SUNDE™
Green Computing for Everyone

SUNDE VDI Architecture

Contents

1. An Introduction of SUNDE VDI Architecture

Virtualization is a powerful trend today. Many companies have adopted virtualization technologies for their servers and in their data centers to simplify administration and to reduce management chores and operating costs while maintaining reliability and safeguarding against disasters. Seeing the significant benefits virtualization delivers in those environments, many companies are extending the power of virtualization by turning to Virtual Desktop Infrastructure (VDI) solutions.

Virtual Desktop Infrastructure is a desktop virtualization technique enabling users to run desktop operating systems and applications inside virtual machines (VM) that resides on a server in the data center. Desktop operating systems inside virtual machines are also referred to as virtual desktops. By consolidating and centralizing the virtual desktops, desktop maintenance and costs are streamlined, administrative and management tasks are significantly reduced; data is easier to safeguard and back up and even power consumption can be dramatically cut down.

SUNDE® offers a complete, purpose-built solution for virtual desktops combining a unique Zero Client endpoint with tools designed specifically for the deployment and management of virtual desktops. SUNDE virtual desktop hardware consists of a Zero Client device—Diana which connects to a keyboard, mouse, monitor and Ethernet connection. Diana Zero Client enables users to execute a desktop operating system within a virtual machine running on a single computer or server. Every endpoint operates as a completely self-contained unit with its own operating system, peripherals, and applications. The vPointServer software on the server contains vPoint display protocol, delivering a rich end-user experience that includes 1080P full screen video, multi-media, user personalization and secure desktop roaming. Diana Zero Client architecture paired with VDI solution becomes a quick, secure way to deliver applications to users.

This whitepaper will help you understand SUNDE Diana VDI architecture and the technology involved in server-based virtual desktops computing and briefly compare SUNDE Diana Zero Client to a variety of dominant VDI architectures. It also provides general guidelines for sizing and configuring the supporting server and storage infrastructure to help ensure a successful Diana VDI system deployment.

2. VDI Attributes and Benefits

Similar to earlier end-user virtualization approaches like terminal services, VDI solution offers many benefits from consolidating and virtualizing desktops.

Improved efficiency.

- A new VDI workstation can be set up in less than 15 minutes compared to hours or days for a traditional workstation. IT technicians can create a library of VDI images to meet all of the company needs.
- Helpdesk IT technicians can perform tasks from within the data centre, eliminating the need to travel to the user's location trouble-shooting. Problem resolution will be quicker as everything is located within the data centre.
- Centralized virtual desktop images can easily and quickly be monitored, backed up and recovered, and patched or upgraded. One support technician can handle 5 times as many VDI users compared to PC users.
- More scalable management by storing and managing thousands of virtual desktop images on fewer centralized physical servers, accessed from a single management console.
- The endpoint's connection to the virtual desktop can be suspended at any location and then immediately resumed from any other endpoint without any interruption of applications or open files – such as when moving from your office to a conference room – users can quickly access resume work at any location.

Green credentials and lower costs

- Consolidating desktops onto shared server hardware gives users more cost-effective peak computing resources with much greater utilization levels overall.
- Most VDI clients use less electricity than a desktop computer. Users can deploy VDI to reduce carbon footprint and save money in power costs.
- Server based services can be controlled and used more efficiently e.g. load balancing and shutting off virtual machines whilst not in use.
- Higher utilization rates with centralized hardware upgrades and software licensing can be achieved.
- As the VDI desktop client lasts longer, refresh is typically 7-10 years, compared to 4-5 years for a traditional desktop. This can save both on purchase cost and replacement parts but also on warranty fees, user downtime and IT staff productivity.

Improved security and data integrity

- There is no local PC storage device - data is centrally stored within the data centre. Data loss stemming from both hardware failures and from the loss or theft of PCs and laptops can be eliminated.
- Strong security management, monitoring and control over clients and network transmissions ensure compliance with data security and records retention policies.
- Server based computing improves a company's ability to use resources as a common pool.

Better productivity

- Configuration of desktop resources (memory, applications and storage) can be modified more quickly, with no interruption to the end-user or any need to travel to a user's location or to round-trip ship a computer for upgrading.
- There is no user-training required as the experience is exactly the same as a traditional PC.

But instead of running a single operating system on shared server hardware, VDI solution is intended to deliver the full capabilities of a native Windows desktop to users. VDI has a number of advantages that terminal servers have a tough time matching.

For one, more applications can run in VDI, Not all applications can be installed in a terminal services environment, due to the fact that they require full access to the operating system, not just to what the user can access.

For its own Remote Desktop Protocol (RDP), which powers a number of terminal services, Microsoft has developed a workaround to redirect system call requests, though some of the applications still may not work correctly.

Applications in a terminal server environment can also have issues when it comes to graphic displays. Flash typically cannot be rendered through RDP by traditional means. Some applications that use the Windows Presentation Foundation, which needs to interact with a graphics processing unit, also will not work in terminal server.

Because of such issues, Most times, Windows 7 platform in a virtual machine is a lot better when it comes to application compatibility.

Under VDI, every user has his or her own copy of the operating system that can be customized to suite individual needs. VDI promises significant benefits including:

Increased flexibility-- Flexible desktop provisioning allows virtual desktops tailored to the needs of specific users, engagements or work locations. Each desktop virtual machine can be customized with specific settings, productivity applications.

Less compatibility issues-- multiple OS environments can co-exist on the same physical server. VDI eliminates most application-compatibility issues and also enables OS migrations without having to upgrade server hardware.

Reduced conflicts-- Each end user gets his or her own OS, resources and applications, keeping users isolated from each other. VDI protects each user from problems generated by other users.

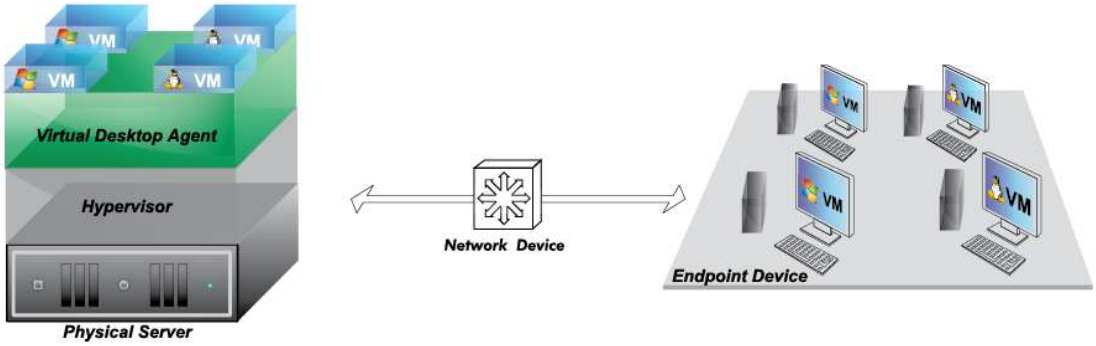
Enhanced Flexibility-- With snapshot technology, users have the ability to roll back desktops to different states. This offers great flexibility in events of an OS corruption or malware infection.

VDI is growing in popularity for environments where system state must be preserved, advance rights are required, or user isolation is an issue.

3. A Close Look into Dominant VDI Architectures

Different architectures are available for virtual desktops: what level of centralization, which hypervisors, management tools, and connection brokers to use; whether virtual desktops are only server-based or also client-based, etc. In this paper, we will focus on the most popular configuration with a client connecting to a server running the virtual desktop.

VDI simulates a copy of desktop including its operating system, software applications document and other customized data, which are stored and executed entirely from the server. Users access their desktop remotely from an endpoint device, ideally experiencing the same as on a physical desktop. To achieve this, the following components are necessary:



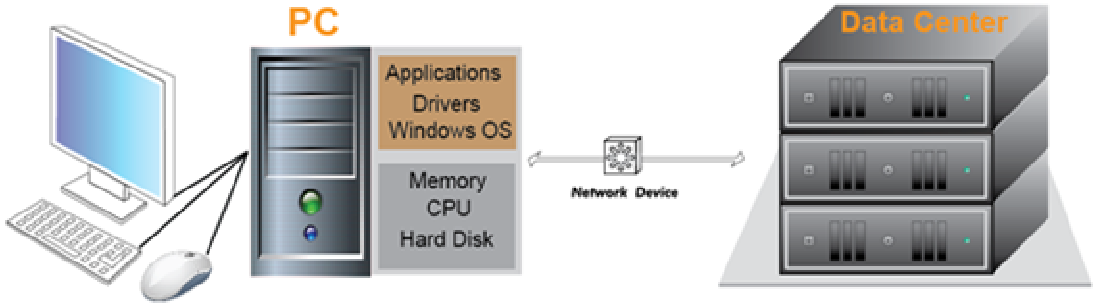
- Physical PC(s)/ server(s) -- a physical environment in which all data are executed and stored.
- Hypervisor -- also called virtual machine manager; virtualization software capable of creating and hosting multiple virtual machines.
- Virtual desktop agent-- a connection broker to manage the desktop and for connection to the user's client device via a remote session protocol.
- Client machines/ endpoint device-- a physical device used to see and control the user's virtual desktop.

The PCs/ servers use the hypervisor to create a virtual machine that simulates roughly the same capabilities as physical desktop computers. Virtual machines connect over local area networks to specialized endpoint devices at the users' location that in turn are connected to peripherals like monitors, keyboards, mice and other peripherals to make a complete system.

Since a variety of devices are used today to access VDI infrastructures, in order to achieve optimal results, it is critical for users to make careful choices in both the technical architectures and the products included in their VDI deployment plans. Possibly the most critical choice is the endpoint types or architecture. This choice will often drive many of their other VDI architecture, technology, and vendor choices.

An easy approach is to use **conventional PCs** (also known as thick clients) essentially as a browser to access servers in the data center. Reallocating existing thick clients is a real cost savings for virtual desktop customers because there's no upfront investment for

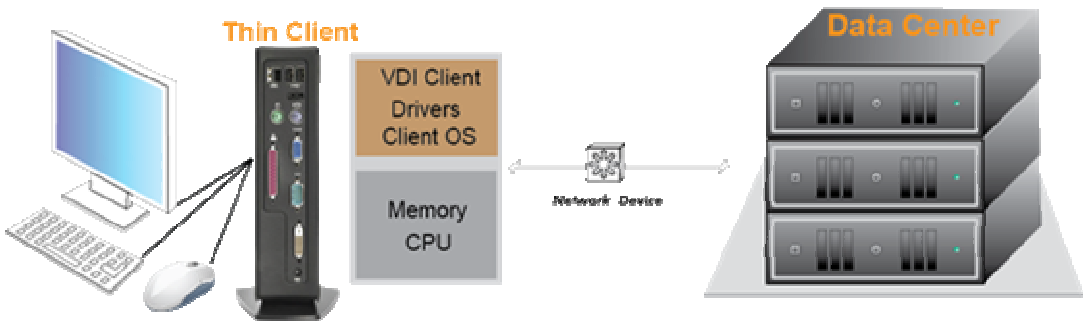
desktop systems. But this conventional PC architecture centralizes nothing other than perhaps user files stored on shared file servers accessed across the LAN. Each PC is a fully configured computer with an operating system, drivers, applications, and firmware along with hardware components like a CPU, memory and storage devices needed to hold the operating system and applications.



PCs are sometimes used as deployment platforms for virtual desktop trials, running VDI Client software much like a thin client and connecting to a desktop virtual machine on a data center server. While this might seem like a simple way to test virtual desktops, leaving a PC at the user's desk also leaves all of the reliability, maintenance, and security problems in place and can effectively wipe out many of virtual desktops' potential benefits for IT productivity and TCO.

One alternative to a PC as a VDI endpoint device is what is commonly referred to as a **thin client** – the term "thin" being a comparison to the relative "fatness" of a PC used as a client device.

A thin client takes on many different forms but ultimately includes a CPU, RAM, and local storage and allows for the network connection. Some clients may be higher end to provide better graphics solutions and hard drives, making them more like real PCs than thin clients. They shift the bulk of the operating system and application processing tasks to a central server. The whole dilemma with thin clients is that they have to include a CPU, memory and often even local storage like disks or flash memory to hold VDI client software, local drivers, not to mention energy and cooling, but also include a client operating system such as Windows Embedded, Windows CE, or a proprietary Linux variant that need to be patched, managed, and secured. They're as complex as regular PCs. As you can see, "thin" doesn't mean low maintenance.



Thin clients are generally not designed specifically for VDI. They typically need added licenses to protocol extensions in order to get the terminal services protocols such as VNC, ICA or RDP they use to perform essential VDI functions and rich multimedia display. In many cases these thin clients begin to duplicate the costs and IT management overhead of the traditional PCs they replaced, significantly neutering the potential benefits from deploying virtual desktops.

A more effective endpoint alternative to thin client complexity is a **Zero Client** (also known as ultra thin client). Similar to a thin client, a Zero Client moves the computing power back to the data center, leaving little more than a keyboard and monitor at a user's desk. However, Zero Clients have no extra software, drivers, operating systems, CPU, power supply or memory but only contain the necessary hardware to initialize a conversation with the network, begin network protocol processes, and display server output. Zero Clients centralize all software, processing and management to just what is running on the server.

Compared to traditional PCs or thin clients, Zero Clients promise benefits of
Streamlined management -- no locally installed operating system and very little or even practically no device-side software, lowering software licensing and maintenance fees – and eliminating the burden of managing software patches and updates for the client OS and drivers.
No more struggles with security -- completely invulnerable to viruses or other cyber attacks. The lack of a local operating system shifts total threat exposure back to the server.
No long delays – without the need to boot heavy local software, Zero Clients can be ready to work, typically, in less than 10 seconds.
No configuration headaches -- Plug and play type to make quick Zero Client deployment and redeployment. Users are given instant access to applications and data; requiring little technological administration.
Longer service life -- Lack of moving parts such as hard-drives or CPU fans improves life spans in harsh environments.
Green credentials and energy saving -- considered to be the greenest computing option because power usage is much lower-- often less than five watts; and CO2 emission is reduced.

Drawbacks of Zero Clients as VDI endpoints include:

They require sufficient network bandwidth, since by definition they do not have the processing hardware and firmware/OS required at the endpoint to execute network compression/decompression algorithms.

Because they are specifically designed to leanly support a VDI communications protocol, Zero Clients generally cannot be later repurposed for terminal services or other uses.

4. Potential Risks of VDI architectures

While VDI offers many advantages, using the technology comes with a cost as well.

Most notably, VDI is harder to install than a terminal server setup, especially in large deployments. One might assume that a VDI deployment would be similar to a terminal server setup, but it usually is more complicated. For most deployments of VDI, customers must take on the integration of the endpoint device with management tools, connection brokers, and VDI protocols from multiple vendors, which can significantly raise the complexity and increase the risks and fragility of a VDI deployment. And high skill levels for IT staff are typically required for deployment and maintenance.

Cost is another factor that users should go in deep. In most cases users are being misled if they think that they are going to get a direct financial boost from implementing VDI. In general, some cost savings are possible with VDI if users consider deploying cheaper thin client or Zero Client devices on desktops as opposed to full-blown PCs on desks. However, back-end costs for VDI server infrastructure, licensing and other costs could outweigh these desktop device savings.

The examples below present all of the components and costs except for maintenance when using Wyse thin client and Pano Zero Client as VDI endpoints in their each own system for a 100 seat VDI deployment.

Wyse thin client VDI architecture

—consists of Wyse thin client hardware, Wyse Streaming Manager appliances (used to reduce the image management overhead of the thin client operating systems), the VMware View suite (which includes vSphere hypervisors, the vCenter Server management tool, the View Manager connection broker and the View Agent/Client/Server VDI components) and server hardware.

The initial capital outlay to purchase a 100 seat Wyse thin client VDI deployment comes to as blow:

Wyse R00L Thin Client – 2 GB Flash, 1GB RAM, 1.5Ghz CPU.
$549 *100 = $54900

Wyse Device Manager Enterprise upgrade from standard license .
$19 *100 = $1900

Maintenance on Wyse Device Manager Enterprise.
$11 *100 = $1100

Wyse Streaming Manager Appliance, (R90LE) one per 25 clients.
$825 *4 = $3300

Wyse Streaming Manager Software license per thin client.
$200 *100 = $20000

Maintenance on Wyse Streaming Manager.
$45 *100 = $4500

Wyse TCX Suite protocol extension bundle for RDP
$35 *100 = $3500

Required maintenance on TCX Suite
$8 *100 = $800

VMware View Enterprise (vSphere, vCenter, View Manager, etc).
$150 *100 = $15000

Window 2003/2008/XP/7 virtual desktop access license per year
$100 *100 = $10000

Server Hardware w/12 CPU cores, 72GB RAM, 7164GB SAS drives
$7200 *4 = $28800

Total cost for 100 thin client VDI seats (at list prices) $143800
Cost per Wyse thin client VDI seat $1438

Based on this configuration the initial capital outlay to purchase a 100 seat thin client VDI deployment comes to $ 1,438 per seat. In addition to these initial capital outlays, thin clients usually require payments for maintenance on not just the hardware but also each of the software components which can end up adding substantially to continuing operating expenses.

Pano System Zero Client VDI architecture

Pano System Zero Client VDI seat along with either VMware vSphere and vCenter server-based licenses or VMware View VM-based licenses comes to a little simpler as $ 891 per seat but the hardware savings still erodes as more low-end PCs emerge at the sub-$350 price point.

Pano system, complete with Pano zero client, Pano Controller, Pano Maestro and one year of free maintenance.
$389 *100 = $38900

vSphere Standard Edition server CPU licenses.
$795 *8 = $6360

vCenter Standard Edition unlimited hosts license
$4995 *1 = $4995
Or with VMware View Enterprise concurrent DVM licenses
*$150 *100 = $15000*

Window 2003/2008/XP/7 virtual desktop access license per year
$100 *100 = $10000

Server Hardware w/12 CPU cores, 72GB RAM, 7164GB SAS drives
$7200 *4 = $28800

Total cost for 100 Pano zero client VDI seats (at list prices) $89055
Cost per Pano zero client VDI seat $891
Cost per Pano zero client VDI seat based on VMware View $927

The initial capital outlay to purchase a 100 seat Pano Zero Client VDI deployment comes to as blow:

Of course, some of these costs are offset by extending the life of obsolete client hardware and the fact that there is less hardware to buy, manage and maintain in office environments. When VDI is done correctly, VDI probably ends up being net neutral as far as costs are concerned--your increased up-front costs are offset by reduced day-to-day costs. But in most cases it will take something like five years before a VDI project pays for itself, by which time it will probably be time for a new project.

5. SUNDE VDI Architecture

SUNDE VDI architecture simplifies VDI deployment into only the Diana Zero Client as access device at the endpoint and vPointServer software installed on the server, freeing complexity and costs of deployment and maintenance from integration with expensive software and licenses. The complete VDI solution that SUNDE provides consists of the following components.

ENDPOINT HARDWARE

SUNDE Diana Zero Client is the heart of SUNDE VDI architecture, consisting of a compact purpose-built desktop virtualization hardware endpoint that sits on the user desk and connects the display, input devices and other USB peripherals to the VM running on the server. It is a true Zero Client because in contrast to thin client and PC endpoints it contains no CPU, no storage, and no operating system or software. As a result, it consumes very little power — about 5 watts when fully active and under 0.2 watts when in sleep mode — and is tamper-resistant and never stores any data locally, eliminating the risk of data loss from equipment theft. More importantly, it requires no endpoint management software, no patch management, no firmware upgrades, and no local OS licensing fees or updates – both significantly reducing virtual desktop deployment costs and improving on-going IT productivity.

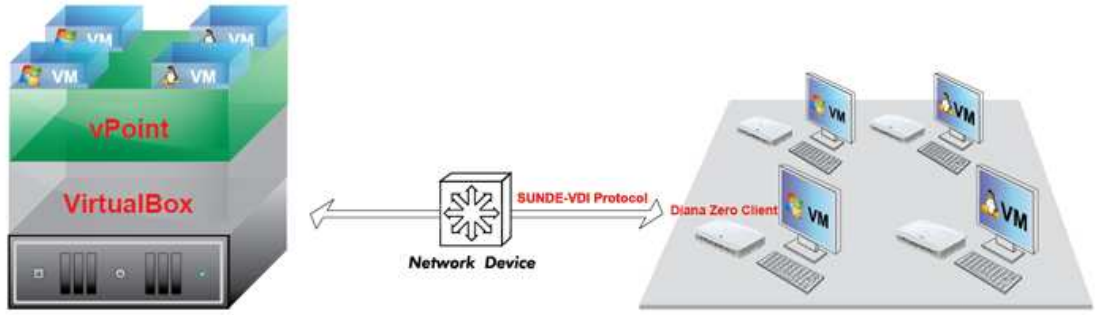
In contrast to most thin clients, the Diana Zero Client itself contains no USB or other drivers. Instead, it utilizes only the native drivers in the Windows Operating System running in the connected VM and simply handles communications between the VM operating system and the ports on the Diana Zero Client, much like a PC system bus or chipset.

This approach improves performance when displaying video or other multimedia and also greatly simplifies deployments since most types of USB devices work on a Diana Zero Client without any specialized support – unlike thin clients, vendors do not have to write or supply special drivers to allow peripherals like scanners or printers to connect to the endpoint – instead standard Windows drivers can be used.

Diana Zero Client contains various jacks for connecting desktop peripherals. These include a DVI-I video port, an RJ-45 Ethernet jack, four USB connectors, plus an analog audio port for headphones and speakers. It also includes a single user interface element, the button located on the front corner of the top. The button serves both as an indicator of the connection status, glowing steady blue when successfully connected to a VM, and as a button that allows the user to interrupt the Device-VM connection and return to the SUNDE login screen and connect to another VM. Pressing the button can act almost as a virtualized equivalent of the Ctrl-Alt-Del used to regain control of a physical PC but it never causes the VM to reboot or restart, preserving whatever work and applications are open

so you can log back in to resume work. (See detail specifications of Diana Zero Client at page 16 of this whitepaper)

SERVER SOFTWARE



Hypervisor -- Oracle VM VirtualBox

A fundamental software component supporting the SUNDE Diana VDI is the Oracle VM VirtualBox 4.0. VirtualBox is Oracle's hosted virtualization platform, also known as a Type-2 hypervisor, which means the hypervisor is installed on top of an operating system, not on top of bare-metal equipment. Oracle has announced the general availability of version 4.0 of the Oracle VM VirtualBox free open source virtualization platform, which is a great saving for VDI users. Apart from being free for public use, VirtualBox also includes an extensive toolset to manage virtual operating systems.

（For more information see https://www.virtualbox.org/）

Connection Broker – vPointServer Software

SUNDE vPointServer Software

vPointServer software coordinates the management and administration of SUNDE Diana Zero Clients and virtual machines (VMs) with the virtualization platform software components. vPointServer software enables IT administrators to provision new VMs for users, authorize users and user groups to access specific VMs, and monitor the availability of running VMs. vPointServer software also allows IT administrators to manage thresholds for available VMs to ensure users don't need to wait when logging in while still conserving compute and power resources by shutting down unused VMs.
vPointServer software has two distinct roles, any of which may be enabled for any particular VM during the initial setup process:

vPointServer consists of 3 components:

vPoint Management Console –provides connection and management of Diana Zero Clients, user accounts and virtual desktops, including discovery, login and user authentication of Diana Zero Clients, user account creation and VM assignment, connection brokering between users and their assigned VMs, monitoring and control over virtual desktops, etc.

vPointGuest – includes USB and Audio applications to run in the VM. These applications are transparent to the USB and Audio subsystems that reside in the devices and enable the VM to support a

variety of USB desktop peripherals and 12 bit stereo audio input & output at the terminal.

SUNDE-VDI Protocol – provides the communication link between the vPointServer software and the Diana client devices.

Remote Display Protocol – SUNDE-VDI protocol

SUNDE-VDI Protocol is specifically designed for SUNDE VDI solution. SUNDE-VDI Protocol provides the communication link between the vPointServer software and the Diana client devices, delivering a full PC experience including rich multi-media, full screen 1080P streaming video and Flash, dynamic graphics, and seamless responsiveness. Unlike remote display protocols, such as ICA or RDP, repurposed for VDI and used by thin clients originally designed for terminal services or other prior generation architectures, SUNDE-VDI Protocol doesn't require any costly or complex protocol extensions to support virtual desktops. SUNDE-VDI Protocol is included with and installed as part of the vPointServer Software and Diana client devices.

Virtual desktops in server-based approach that used by the SUNDE VDI solution, rely on a physical computing infrastructure along with a number of centralized virtual infrastructure software components running on the physical infrastructure. In addition to those central VDI components of virtual infrastructure software and client devices that SUNDE VDI solution provides,

For the host system users will need

- Servers with windows OS mounted
- OS images of either Windows or Linux to mount on VMs
- Storage
- Network

For each workstation users will need

- USB Keyboard and mouse
- Monitor with DVI input
- A category 5/6 network cable to connect to Ethernet network
- Optional: speakers, headphones, microphones and USB peripherals

6. SUNDE VDI Server-based Infrastructure Sizing

The number of users, intended application suite and overall performance expectation determine how powerful a host system must be in order to deliver the desired end-user experience. This section provides high-level guidelines for determining the system requirements for various numbers of Diana VDI users with various computing workloads. These guidelines can be used as a starting point for sizing your deployment – but our strongest recommendation is to thoroughly evaluate expected workloads for your Virtual Machines (VMs) and expect to make some adjustments and fine tuning as your Diana virtual desktop deployment progresses.

Understanding Virtual Desktop Workloads

Prior to deployment, you should develop use cases for the users you expect to connect to a host. An important consideration in developing use cases involves determining the number and types of applications users will need to operate. These requirements help you identify and measure the users' standard workloads. For example, you should measure the CPU, memory and storage utilization for a typical user workload in your environment. This workload data and the total expected number of users will help you determine the system requirements for your host system.

Light Workloads

- Task or knowledge workers running only 1 or 2 applications; i.e. a web browser or a billing application.

- Memory allocation of 768 MB (XP) to 1 GB (Windows 7) per VM .

- As many as 6 – 7 or more active VMs per core can be allocated.

- Storage system needs to provide roughly 30 IOPS per active user.

Medium Workloads

- Knowledge workers running multiple applications simultaneously, including Microsoft Office applications.

- Memory allocation of 1 GB (XP) to 1.25 GB (Windows 7) per VM.

- About 4 – 5 active VMs per core.

- Provide around 40 IOPS per active user.

Heavy Workloads

- Power users using scientific applications, high end graphics or software development.

- Memory allocation of 2 GB or more per VM.

- Only 3 – 4 active VMs per core.

- As much as 50 IOPS per active user.

- For best performance, reserve as many resources as needed

– create reservations in hypervisor and/or provide dual virtual CPUs per VM, even if more VMs than cores on server.

Configuring the server and storage infrastructure

CPU load of a VM is highly dependent on the workload-- VMs per Core: 3 – 7

- Typical VM load utilizes up to 15-25% of physical CPU, equal to 4-6 VMs per core

- For medium workloads, allocating 4-5 VMs per core is recommended

- 6-7 VMs may be allocated per core for lighter workloads

Disk performance is key to VM responsiveness-- VMs per Disk (15K): 4 – 6

- Both sufficient IOPS (30-50 per VM) and low latency (average read and write latency under 20 ms) required for optimal performance

- Enterprise-level 15K SAS RAID supports 4-6 VMs/drive excluding parity drives

- Lower performance disks may be used with fewer or less demanding VMs

- Either direct attached storage (DAS), or iSCSI/FC SANs may be used

- Large on-controller caches contribute greatly to storage performance

- Test SAN accordingly, actual results vary depending on VM workloads

Adequate VM memory ensures a positive individual user experience

-- VM physical memory: 768 MB – 2 GB

- Depending on workload and VM OS, 768 MB – 2GB should be allocated

- Under-allocation of VM memory can result in Windows paging and over-burden the disk subsystem

- Although not desirable, the total physical memory on server can be over-allocated

- the hypervisor will make intelligent paging decisions for VM's

- Typically, 70-80% of VM memory will be in physical memory, the rest will be in the hypervisor swap.

7. Specifications of Diana Zero Client

Power supply	Input AC110V ~ AC240V 50/60 Hz, Output DC 5V/ 2A	
Power consumption	5W	
Connections:	***Front Panel***	***Rear Panel***
	4× USB 2.0 ports, 1× Power LED/switch, 1× microphone jack, 1× speaker jack	1× 5V DC in, 1× DVI monitor, 1× RJ45 Ethernet, 1× reset key
LED indicators	power, network link, and network activity	
Display resolutions	***Normal display***	***Wide screen***
	640*480, 800*600, 1024*768, and 1280*1024	1280*720, 1280*800, 1366*768, and 1440*900
Networking	10/100 Mbps Switched Ethernet	
Audio	12 bit stereo audio input / output via 3.5mm stereo jacks	
Internal Hardware	All solid- state design. No moving parts, no fans, no local user storage. Kernel and firmware are updatable	
Multimedia Support	Hardware-accelerated 2D graphics, hardware-accelerated video support for most media formats on stand-alone media player applications and browser-based video play at full frame rates.	
Color Depth	24 bit	
Screen Orientation	Horizontal & vertical display for outdoor advertising permitted by SUNDE Net Point Server	
Supported USB Peripherals	Mouse/keyboard, wireless mouse/keyboard, webcam, memory devices, printer, scanner, barcode scanner, U key, USB to parallel/ serial converter, etc	
Supported Operating System	Supports all Windows Operation Systems	
Supported Cloud Platforms	Does not support Cloud Computing platforms	
Max. No. of users per OS	Depends on the configuration of the host PC	
PC configuration	See recommended hardware configuration guide at sunden.com/support	
Software	SUNDE vPointServer Management Console with SUNDE-VDI Protocol	
Reliability (MTBF)	>100,000 hours (calculated using Bellcore Issue 6 TR-332, Case 2, Part I at 40°C)	
Certifications	FCC class B, CE	
Environmental	0-40 degrees Celsius; 10-85% relative humidity (non-condensing); No moving parts permits use in high dust/ particulate/ vibration environments	
Size (L*W*H)	180mm*130mm*32mm/ 7.1 inches*5.1 inches*1.3 inches; shipping size (includes power adapter, documentation, packaging, etc): 265mm*195mm*45mm/ 10.4 inches*7.7 inches*1.8 inches	
Weight	154g/ 0.34lbs, shipping weight (includes power adapter, documentation, packaging, etc): 0.7kg/ 1.55lbs	
Kit contents	Each Diana kit includes an access device, power supply, quick install guide. SUNDE vPointServer software CD, installation & user guide can be downloaded at sunden.com/support; VESA-compliant monitor mounting bracket is optional for an additional cost. PC, monitor, keyboard, mouse, speakers, microphone, and other peripherals are NOT included and must be purchased separately	

8. Benefits from SUNDE Diana VDI solution

VDI enables IT staff to deploy, manage, secure and support desktops entirely from within the data center and delivers the full capabilities of a native Windows desktop to users. Zero Clients by design have no local software and hardware storage or processor, eliminating desktop related problems of security risks, virus/malware infection and data loss. And without fans or hard drives also increase long service life and reduce both energy costs and user downtime.

SUNDE Diana Zero Clients paired with VDI deliver both physical and virtual benefits of virtualization to desktops by reducing significant device & energy costs, providing uncompromised end user experience with customization, almost entirely removing administration burdens, and streamlining desktop security.

Aside from the clear technical and productivity merits, SUNDE Diana VDI solution simplify VDI deployment by eliminating heavy backend supports and using SUNDE provided server software, removing heavy upfront and ongoing cost of other VDI implements.

The initial capital outlay to purchase a 100 seat SUNDE Zero Client VDI deployment comes to as blow:

SUNDE VDI complete solution with Diana zero client, SUNDE vPointSever package and one year of free maintenance.			
$280	*100	=	$28000
Window 2003/2008/XP/7 virtual desktop access license per year			
$100	*100	=	$10000
Server Hardware w/12 CPU cores, 72GB RAM, 7164GB SAS drives			
$7200	*4	=	$28800
Total cost for 100 Diana zero client VDI seats （at list price） $66800			
Cost per zero client VDI seat $668			

From comparison with other implements, it is clear that a SUNDE Diana Zero Client VDI seat along with no back end cost is much simpler and comes to the cheapest as $ 668 per seat.

By integration of all the above elements SUNDE Diana VDI solution delivers a variety of virtualization benefits and a full PC experience to end users while still lowering the overall costs of company computing.