Beyond VDI: Why Thin-Client Computing and Virtual Desktop Infrastructures Aren’t Cutting it

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# Desktop Virtualization: Road to Discovery

<table>
<thead>
<tr>
<th>DATE</th>
<th>INSTITUTION</th>
<th>CONCEPTS</th>
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</thead>
<tbody>
<tr>
<td>1999</td>
<td>w. Sun Labs</td>
<td>Sun Rays</td>
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<td>2002</td>
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<td>2003</td>
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<td>Virtual Appliances for Deploying &amp; Managing Software (LISA 2003)</td>
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<td>2004</td>
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<td>2005</td>
<td>MokaFive</td>
<td>LivePCs: ($3M, Vinod Khosla)</td>
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<tr>
<td>2006</td>
<td>MokaFive</td>
<td>LivePC Lab: ($15M, Highland Capital, Khosla)</td>
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<td>2007</td>
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<td>2008</td>
<td>MokaFive</td>
<td>DaaS Desktop-as-a-Service Platform</td>
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<tr>
<td></td>
<td>Stanford</td>
<td>POMI 2020: Programmable Open Mobile Internet ($10M from NSF)</td>
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2000: OS Virtualization

Inspired:
- Linux Zap ['02]
- Solaris Zones ['04]

Microsoft Windows in the future?

2001: Virtual Desktop Infrastructure
2003: LivePCs

- LivePCs = Secure, managed VM images in the cloud
- PCs (Windows, Linux, Mac PC) are generic platforms
- USB flash: personalized cache as a network accelerator
  - Supports disconnected operation

LivePC Creator/Player
Top Three Myths Around VDI

3. Thin-client computing reduces the hardware cost
Cost of End-Point Hardware

- Thin-client hardware: $300 + $60 a year (no monitor)
- PC: $499 (no monitor)
  - Intel Pentium Dual Core 1.86 GHz, 2GB M, 160 GB SATA drive
- Consumerization of PCs: $0
  - Let the employees use their own computers
Moving desktops to data centers?

- Server virtualization in data centers:
  - Consolidation reduces cost and energy

- Desktop virtualization in data centers?
  - Additional cost: data center operation
  - Servers: 4-10 users per processor
    (Terminal services: 40 users per OS)
  - Storage: 5GB per user
  - Energy; rent; labor
Cost of Server Operation

- The “Superbowl” effect
  - Must provision for the “important moment”
  - Superbowl for TV networks, final projects at school
  - 9 to 5 for companies?
- Redundancy to guard against a single-point of failure
  - Google docs (July 8, 2008: 45 minutes)
  - Amazon EC2 (July 20, 2008: 8 hours)
- Resource allocation and management among clusters

LivePCs: an http server can support thousands of users
Top Three Myths Around VDI

2. Central management => centralized execution

3. Thin-client computing reduces the hardware cost
Security and Management, commtouch, May 2008

- Number of active zombies per day: 10-15 millions
- Typical number of zombies in a single botnet: 10,000 – 200,000
- New zombies that come ‘alive’ every 24 hours: 200,000-500,000
- Typical Zombies Activities: Spam, phishing, malware, command & control, data theft, click fraud, DDoS
- Spam activity on the Internet accounted for by zombies: 120 billion messages daily

Stealthy security breaches are harmful!
System Admin with Virtual Machines

- VMs by themselves do not improve management

- VMs: complete machines “on a platter”
  - Virtual machines → holistic management
  - Virtual machines → outside-the-box security control

- Central management ≠ centralized execution
  - Physical security ≠ security
Administration Work Flow

LivePC Creation Tools

One-Click Post

Multi-Platform Support
Online and Offline Use (Cache-On-Go)
Faster Launch (Streaming & Predictive Fetch)

System & User State Separation
(Rejuvenation)

Automatic & Incremental Updates via RSS
(Slim Transfer & Auto Subscription)
Securing the End Points with Encrypted Keys

- Hardware / software:
  - Encryption
  - Revocation
  - Self-destructs after 10 incorrect password guesses

- Hardware only:
  - Self-destructs if physically tampered
Holistic Management

Delivering a mirror of a golden image
Rejuvenate system disk by default
Incremental updates

• Image provisioning
• Software deployment
• Software updates
• Software rollback
• Lockdown
• New services (e.g. encryption)
• Revocation
Minimizing Virtual Image Sprawl

- A single virtual image for employees in the same dept
  - Running on different hardware
  - Different user states
Separation of System and User State

- User state customization:
  - a separate virtual disk for user state
- Machine customization
  - Domain join
  - Active Directory with group policy
  - Cached credentials
- Local environment customization
  - USB and network printer pass through
Outside-the-Box Security

• Quick patching
  • Only touched blocks that need to be fetched
  • Can recall patches easily if necessary
• Recover from zero-day vulnerabilities
  • Automatic rejuvenation
  • Viruses in the user state:
    Defense-in-depth; clean with new anti-virus/OS
• Only way to get rid of all root kit attacks
• Baremetal version – eliminates keylogging
Top Three Myths Around VDI

3. Thin-client computing reduces the hardware cost

2. Central management $\Rightarrow$ centralized execution

1. Central management $\Rightarrow$ bad user experience
Overheads of Virtual Desktop Infrastructure

- VM
- Multiplexed VM
- Remote display
Main Frame to PC/Laptop Revolution

**VDI is a Throw Back to Main Frame Days**

- Allows occasional disconnection from the network
- Fast and cheap hardware
- Interactive applications
- 3D graphics: Google earth
- USB peripherals
- **Personal Computer** -- personal control: hw, applications

**Question: Why Not?**
MokaFive: “Eat your cake and have it too”
New Frontier: Security + Quality of Life

Security
- Information leakage
  - Data breach disclosure
    - 12000 lost laptops per week in airports
  - Encryption statutes
  - SOX
  - HIPPA
  - IP
- Foreign travel

Quality of Life
- Portability
  - Platform of choice
    - Macs, EEEPC
- Personalization
- Performance
- Green initiative
  - Work from home

Corporate LivePCs on Consumer PCs
Use Cases

- Business: HR staff's home access to employee data
  Disaster recovery: a backup PC in your pocket
- HMO: Patient data access in clinics, hospitals, homes
- Law firm: Proprietary client info & software access
- University: Labs for running different courses
- ISV: Demos on customers' machines
Future Use Cases

- Hotels
- Internet cafes
- Consumers
Stanford POMI 2020 Project: Programmable Open Mobile Internet

10x cheaper, 10x more users
Technological Trends

Convergence of broadband, wifi, cellular, wimax
Convergence of PC, CE, phones
Three-Tier Architecture

Personalize the generic PC,
Borrow the power, display, keyboard, memory, ...

My key, cache, window into my
digital ID, digital personality, digital assets, and the internet
Conclusion: Virtual Desktop as a Service

Pioneered Virtual Desktops
- Optimized for DaaS
- “The Collective”
- 15 patents pending

Create
- Creator Wizard

Deliver
- One click post and subscribe
- Faster launch

Users free to work anywhere
- Online & offline
- X-platform
- Isolation (Secure and Confidential)

Maintain & Control
- Incremental update
- Rejuvenation
- Revocation, AAA & Encryption
- BareMetal™