Utilizing KVM in production
KVM Gets Down to Real Business

Qumranet Desktop Virtualization Solutions by
Dor Laor

June 12, 2008

Agenda

- SolidIce Quick view
  - Motivation – challenge - solution
- Product components & features
  - KVM hosts
  - Management
  - Spice – Remote desktop protocol
  - Storage
- KVM usage in detailed
  - Problems solved
  - Problems to be solved
  - Stable branch & testing
- Performance & Conclusions

At a glance

- SolidIce is desktop virtualization solution
  - Uses KVM hypervisor
  - Uses Linux
- Strives to preserve the user experience
  - Uses home grown remote desktop protocol - Spice
- Various deployment options
  - Server Based Computing
  - Client Based Computing
  - Branch offices

Motivation For Desktop Virtualization

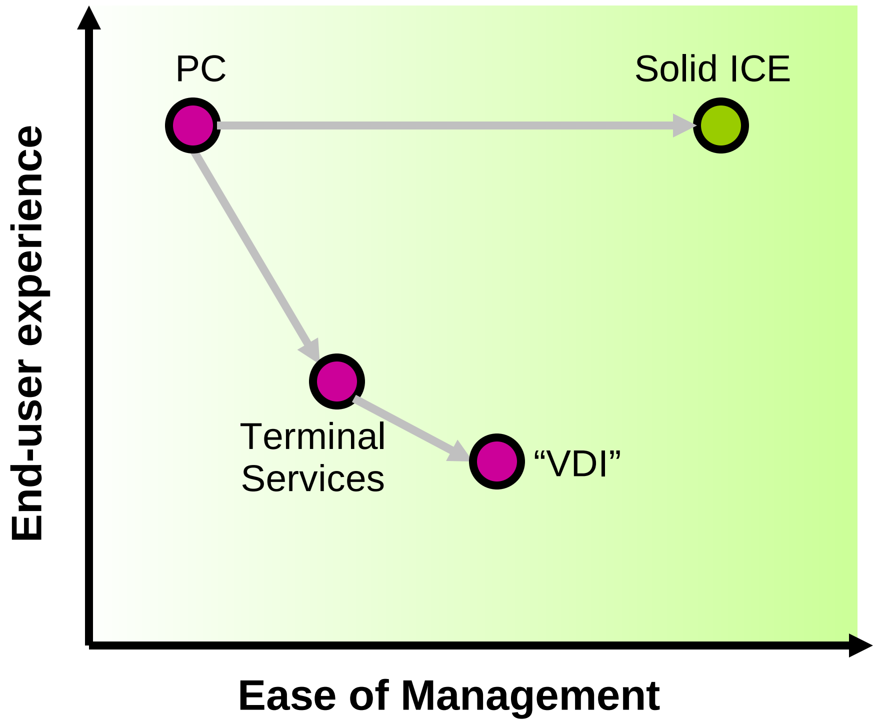
PROVISIONING	Provisioning new machines Supporting new hardware
SUPPORT AND MAINTENANCE	Desk-side visits Patches and updates
FAILURES	Desktop backups Failures (HD, PS, fans etc) Disaster Recovery
SECURITY AND COMPLIANCE	Enforcing security policies Compliance and audit trails
POWER	Increasing power costs

- **Total cost of maintaining and managing a PC environment is $3,000 - $5,000 +***
- **Complexity increases with multiple sites and lack of trained desktop personnel.**

**** Gartner 2007***

The Challenge – End User Experience

Approaches to solve desktop delivery challenges



Terminal Services Drawbacks

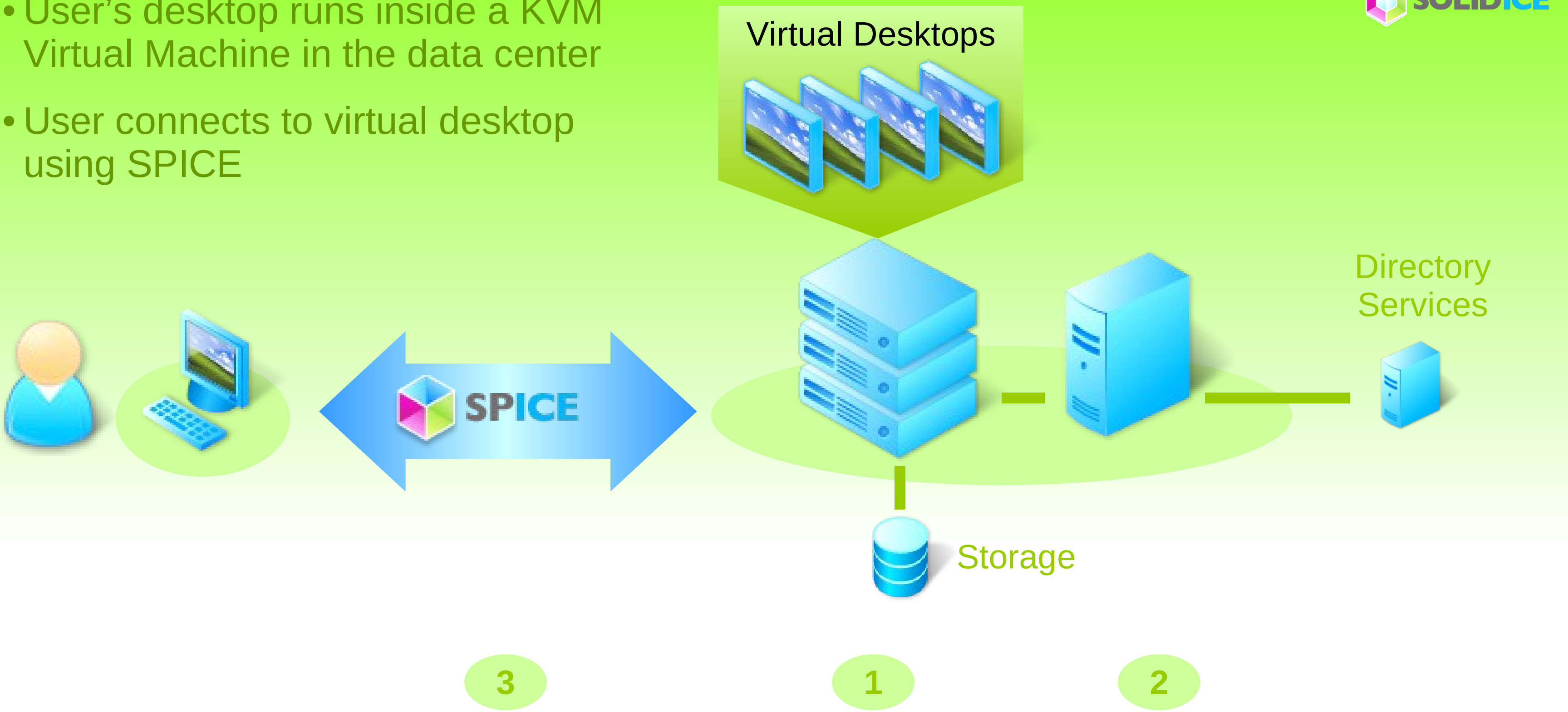
- Not enough isolation
- Apps need to be multi-user enabled
- Complex to roll out new applications

VDI Drawbacks

- End-user experience is not sufficient
- System cost is prohibitive
- Not built/ready for desktops

Solid Ice: Conceptual Overview

- User's desktop runs inside a KVM Virtual Machine in the data center
- User connects to virtual desktop using SPICE



Thin Client or repurposed PC

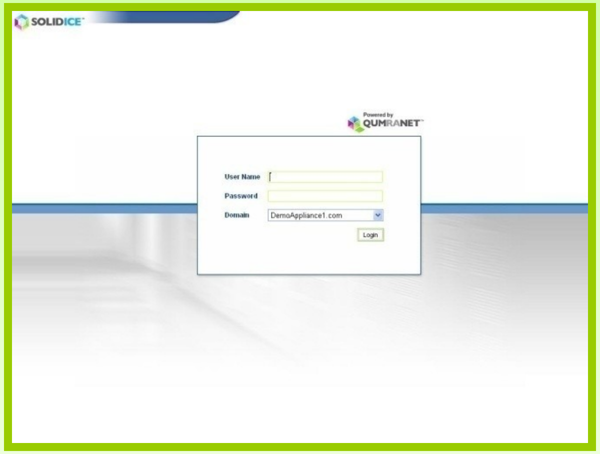
SPICE Remote rendering technology

Virtual Desktop Server (VDS) Cluster

Virtual Desktop Controller (VDC)

How Stateless Solid Ice works

USER VIEW

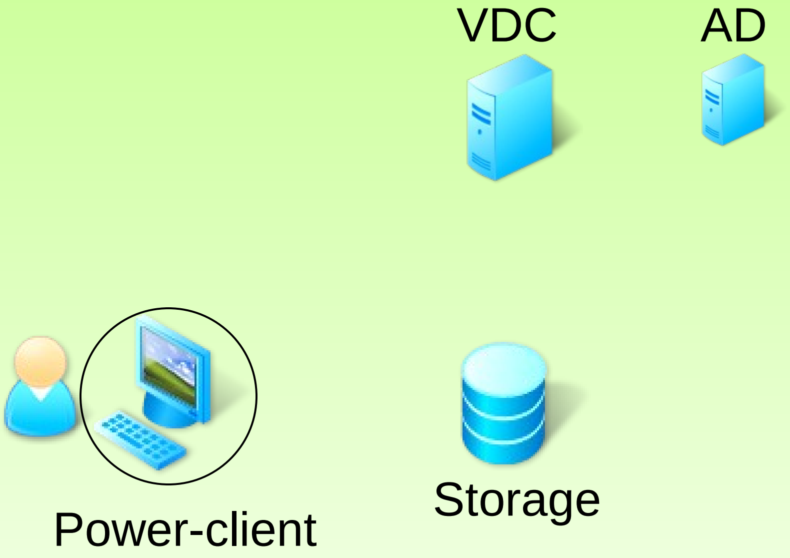


User Name

Password

Domain: DemoAppliance1.com

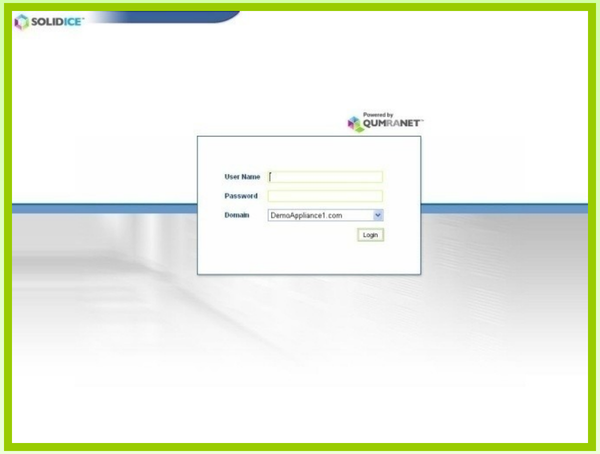
SYSTEM FUNCTIONING



User powers on the power-client, and sees the log-in screen

How Stateless Solid Ice works

USER VIEW



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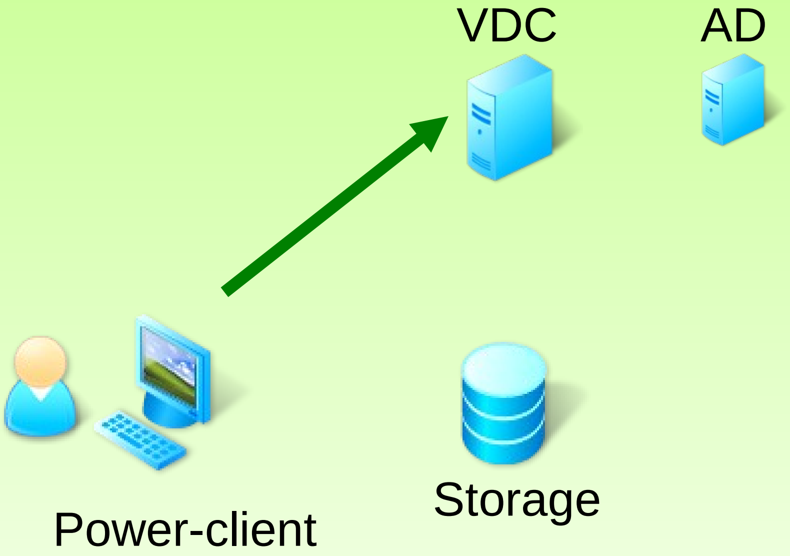
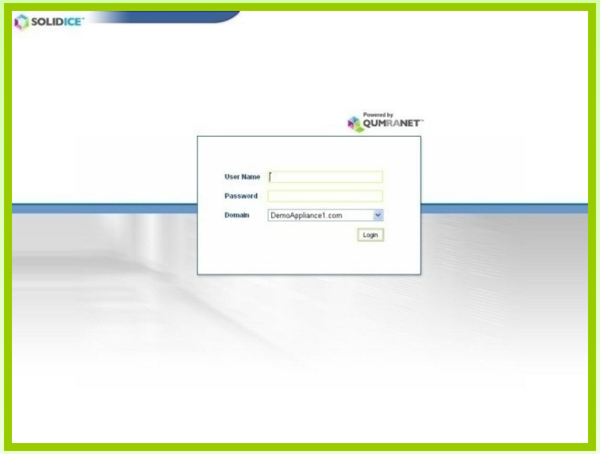


User logs in with AD username and password

How Stateless Solid Ice works

USER VIEW



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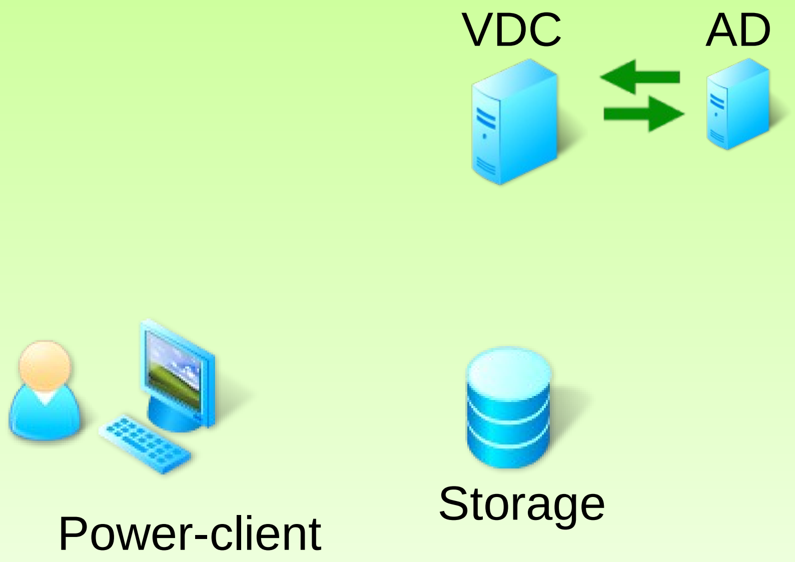
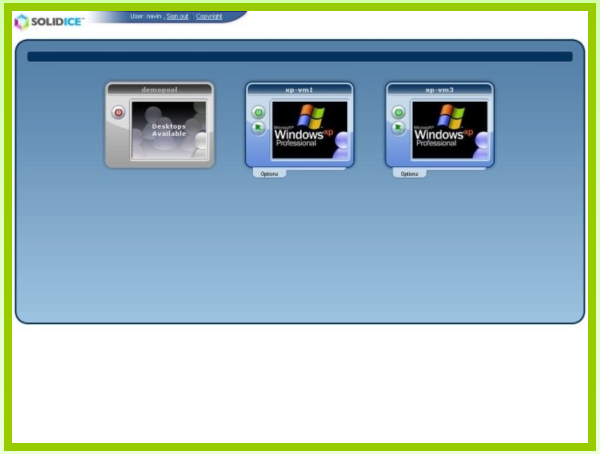


VDC authenticates the user against AD

How Stateless Solid Ice works

USER VIEW



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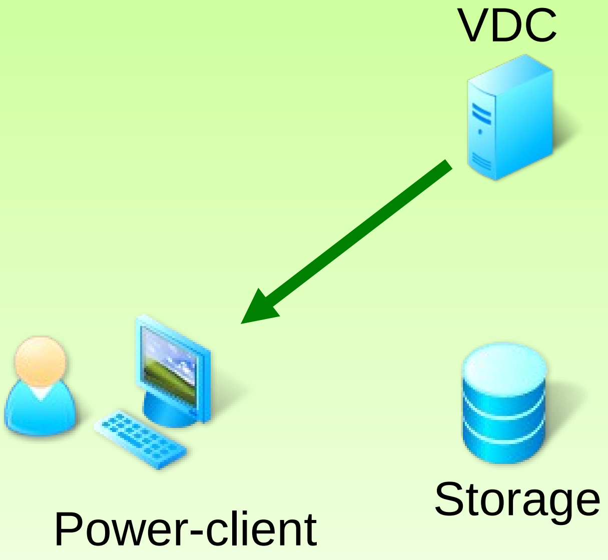


VDC

AD

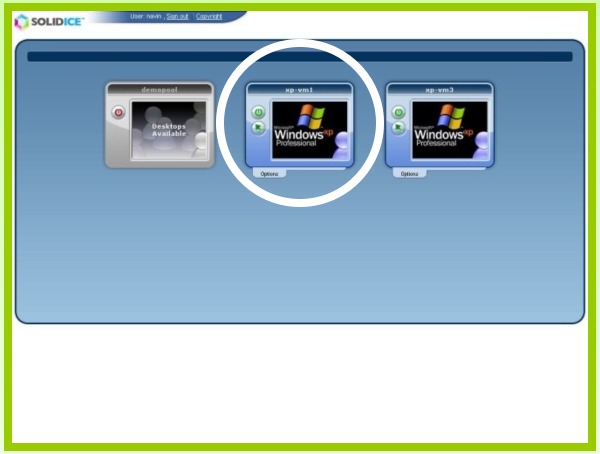
Power-client

Storage

VDC presents the user with a list of virtual desktops he/she is allowed to log into (in case of multiple)

How Stateless Solid Ice works

USER VIEW



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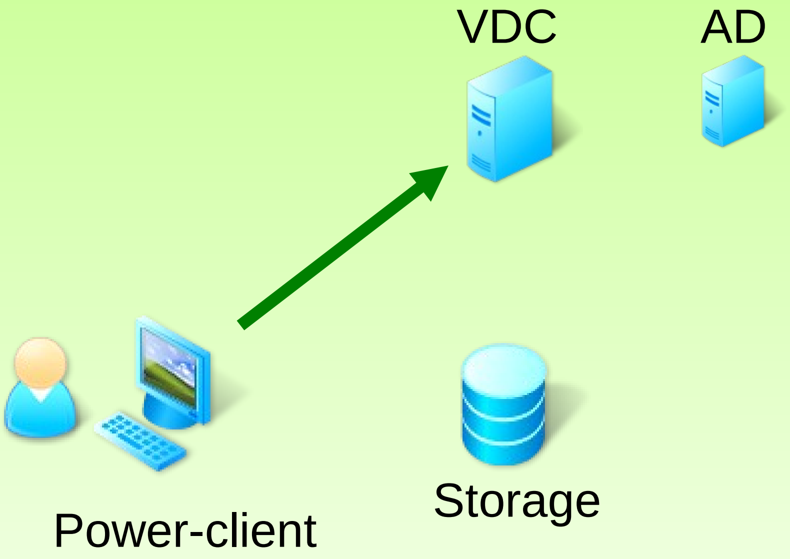
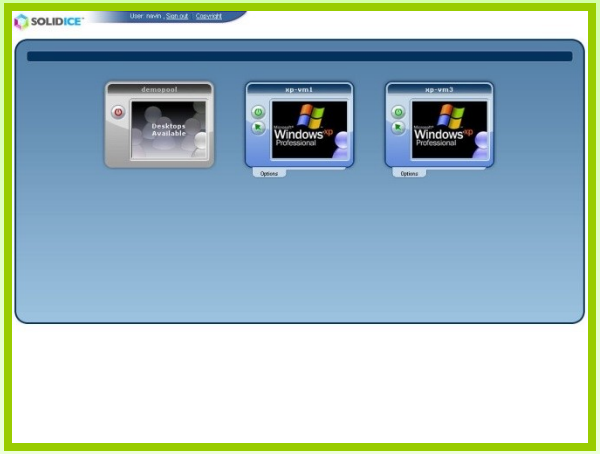


User selects the desktop that he/she wants to log into (if they have multiple desktops)

How Stateless Solid Ice works

USER VIEW



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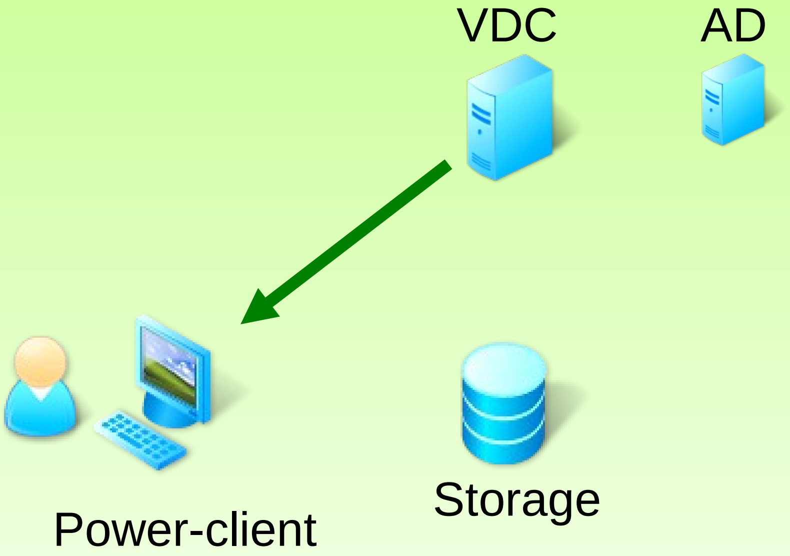
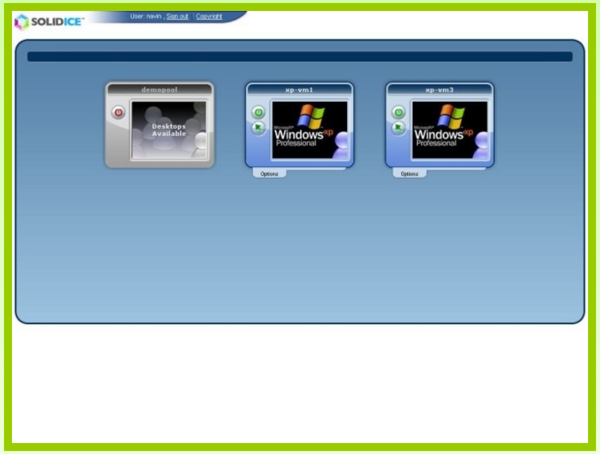


VDC provides the power-client with relevant information and credentials

How Stateless Solid Ice works

USER VIEW



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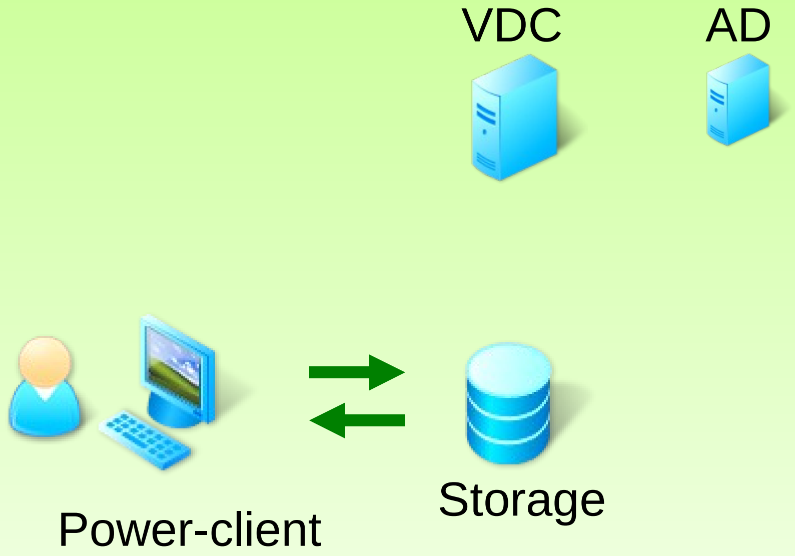
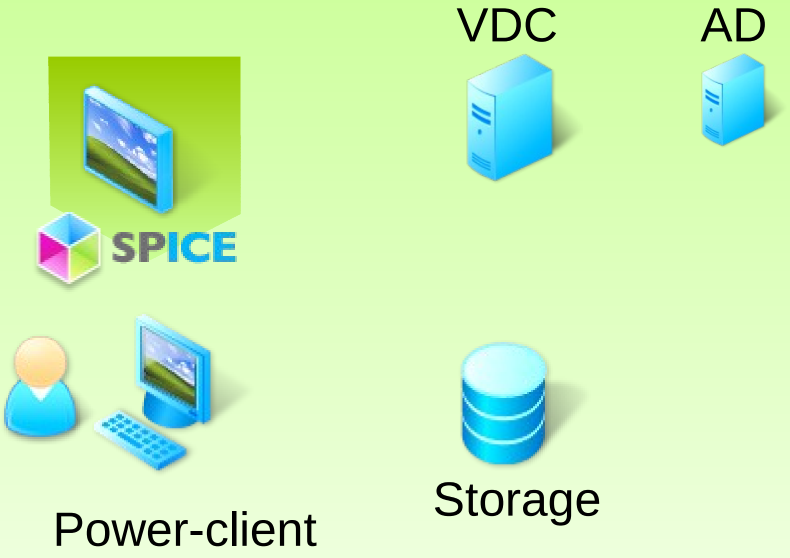


The power-client streams/runs the image from central storage

How Stateless Solid Ice works

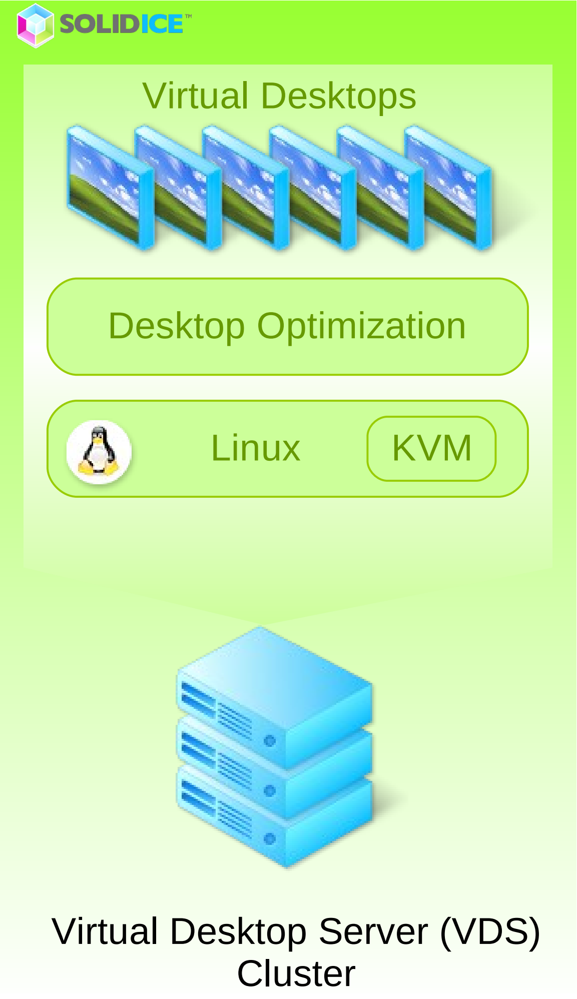
USER VIEW

SYSTEM FUNCTIONING



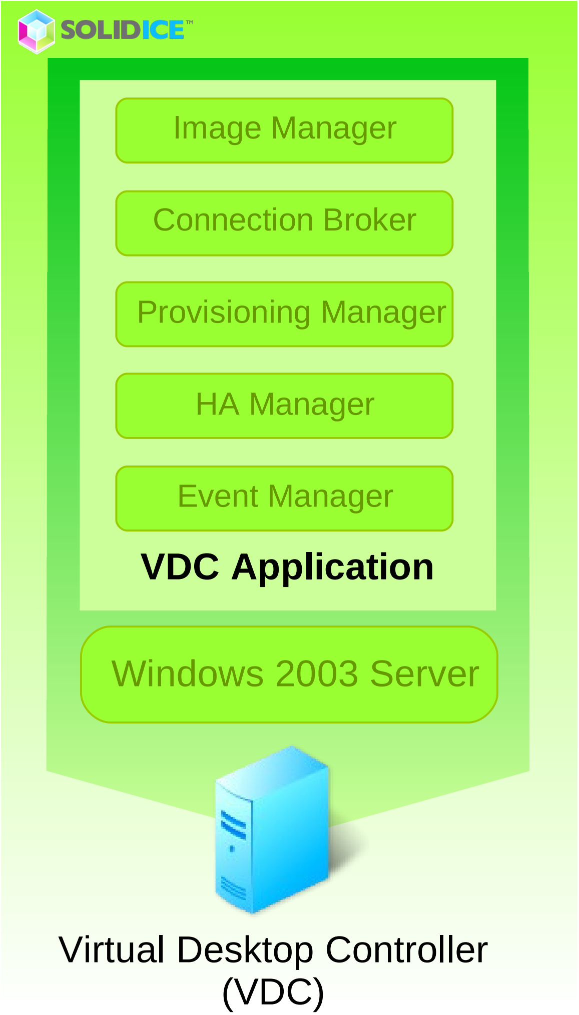
The power-client launches the virtual desktop with a local spice session

Solid Ice: Virtual Desktop Server



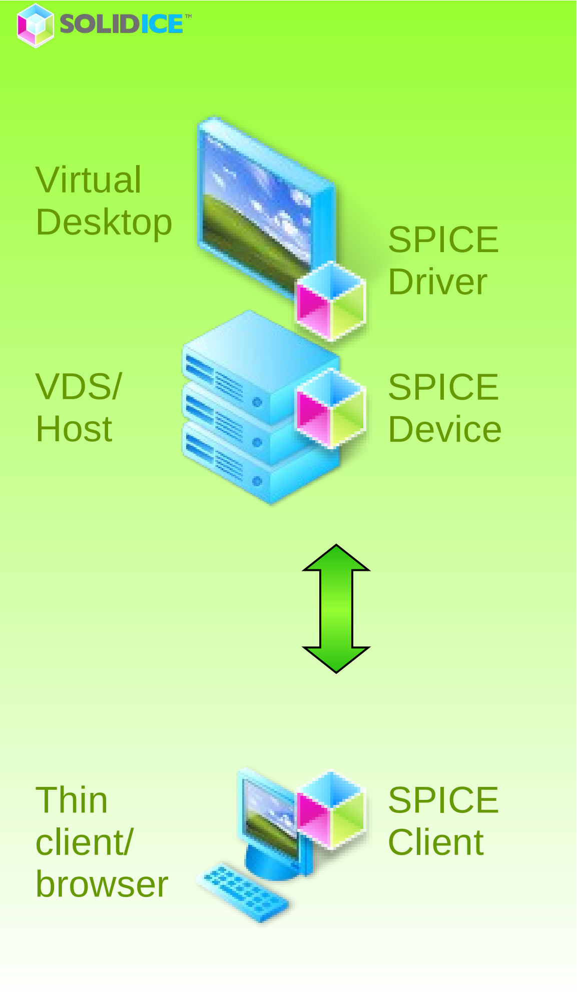
- **Leverages KVM & Linux**
  - Networking, bridging, taps
  - Priorities
  - Memory - Page-sharing, ballooning, swapping
  - Encryption for controller connection & remote clients
  - Uses NFS
  - Unix sockets for monitor & vmchannel
- **High Density of Virtual Machines/Desktops**
  - Shared pages, ballooning and swapping
  - Spice with hw acceleration
  - 2-5x other solutions (workload dependent)
- **High Availability: Operates in clustered model**
  - Controller can kill (fense) a server and re-run VMs on another
- **Easy to Use**
  - Automatic installation of packages
  - Single Sign On

Solid Ice: Virtual Desktop Controller



- **Built from the ground-up for desktops.**
  - 90% reduction in storage
  - Load balance highly utilized server
  - AD/LDAP integration, multiple domains
  - Integrates with desktop build process
  - HA Monitoring of VDSs.
  - Audit trails, reports and more
- **Manage every aspect of the virtual desktop infrastructure from one central location**
- **Search driven User Interface**
  - Cross-correlate information instantly (virtual desktops, servers, users etc)
- **Power-shell based scripting API**

Spice – Remote Desktop Protocol



- **User-experience indistinguishable from physical PC**
  - 30+ frames per second video
  - Native color, full resolution
  - Bi-directional audio and video for video-conferencing/VoIP
  - Multi-monitor support (4+ monitors)
  - USB 1.1 and 2.0 support

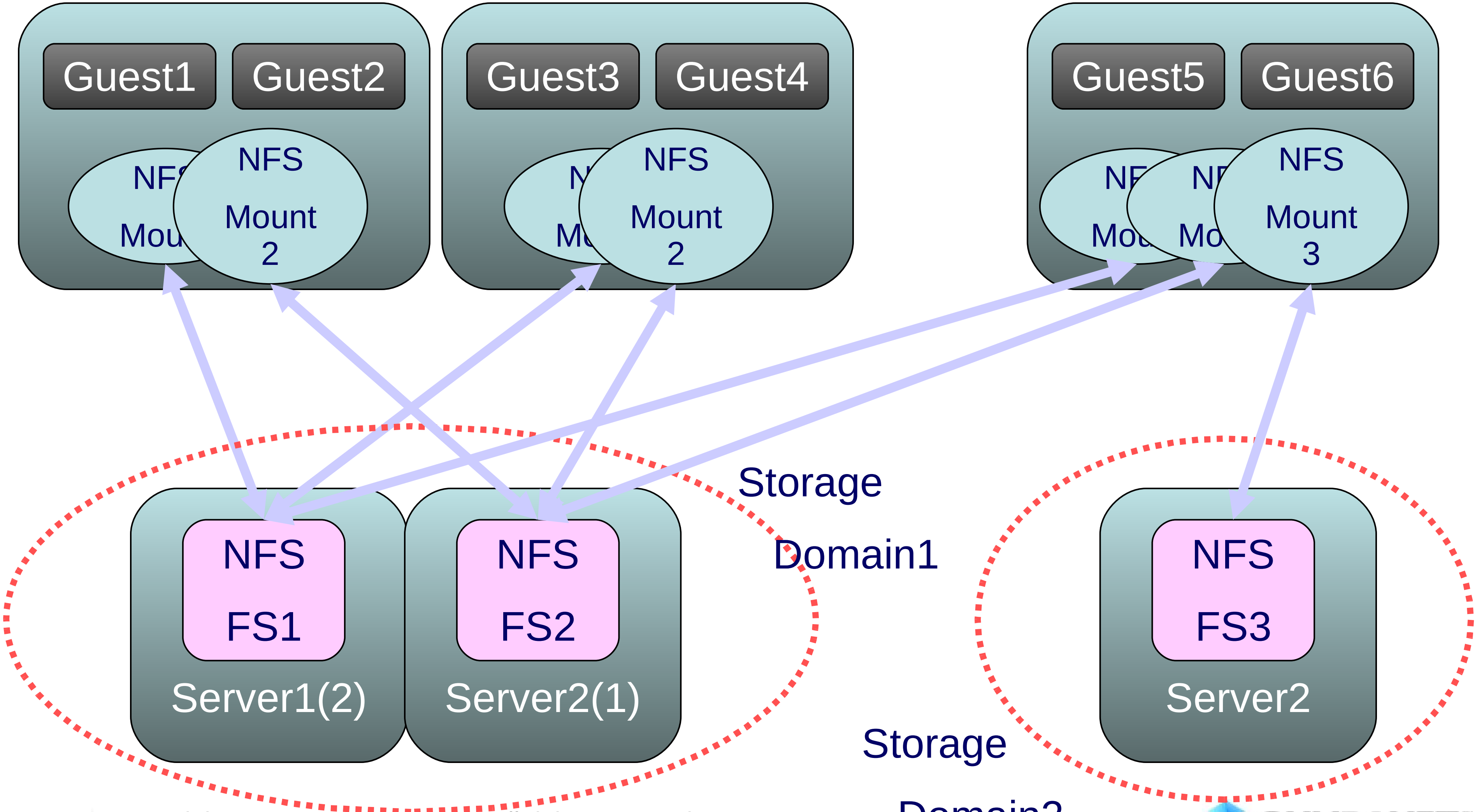
- **SPICE is an adaptive remote rendering solution**

  Utilizes graphics processing capabilities wherever they exist

  - Offloads graphics processing/rendering to client (if powerful) **and/or server**

- **Improves desktop density on the server**
  - Minimizes rendering on the server side (adaptive)

Storage: NFS & Multiple Mount points



Cool Features

- **Integrated**
  - Client-VM-Server-Active directory
- **Super dense**
- **Enhanced remote desktop experience**
  - Video / Multiple monitors / Audio / USB redirection
- **Search based management rocks**
  - Need to manage 10^5 objects
- **Image management**
  - Templates, shrinkage, collapse-backup, sync with remote site
- **External hibernation, live migration, live snapshots**
- **Many use cases**
  - Server based / Client based / Branch office
  - Runs Windows*, Linux* guests

Benefits Of Solid Ice For All Stakeholders

End-users

- User experience indistinguishable from physical PC
- Non-intrusive to user
- Access work PC from anywhere
- Computing power on demand

IT administrators

- Centralized management
- Fully integrated system built for virtual desktops
- Open, architecture (no high-end servers, proprietary file systems etc)
- Non intrusive to IT
- Significantly reduced storage requirements

Enterprise

- Full control over costs of desktops
- TCO savings of >50%
- IRR >100%
- Improved auditing ability/ compliance
- Power saving approach, green enterprise initiative

Solid Ice Potential Use Cases

Use-case	Customer Benefits
IT Training Rooms	Eliminate provisioning and re-provisioning time
Consultants & Contractors	Security, provisioning time, capex
Developer Desktops	Linux PC to WinXP VM, or vice-versa, on-demand
Outsourcing	Intellectual property and data security
Primary Desktop	Significant manageability benefits, ROI
Work-from-home	Access work PC (virtual desktop) from home, capex.
Disaster Recovery	Pool of DR desktops, or individual desktops

KVM Best Practices in Solid Ice

- **Use KVM :)**
- **Use RHEL/SLES Linux for Virtual Desktop Servers**
- **Windows standard HAL performs better**
- **Time drift fix is a must**
  - -no-kvm-pit --> -no-irq-chip :(
- **Migration keep breaking every qemu merge**
  - Regression tests
- **Tpr optimization/FlexPriority is a must for windows acpi**
- **Use templates based snapshots**
- **Monitor/vmchannel unix socket**
- **External hibernation** – migrate into file
- **Every device has a fallback**
  - Virtionet-rtlnet, spice-vnc-rdp,networking- vmchannel,
- **Upgrades using cdrom (change cd)**
- **Massive tests are paramount**

Developed Features

- Good hypervisor to form a great community!
- VMDK image format support
  - Actually we now use it only as a migration path
- Time drift fix
  - Rtc, pit
- Pvnet, virtionet, virtio network drivers for windows
- E1000 network drivers
- Migration (along with Anthony Liguori)
- In-kernel apic (beginning)
- Tpr optimization
- Balloon driver (+Marcello, Rusty)
- Vmchannel driver
- KSM
- Usb isochronous; 2.0

- Task switching (Ghost)
- MMU notifiers
  - Kprobes
- AMD support (with amd of course)
- > 3.75G support
- Zero block de-dup
- Image sync – dirty bits

Still Left

- Monitor shared library for Stable machine readable protocol
- Various time drift fixes
  - RTC, Get rid of in-kernel pit
- Migration issues
  - AMD – Intel migration
    - Choose performance vs flexibility
  - Least common denominator
    - Masquerade the cpuid bits
- Use libvirt
- Virtio based vmchannel, balloon (windows)
- Static pci slots
- Stabilize scsi for windows
- Stabilize the various Linux guests

Versions, Stability & Tests

- Our mainline features are massively tested by internal QA
  - How ever we do not test all types of Linux guests.
  - If things break in mainline tree we discover it way too late
  - Until May 2008 we use to branch mainline in a random point
- Now we base it over community published stable branch
  - Official kernel release – starting at 2.6.26
  - Use latest 'stable' userspace – kvm-68
  - Only apply bug fixes
  - **Until it reaches standard distributions it can serve as community stable branch**
- Build open source test framework
  - Stabilize KVM
  - Discover regression fast

Results - Office workload

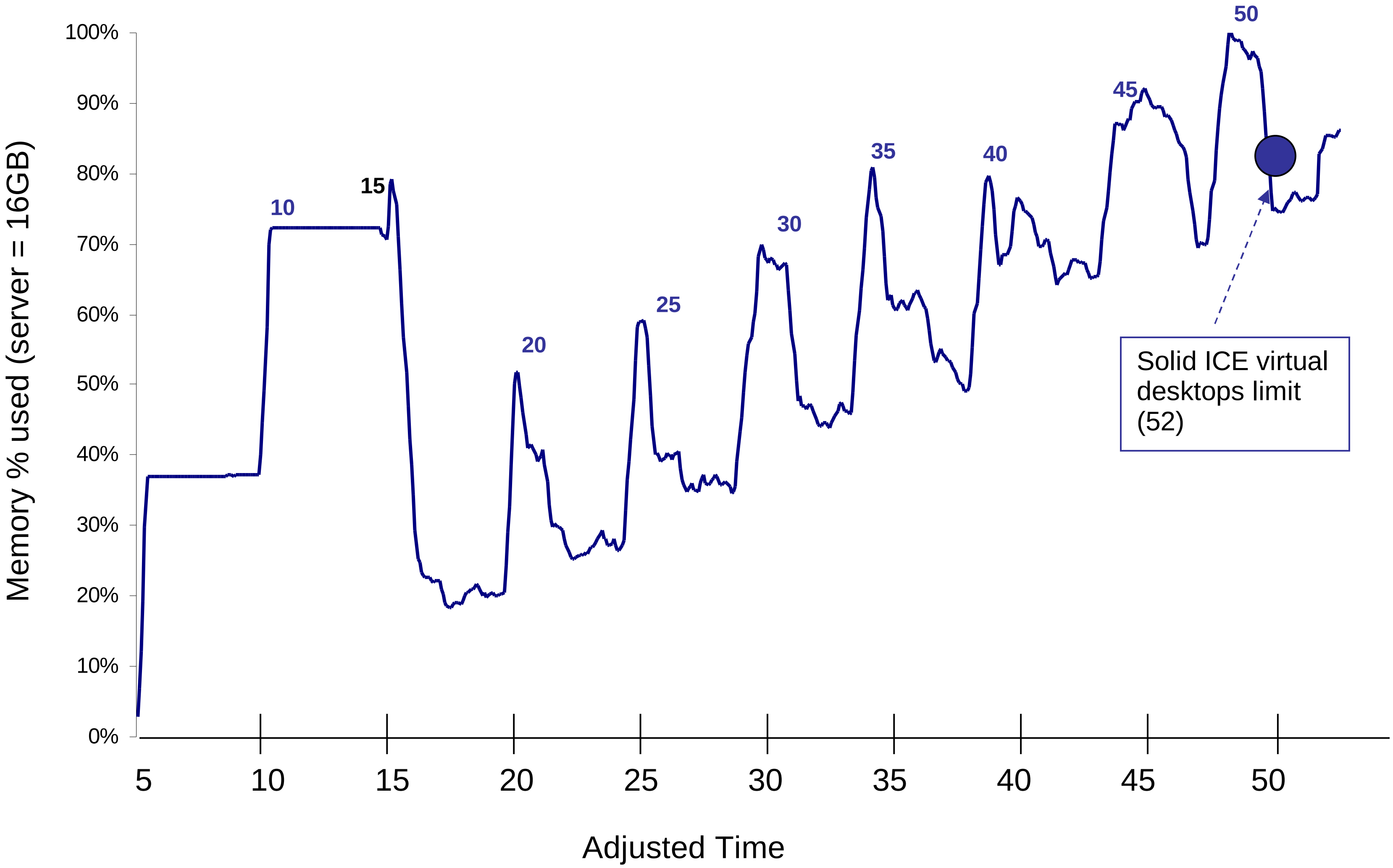
- Started batches of 5 Virtual Desktops (VD) at a time, every 5 minutes

- Each of the VDs ran a script of office workload continuously

- One VD was constantly manned by a real user doing office workload

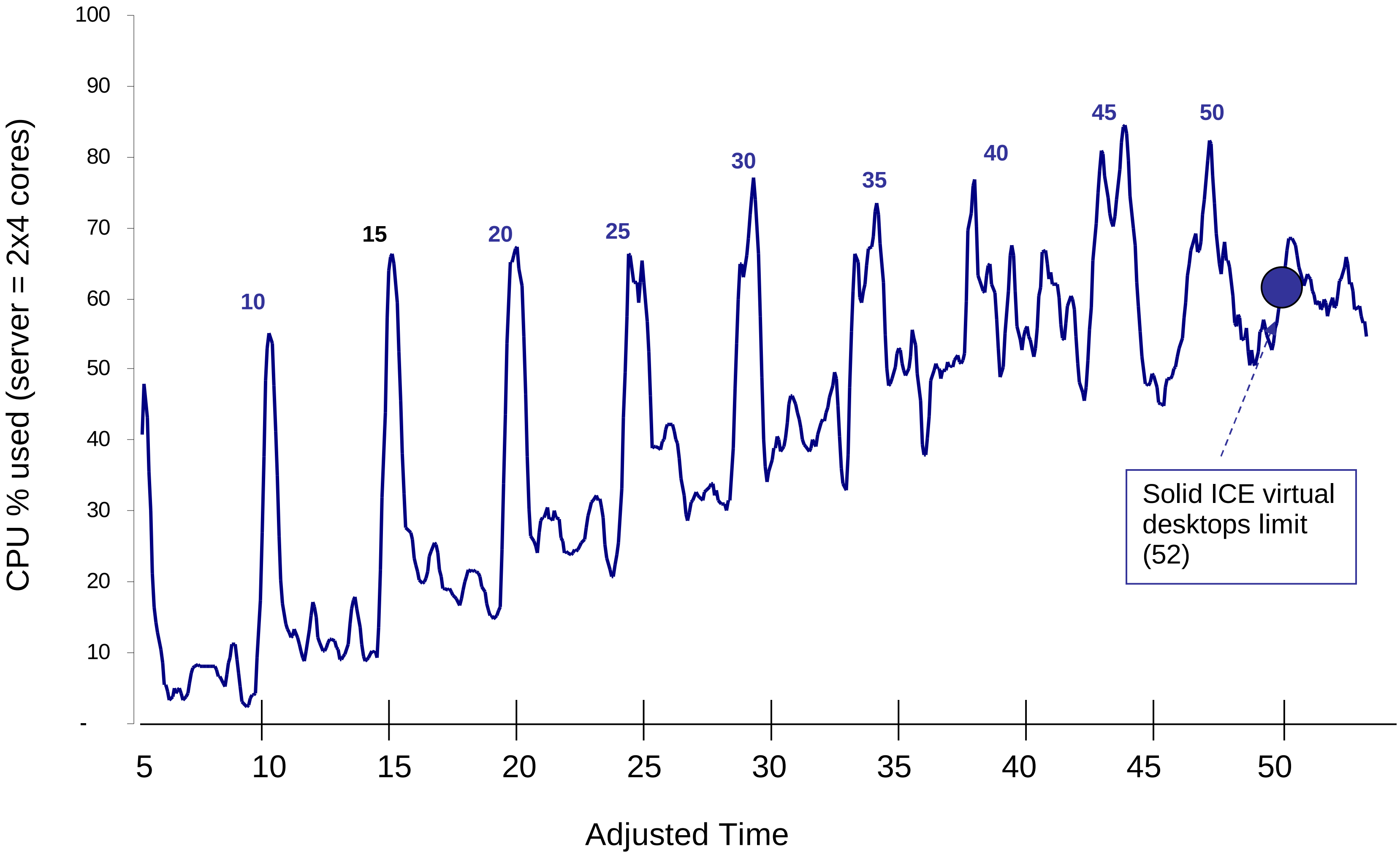
- The test stopped when the user could not do natural office work

Office workload – Solid ICE Memory Usage



Solid ICE virtual desktops limit (52)

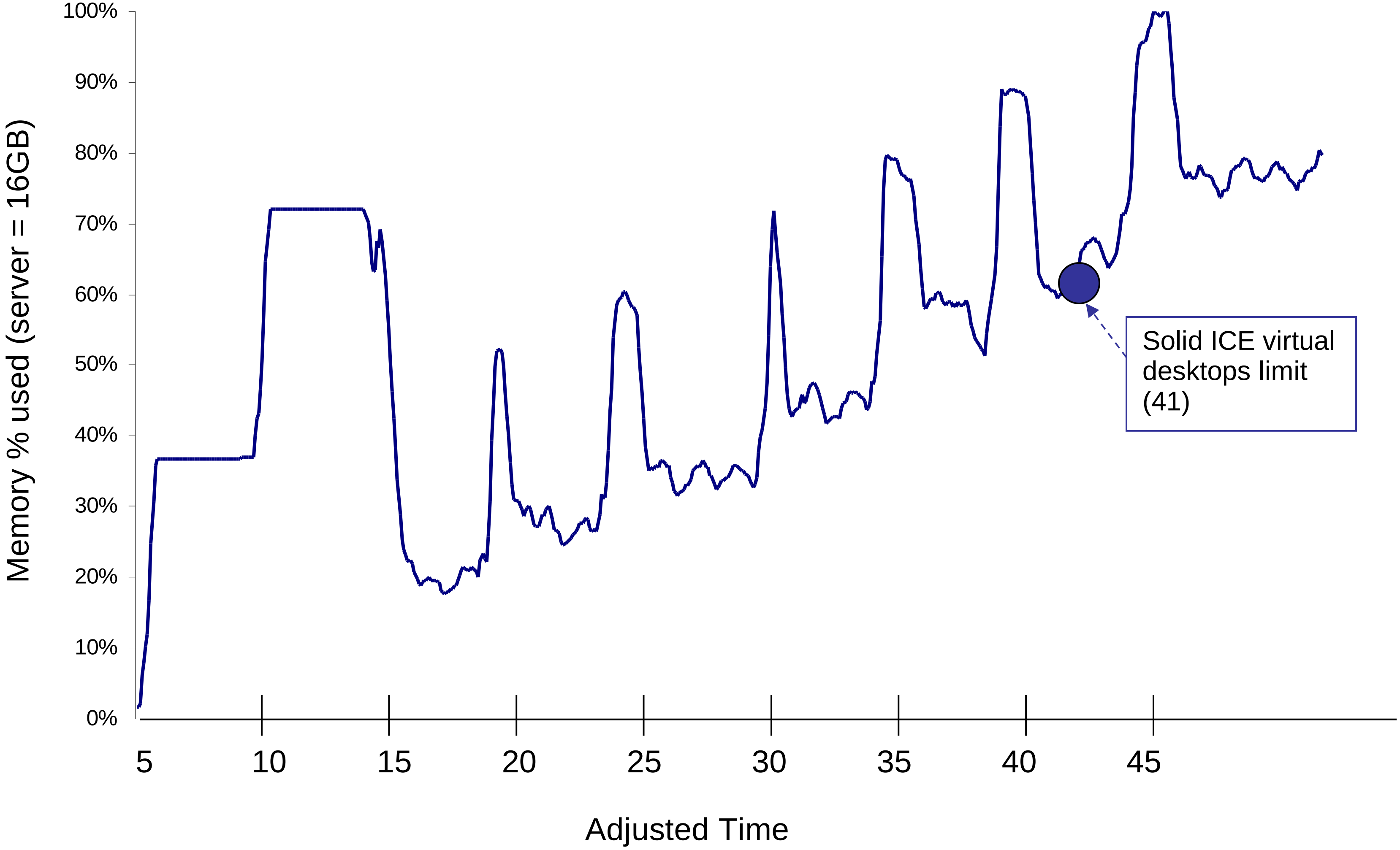
Office workload – Solid ICE CPU Usage



How we tested – Mixed Multimedia workload

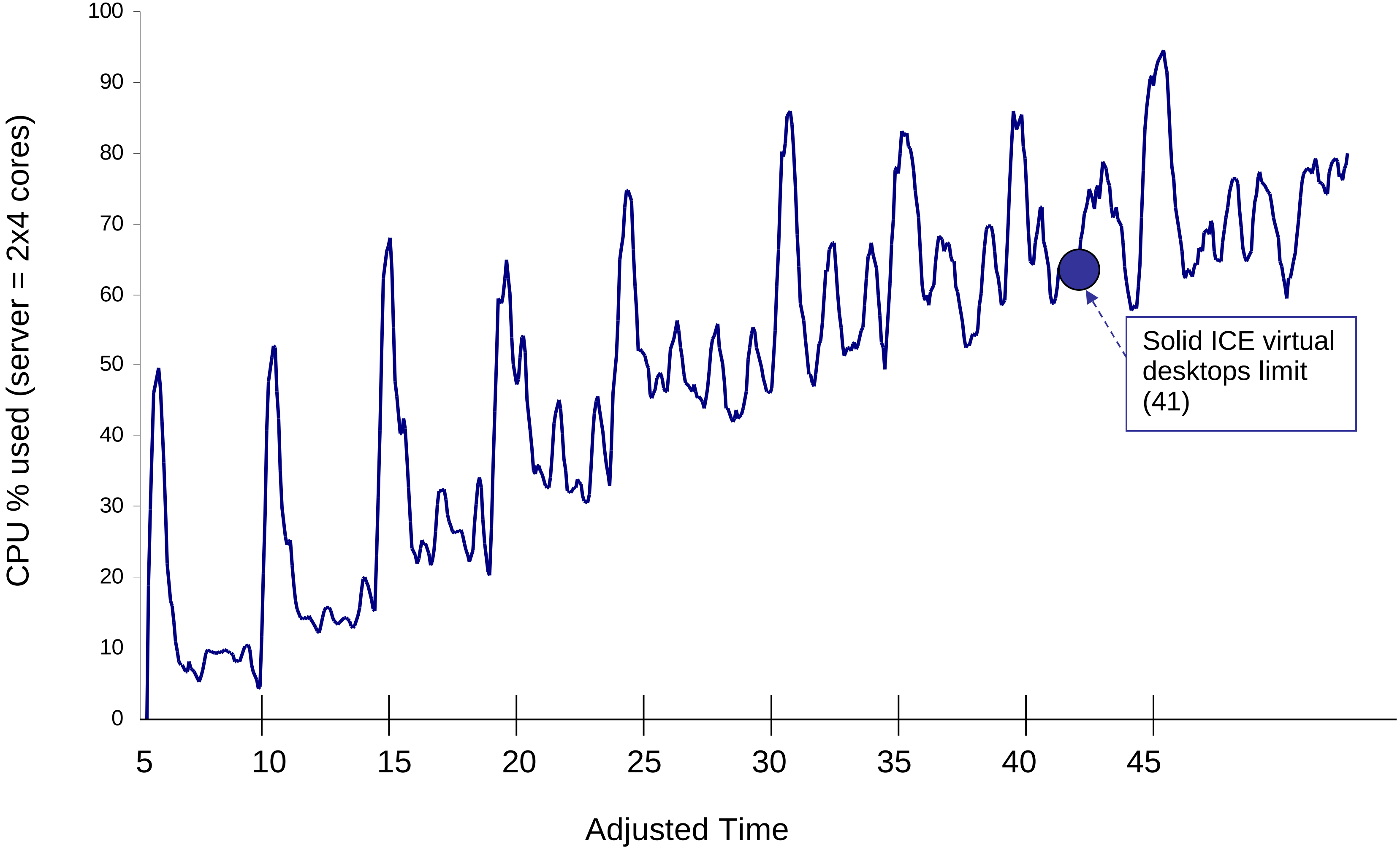
- Started batches of 5 Virtual Desktops (VD) at a time, every 5 minutes
- 4 of the VDs ran a script of office workload continuously
- The 5th VD ran full screen video
- One VD was constantly manned by a real user doing office workload
- The test stopped when the user could not do natural office work or the video was completely unwatchable

Video workload – Solid ICE Memory Usage



Solid ICE virtual desktops limit (41)

Video workload – Solid ICE CPU Usage



Solid ICE virtual desktops limit (41)

Conclusions

- Qumranet enjoys from KVM
- KVM enjoys from Qumranet
- We are the community
- KVM is ready for mainline

Thank You

June 12, 2008