's requirements.
In this situation, the Dynamic Desktop from T-Systems represents the "next generation" workstation. This is not strictly speaking a new technology, but rather the latest state of development of the earlier central computer with its terminals. The growth in network bandwidth and improved virtualization technology enable the "classical" personal computer to be relocated to a data center. All that remains on the desk is a thin client, with screen, mouse and keyboard.

The Dynamic Desktop is rather like electricity generated centrally and distributed by wires. With this, all that is needed is a connection to the grid and users can always access the energy without each needing his or her own generator.

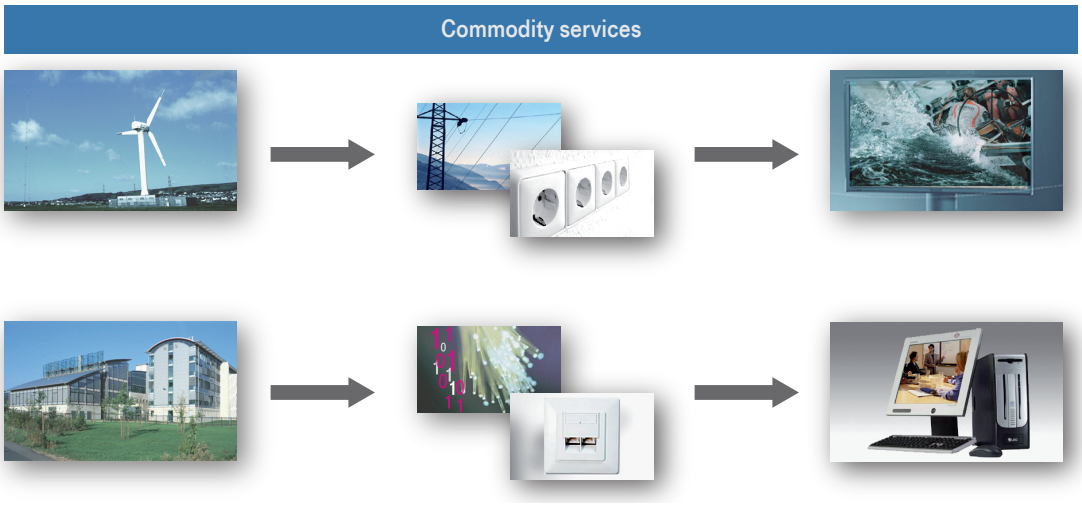

Figure 1: Commodity services.

In the same way, users call up the Dynamic Desktop from the data center over the network. With the fully managed service, their own personal desktop is always available wherever they want to access it from. This means that users are always up to date. The costs of each workstation can be calculated transparently and substantially reduced.

The advantages of the Dynamic Desktop compared to today's PC technology are its lower price and the security of a central desktop infrastructure.

3. What drives companies.

Anyone who has a lot to do with the current desktop services cannot get around the issue of desktop virtualization. Like a mirror, desktop virtualization seems to reveal the shortcomings of classical desktop environments. The chart below shows the major reasons for potential users to opt for desktop virtualization. The survey allowed for multiple answers.

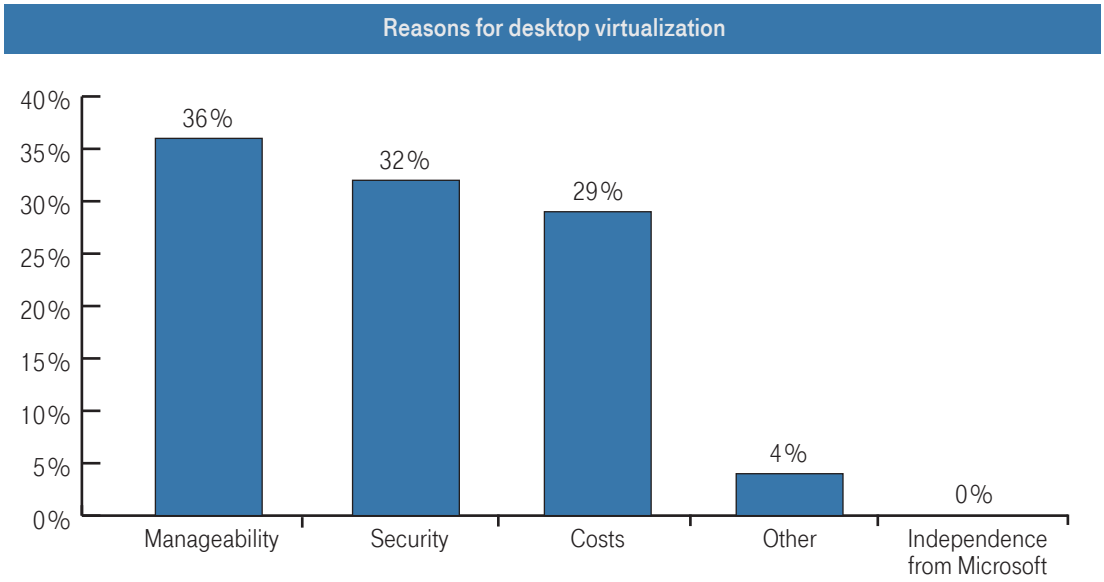

Figure 2: Reasons for desktop virtualization[3] .

3.1 Management, maintenance and support.

With traditional desktops, more than 2/3 of the total cost[4] goes on service and support, operational issues, user concerns, etc. Centralized desktop infrastructures which users access via thin clients offer significant potential savings here. Each user is provided with a virtual desktop reflecting his or her profile, and this is managed centrally. It includes security updates and new software, or regular upgrades to existing software. A high degree of standardization, combined with centralized data and applications, increases the efficiency of the overall solution still more. The thin clients can then run anywhere with minimal management. In rollouts, relocations and periodic replacements, thin clients have advantages over personal computers in that there is no local data storage, so no local installation is needed, a rollout or relocation can be carried out by logistics staff, and thin clients have a longer service life (60 months).

[3] Source: Goldman Sachs, Laura Conigliaro, Rick G. Sherlund, Sarah Friar and Derek Bingham, Independent Insight, US technology Strategy, December 5, 2006.

[4] Meaning the costs to the user to perform his or her actual tasks, and the costs to the IT department to support the user.

3.2 Security.

Data is among the most important of corporate assets today. All the more important therefore to protect it. Many studies have shown that internal theft or misuse of data is right at the top of the list of threats to companies. Backing up locally stored information from desktop computers and notebooks with their countless interfaces – CD and DVD burners and USB ports for bulk storage devices – is costly and hence is often a weak point. This makes it all the more sensible to replace today's personal computer with central data storage and a virtual desktop.

With desktop virtualization, only graphical information is transferred to the terminal - just the contents of the screen. This information is also encrypted. The actual data remain in the secure data center, where the data will also be backed up. It is also easier to protect the central infrastructure against viruses and malware. Because of their simplicity alone, the thin clients are practically immune, or not a "worthwhile" prey for hackers.

And whereas today's infrastructures are generally unusable in case of disaster – such as a fire in the building or a flu epidemic – central concepts allow employees to go on working from home. In this way, companies can maintain their business - albeit in a restricted way.

3.3 Profitability / total cost of ownership.

Since terminal services became available, they have been propagated as a cost-effective alternative to desktop PCs. However, this often involves comparing "apples and pears". Serious comparisons usually distinguish between "unmanaged rich desktops", "typically managed rich desktops" and "well managed rich desktops". And only these last can be properly and meaningfully compared with desktop virtualization. In the past, this sometimes had the effect that significant savings were partially offset by the licenses required for the market-leading solution. Intensified competition in desktop virtualization and open system architectures bring new potential savings and also reduce dependence on individual software vendors.

Along with the provider view for T-Systems, which is able to offer desktop services relatively cheaply, aspects like employee productivity (see above), boot time - the time before the user can work productively - and electricity consumption are relevant to the customer. Based on a customer scenario, a study by the Fraunhofer Institut also indicated significant cost savings:

"This more realistic calculation model yields potential savings of 41-44 % compared to a "managed PC" and as much as 60-70 % compared to a completely manually administered workstation."[5]

[5] Fraunhofer, C. Knermann / C. Köchling, PC vs. Thin Client - Economic Assessment, 2007, pp. 21ff.

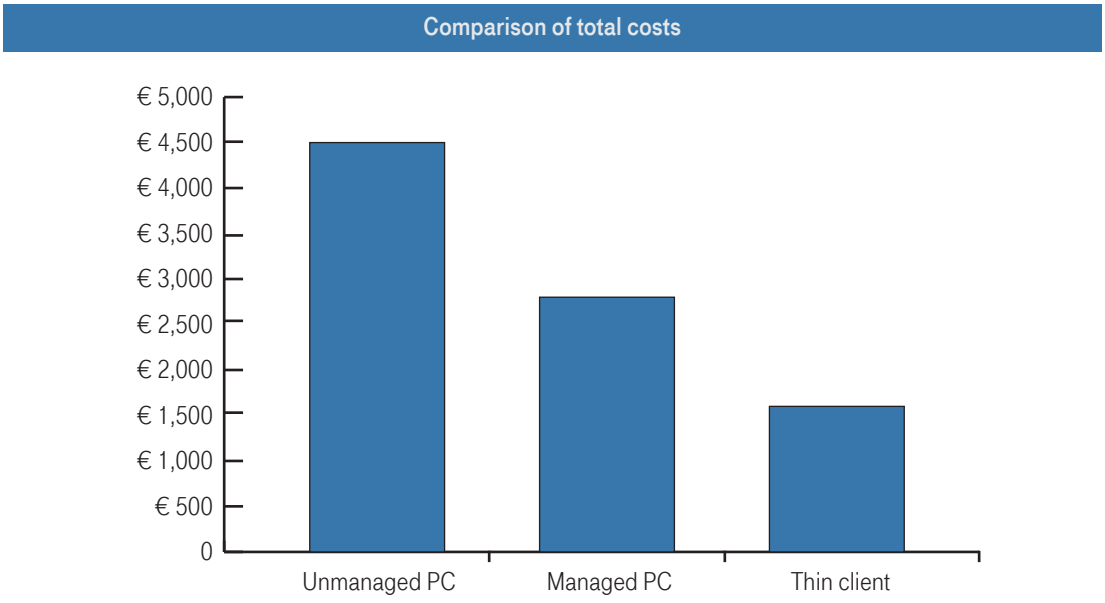

Figure 3.2: PC vs. Thin Client. Economic Assessment.

3.4 Scalability and flexibility.

The constant change that the workstation and the environment are exposed to is a major time and cost factor for companies. This is particularly striking when new departments are set up. Thin clients offer clear advantages here. They can be configured quickly and made available as workstations in the minimum time. The programs and data reside on central servers, so no local installation and configuration is needed. Updates and the implementation of new applications are also simple to perform centrally, making them available immediately to all users.

3.5 Green IT.

IT produces around 600 million tons of CO_2 a year, accounting for 2% of global emissions. To offset this would need around 60 billion trees. This is why pressure is growing on companies and the IT industry. Originally a cost factor, environmental protection is now coming to the fore as an argument in its own right:

When a desktop PC is replaced with a thin client and a terminal server, the emissions from the workstation system fall by more than 54%[6].

One positive side-effect of the low power consumption of thin clients is the low level of noise and heat given off: the use of processors optimized for high performance and low consumption, and the absence of a hard disk, enable fanless devices to be produced. In many cases, this increases the wellbeing and productivity of staff.

Another advantage for the environment, and the budget, is that the service life of thin clients - 60 months - is much longer than that of traditional personal computers (36 months).

[6] Source: Fraunhofer, Environmental comparison of PC and thin client workstations, 2008, page 3.

4. Desktop Virtualization.

Behind the general term "desktop virtualization" are a number of different technologies:

4.1 Terminal services.
With terminal services, all programs exist just once on the server. Every program can then be run by several people at once (multi-user capability). Citrix is the best-known solution on the market. Where Citrix used to describe its Presentation Server (now called XenApp) as a terminal server, Citrix Systems now takes a "broader" view. XenApp also provides application streaming, and alongside it, the Fort Lauderdale-based software manufacturer offers a solution (XenDesktop) that works with desktop images in the data center (see below). As Citrix is an "add-on" to Windows Terminal Services and so brings not only enhanced functionality but also increased costs in the form of licenses and maintenance, many companies deploy "pure" Windows Terminal Services where this is sufficient for their purposes.

Apart from Windows Terminal Services, there are also terminal services running under Linux. Here, optimized server versions provide the end-user with an open source desktop. Instead of Windows and Office, users work with the Gnome or KDE desktop and use OpenOffice.

Both "worlds" (Windows or open source desktop) are offered to customers by the manufacturer NoMachine, which makes use of the open source NX protocol. This significantly reduces the element of license costs and avoids excessive dependence on one software vendor.

4.2 Virtual desktop.
With this type of virtualization, the thin client retrieves an image from a server farm.

Put simply then, these solutions can be described as moving the hard disk and main memory out of the personal computer and into the data center.

The best-known solutions of this type are VMware View and Citrix XenDesktop. The hardware manufacturers offer different variants, which are either integrated with the associated management tools (IBM, HP) or have specific extensions/optimizations (SUN).

The fundamental difference between VMware View and Citrix XenDesktop is the access protocol used. The ICA (Independent Computing Architecture) developed by Citrix scores over the Remote Desktop Protocol (RDP) in its lower bandwidth requirement and - an increasingly important aspect - in terms of latency (delay).

These solutions differ from terminal services in their greater scope for customization, which does however usually come at a higher cost. This cost is partly due to the greater storage capacity needed for the images. The latest approaches do not maintain a completely separate image for each user, but build up the individual user image from a unique master image and user-specific elements.

4.3 Application virtualization.
This solution overcomes the shortcomings of traditional PC installations. The multitude of installed software packages often need specific versions of software system libraries. This produces dependencies and conflicts between applications, pushing the costs of one-off engineering work, and especially of ongoing support, through the roof. Where application virtualization is used, the application is typically installed not locally, but in a 'sandbox' on the client. The sandbox isolates the application, so conflicts in the file system or the registry can be avoided. The best-known solution is undoubtedly Softgrid. This formerly independent solution has been bought by Microsoft and integrated into the overall portfolio under the name App-V.

4.4 Virtual systems.
With virtual systems – as with familiar technologies in the server area - it is possible to create a complete operating system, and hence a complete new environment, on a hardware device, the local personal computer. A distinction is usually made between a host and a guest operating system. It would then be possible, for example, for a company to switch over entirely to an open source desktop but go on running an essential Windows application in the virtual system. Well-known products are VMware ACE (Assured Computing Environment) and Microsoft Virtual PC.

4.5 Blade PCs.
For the sake of completeness, we should also mention solutions in which the "physical" system is relocated. Here, every user has his or her own PC that they can access within the data center. Well-known manufacturers are HP and ClearCube.

5. Dynamic Desktop and My Access Key.

The Dynamic Desktop offers the following advantages:

- Depending on the requirements and situation (e.g. existing licenses), T-Systems deploys the best technology for the customer.
- As an alternative to the familiar and previously usual Windows desktop, an open source desktop (Linux, OpenOffice, Firefox, etc.) can be provided.
- Regardless of the technology, the established processes (such as order and incident management) of T-Systems can be used.
- Moving the personal desktop into the data center and providing variable access creates new possibilities. Examples might be shift working or use by part-time staff. New user groups (e.g. people working in Production) can be added, and new flexibility created (e.g. roaming users).

With strict separation of terminal and applications, Dynamic Desktop constitutes a cost-effective, low maintenance solution.

All you have left on the desk is a terminal. The data and applications are in the data center, where they are managed centrally and in a uniform way. One supposed disadvantage of desktop virtualization is that it provides little or no mobility. Particularly for today's notebook users, the "new world" does not seem to offer an adequate alternative solution. However, a closer look at these needs reveals another more differentiated view: Many notebook users do not really work "on the street", but only need the device to be able to work at other company locations. Dynamic Desktop gives these users their own personal desktop at any company location and any terminal, without any drawbacks like the cost of the notebook, potential damage from loss or theft, etc.

Another option is for employees to use My Access Key to access their workstation environment while on the move.

My Access Key is a USB stick providing access to the personal desktop.

This just has to be plugged into any laptop or PC with an Internet connection, and the integrated Smartcard reader provides encrypted access to the user's own workstation. When they finish work, no traces are left on the computer they have used. This makes My Access Key well suited for access from the home office too. Connecting from their home computer, users have access to their corporate desktop and all the facilities available to them within the company.

With My Access Key plus, an enhanced version, applications can also be run locally from the stick.

6. Way forward and summary.

From the preceding notes, the answers to the questions we asked at the beginning should be clear:

- Is desktop virtualization a technology to be taken seriously, and one that keeps its promises to the customer? Or is it just a by-product of virtualization in the server field, offering no discernible benefits?

  Desktop virtualization such as the T-Systems Dynamic Desktop is a technology to be taken seriously, offering many benefits to companies.

- What new opportunities does desktop virtualization create for future work, and under what conditions?

  Desktop virtualization is not a universal substitute for present-day PC technology. But even today there are plenty of scenarios where Dynamic Desktop is the better solution. There may be purely financial reasons, security-related regulations, flexible working models or a mixture of all of these.

The use of Dynamic Desktop offers clear advantages particularly in companies with many identical and standardized workstation systems. It can also be the ideal solution for shift working, where different people use the workstations at different times.

In short, it is worth taking a closer look at the new services and questioning traditional approaches.

7. Glossary.

ICA	Independent Computing Architecture (ICA) is a protocol for a terminal server / Application Service Provision system developed by Citrix Systems. The protocol defines a specification for transferring data between servers and clients, but is not tied to a particular platform.
IT	Information Technology (IT) is a general term for information and data processing, and for the required hardware and software.
LAN	Local Area Network, comprising cabling and access components. In all practical cases, since the beginning of the 21st century, these have been based on the industry standard IEEE 802.3.
Managed rich desktop	Workstation computer where the initial installation, software distribution and the management of patches and anti-virus patterns are automated.
RDP	The Remote Desktop Protocol (RDP) is a protocol from Microsoft. It provides the technical basis for the implementation of terminal services between two computer systems.
Trojan	A 'Trojan horse", or simply a trojan, is a computer program disguised as a useful application that performs quite a different function in the background without the user's knowledge. A Trojan horse is part of the family of unwanted or harmful programs known as malware. It is often used as a synonym for a computer virus, or as a general term for back doors and root kits, but there is a clear distinction.
Unmanaged rich desktop	Workstation computer where the initial installation, software distribution and the management of patches and anti-virus patterns are not automated.
USB	The Universal Serial Bus (USB) is used to connect a computer to external devices. Devices or storage media fitted with USB connectors (such as USB sticks) can be connected together when the system is running (hot plugging), and the devices and their properties are detected automatically.
VoIP	Voice over IP is the combination of voice and data on a common infrastructure (the TCP/IP protocol). It is used to mean telephony over computer networks - i.e. data networks - that run under the widely used Internet protocol (IP). VoIP technology makes much more efficient use of the existing line resources. This reduces call costs, and the shared network infrastructure enables IT applications and telephony to work better together.
VPN	Virtual Private Network. A VPN is a communication network that uses a public network to transport private data. The connection via the public network passes through so-called tunnels, and is generally encrypted. However, the word "private" does not necessarily mean that the data transfer is encrypted. The term is now usually interpreted to mean an IP VPN, where subscribers are connected via IP tunnels.

WAN

Wide Area Networks (WANs) are intended for voice of data transmission over long distances. The design of such networks is basically determined by the services to be provided. For example, the classical analog telephone network is suitable for telephony, as is ISDN. Public data packet networks, on the other hand, are designed for data transfer services.

8. Table of figures.

Figure 1: Commodity services.

Figure 2: Reasons for desktop virtualization.

Figure 3: Fraunhofer, PC vs. Thin Client. Economic Assessment.

9. List of sources.

[Forrester Research 2006]	David Friedlander and Simon Yates, Desktop Virtualization Is The Future Of The Corporate PC.
[Fraunhofer Institut 2007]	C. Knermann / C. Köchling, PC vs. Thin Client - Economic Assessment, 2007, pp. 21ff.
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[IDC 2007]	Dr. Thomas Reuner, Viewpoint Details, November 2007.

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