# Consumerizing PCs

## from research to product


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**Stanford University**
**moka5, Inc.**

# Part 1

# Motivations

# PCs are unlike CEs

**When a computer breaks,**

- **it is not my fault**
- **“I cannot just buy a new one”**

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# Consumers ≠ System Admins

- System admins = CS students on vacation
- Even Ajax may not run on all browsers
- Manual tasks: disk defragmentation
- Data ares not backed up
- Ultimate resort: re-install the OS
- Consumers have no aptitude, interest, time

**Need to commoditize system admin**

# Security Measures: Arms Race

- Spyware, malware targeted at children
- 1/3 of children ages 10-17 are exposed to unwanted porn
- Viruses, spam, spyware, phishing, bots
- Zero-day vulnerability

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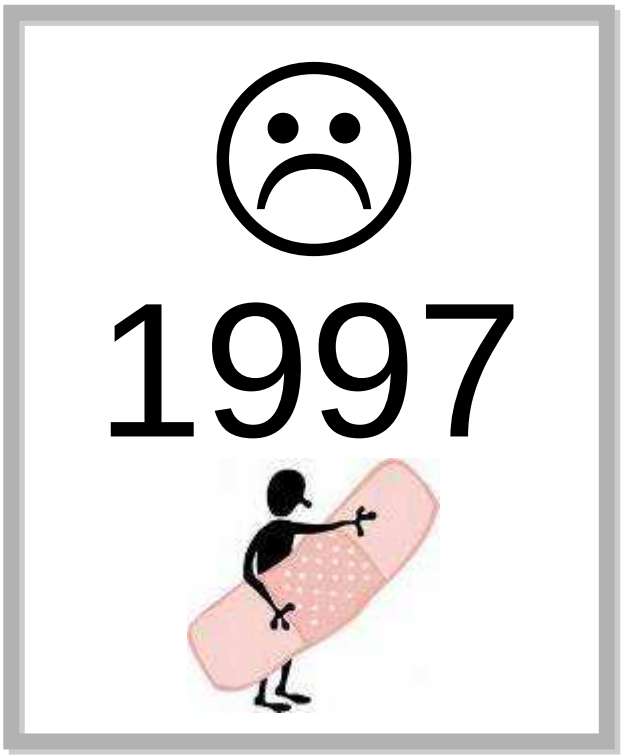
# Company IT Nightmares

- Home computers infecting data centers
- Disasters
- Stolen data

# 10-Year Research





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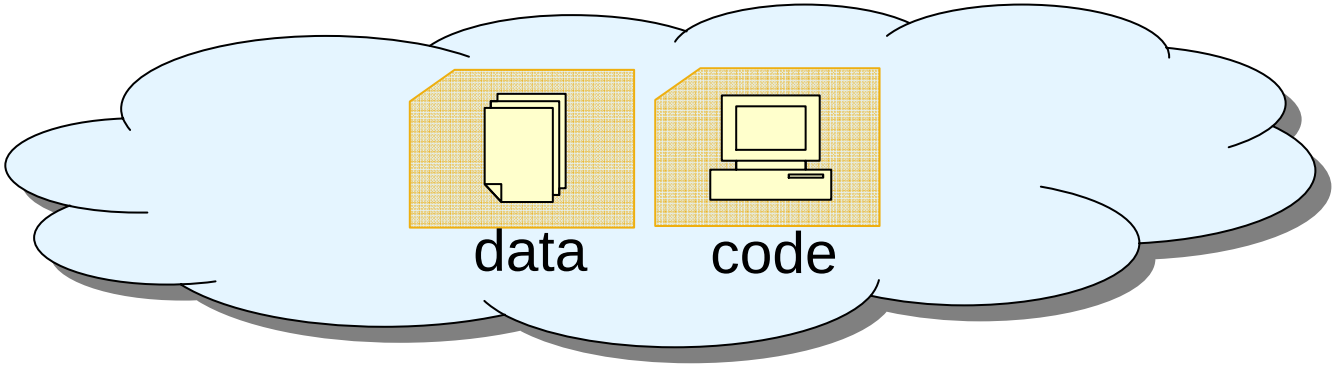
# Digital Asset in the Cloud




**Digital ID/cache unlocks asset in the cloud**

**Carry/access everywhere (network accelerator)**

**Borrow any PC (300M units)**

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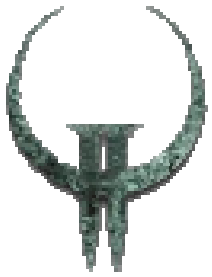
# Personal Digital Asset: Data + (Managed) x86 virtual machines


bddbddb



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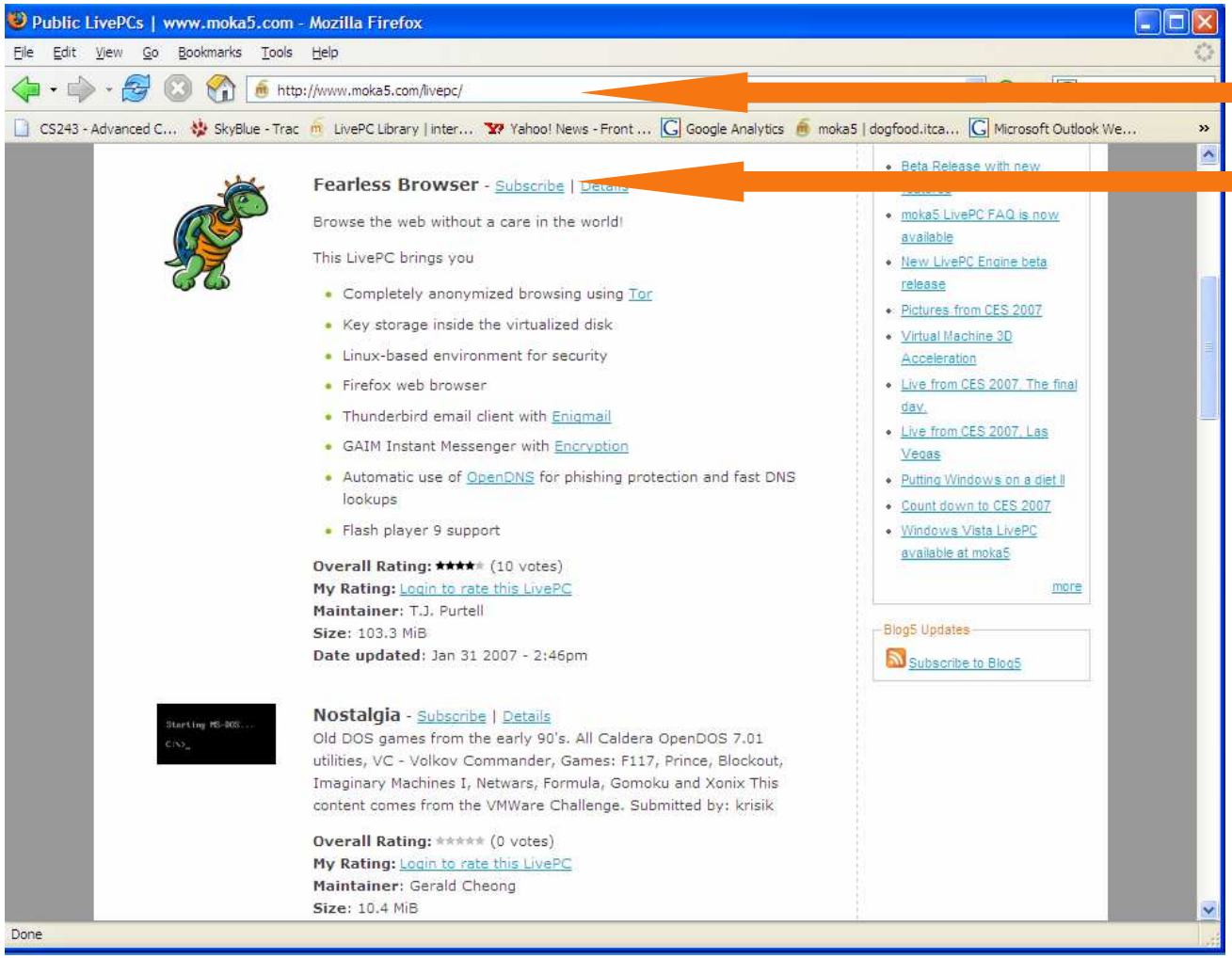
# Demo

## Part 2

# Like Watching TV: select your LivePC




**www.moka5.com**

***Click "subscribe"***

**Choice of LivePCs:**
**OS + applications updated live**

**Peer sharing of LivePCs publicly or privately**

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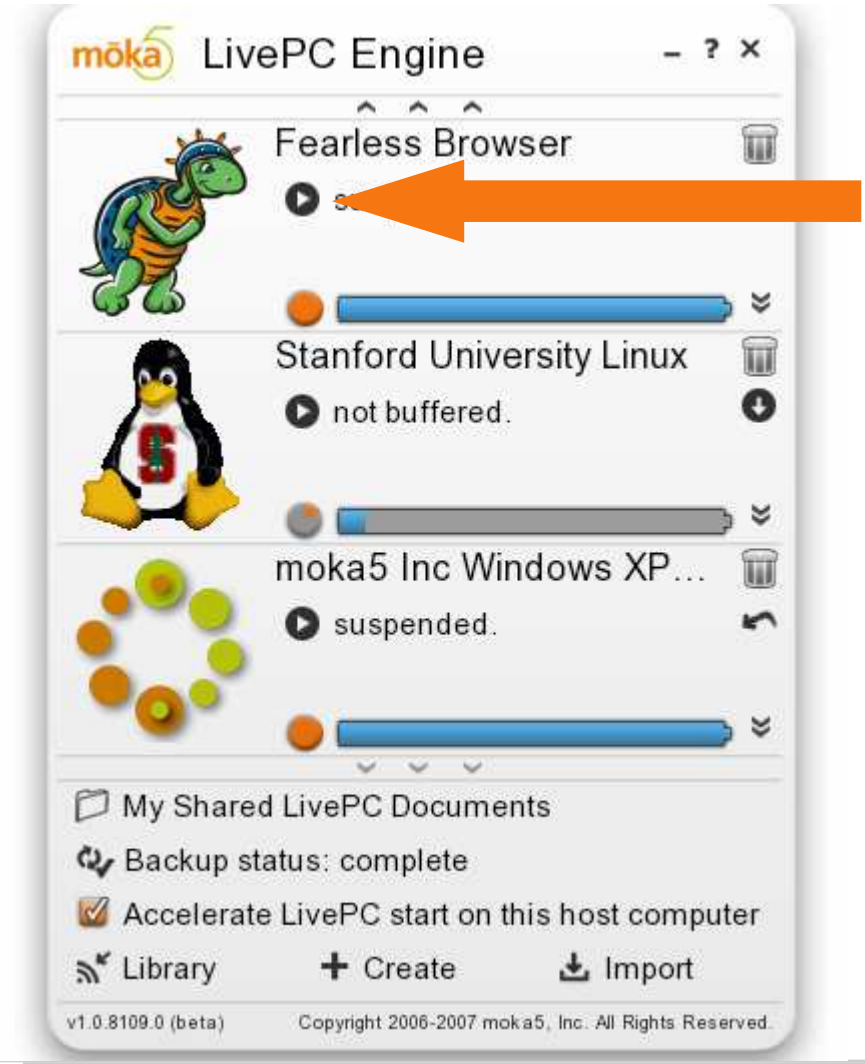
# Play it on any Windows PC




***Plug into Windows PC***

***Click "play"***

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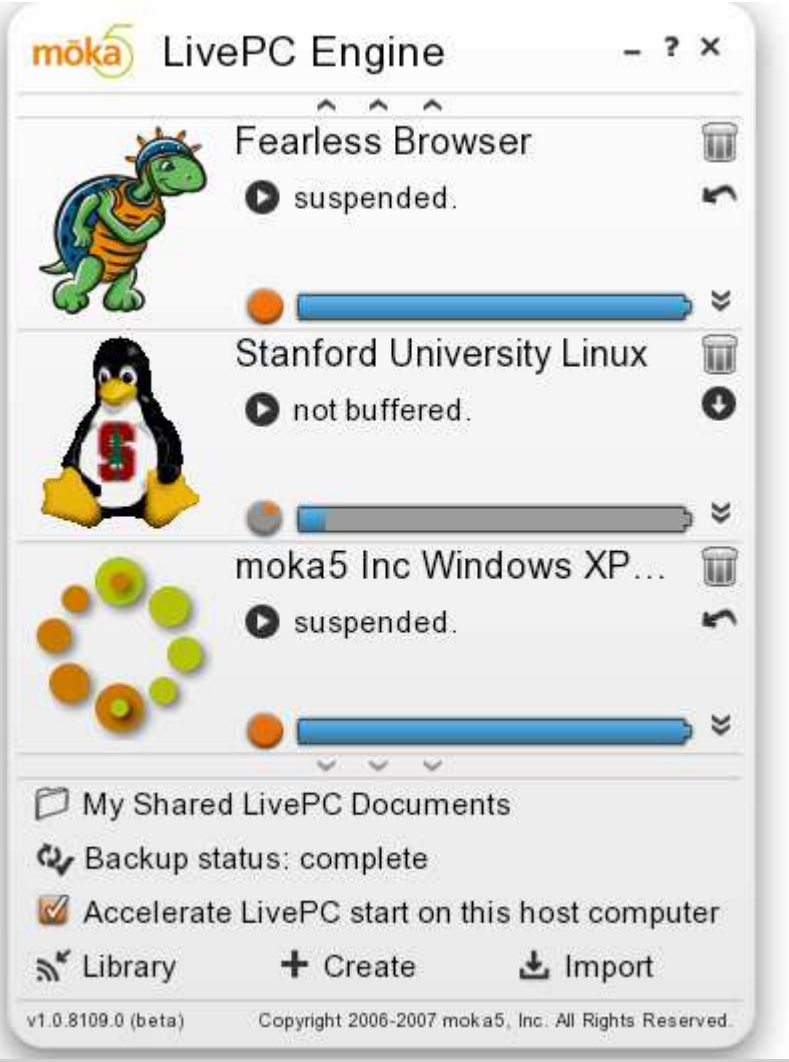
# Secure and safe, no hassles




**Choice of LivePCs**

**Safe and secure:**

- **"Firebreak" between LivePCs & host**
  - **Always up-to-date**
  - **Spyware vanishes with each reboot**

**Private:**

- **Leaves nothing on the host**
- **Takes nothing away**

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# From Research To Product

## Part 3

98
06

# High-Level Milestones

| | |
|---|---|
| 1998 | Sun Rays: Sun Labs |
| 1999 | |
| 2000 | |
| 2001 | Collective: NSF $3M grant to Stanford |
| 2002 | |
| 2003 | |
| 2004 | |
| 2005 | LivePCs: moka5, venture-backed |
| 2006 | |

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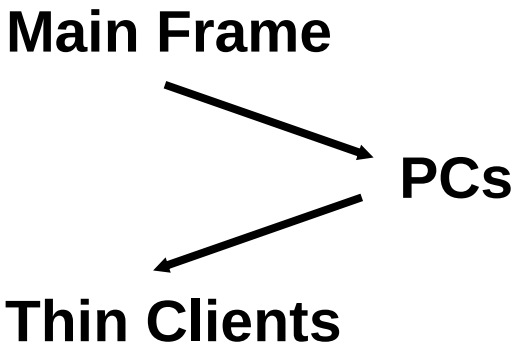
# moka5 at Consumer Electronics Show

# 1. Sun Rays (Sun Labs)




- **Stateless protocol: frame buffer protocol+opts**
- **Smart card: instant access to personal state**

[Interactive Performance of SLIM: A Stateless Thin-Client Architecture. Schmidt, Lam, Northcutt, SOSP, 99.]

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# Sun Rays (Sun Labs)

- ✓ Central management, central execution
- ✓ Smart card enables instant access across Sun Rays

- ✗ Poor interactive performance over WAN
- ✗ No disconnected operation
- ✗ Single point of failure
- ✗ Data center: expensive, hard to scale
- ✗ Cost of thin-client similar to PCs
- ✗ Solaris
- ✗ Management centralized but not solved

# 2. Virtualization of the OS level

**10,000 students log in,**
**but they don't log out!**


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# Virtualization of the OS level

- ✓ **Virtualized user processes in Solaris suspended & resumed independently**
- ✗ **Quick to demo, hard to be complete Requires re-design at the OS level**
- ✗ **Operating-system specific**

**Inspired:**

- **Solaris Zones [’04]**
- **Linux Zap [’02]**

[Supporting Ubiquitious Computing with Stateless Consoles and Computation Caches, Schmidt, Ph.D. Thesis, 2000]

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# 3. Virtual Desktop Infrastructure

- A compute utility model
- X86 virtual machines in the data center
  - Windows, Vista, Linux, MacOS X
  - x86 virtual machine monitor
- Remote display on clients' desks

[NSF Research Grant #0121481, Lam, 2001]

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# Virtual Desktop Infrastructure

- ✓ **User virtual machines can be suspended independently**
- ✓ **Runs all legacy software**
- ✗ **Expensive data-center operation**
  - ✗ **Enterprises but not universities and consumers**
  - ✗ **Miss out on “killer micro” advantage**

[VDI, VMware Product 2005]

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# 4. Distributed Virtual Desktops

- **Distribute virtual machines to end users**
- **Optimized virtual machine transfers**
  - **caching**
  - **for user mobility and management**
  - **incremental update, sharing between variations**
  - **streaming, prefetching with trace optimization**
- **“Is this research?”**
  - **Management was not an academic topic in ‘02**
  - **An NSF research initiative in ‘07**

[Optimizing the Migration of Virtual Computers,
Sapuntzakis, Chandra, Pfaff, Chow, Lam and Rosenblum, OSDI 2002]

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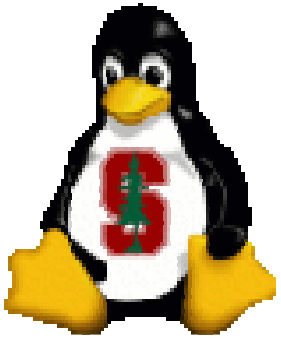
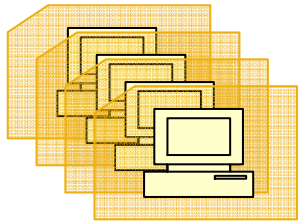
# 5. Virtual Appliances

- **Soft special-function machines**





- **Manage by shipping new diffs**
- **Spyware vanishes upon reboot**



[Virtual Appliances in the Collective: A Road to Hassle-Free Computing, Sapuntzakis and Lam, HotOS 2003]

[Virtual Appliances for Deploying and Maintaining Software, Sapuntzakis, Brumley, Chandra, Zeldovich, Chow, Lam, Rosenblum, LISA, 2003]

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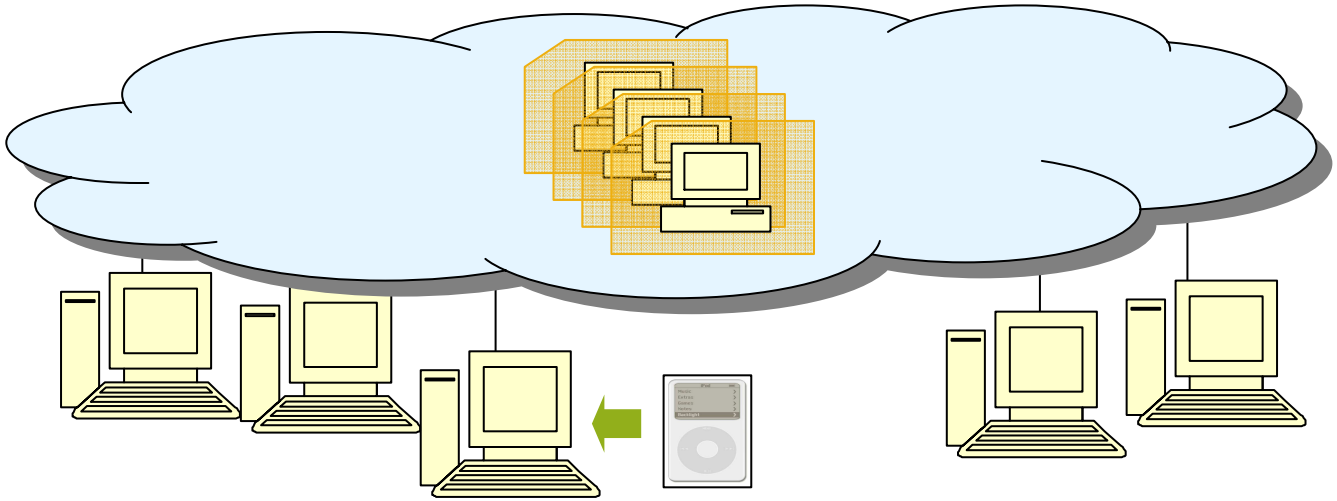
# 6. Collective System Architecture



- **LivePCs: managed x86 virtual machines in the cloud**
- **PC = LivePC Engine (Linux boot)**
  - **Download, boot, upload, cache LivePCs**
- **20GB 1.8 inch drive = portable LivePC Engine**

[US Patent Application Number 11/007911]

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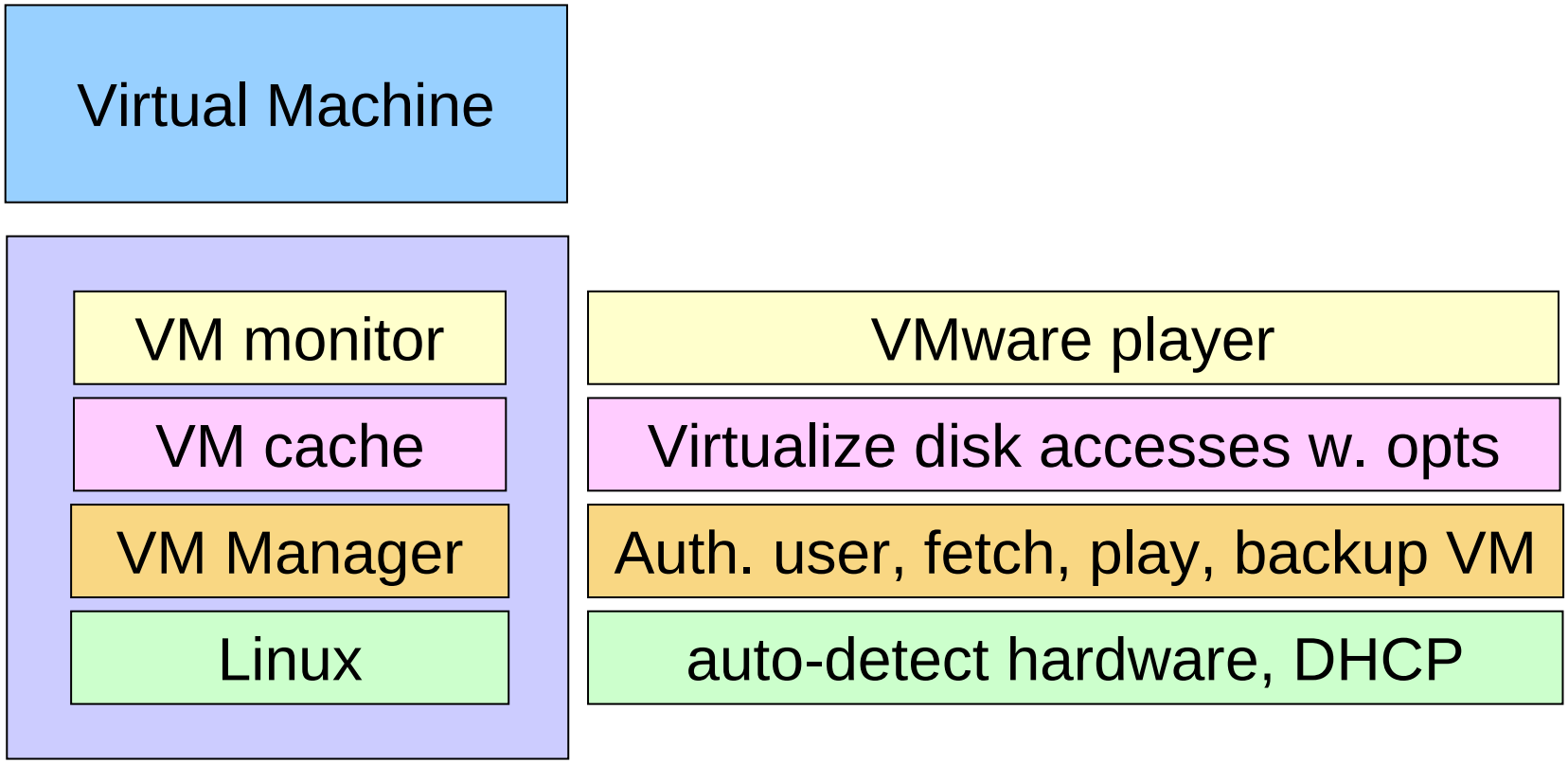
# LivePC Engine (Baremetal Ed.)




[The Collective: A Cache-Based System Management Architecture, Chandra, Zeldovich, Sapuntzakis, Lam, NSDI 05]

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05

# 7. Community Portal: self service

LivePC publisher

Upload LivePC

**web server**

Web-based Registration

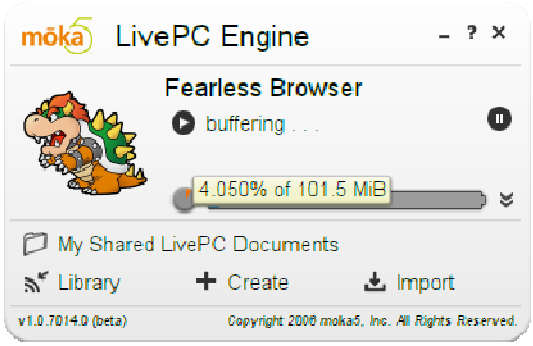
Update request

LivePC Stream (http protocol)

**LivePC Subscription service**

Subscription Status request

Update notification (RSS feeds)




[www.moka5.com]

06

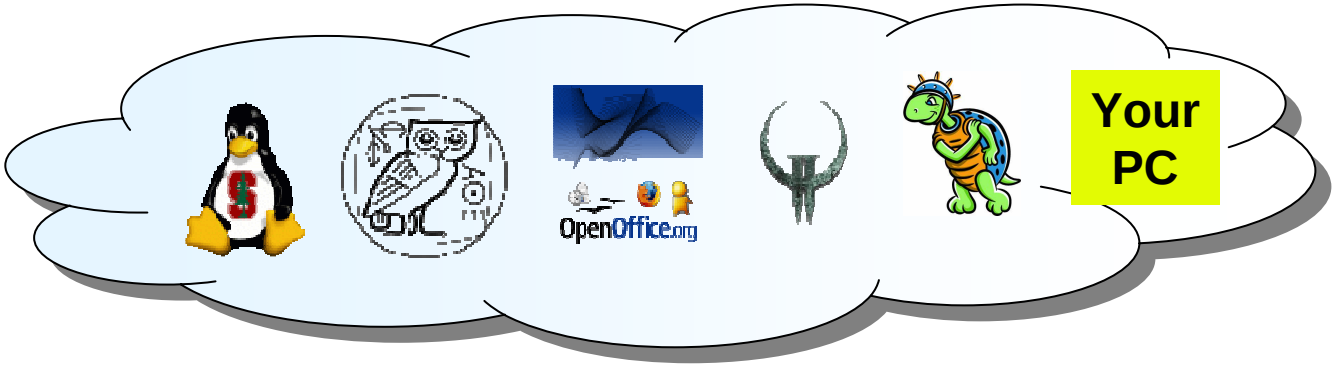
# 8. LivePC Engine: Windows app

- Linux does not work for all hardware
- Hard to get network connection upon bootup
- Borrow not just hardware,
  but also Windows device drivers + network connection
- Dynamic install of Windows application
- Less secure, more portable

# 9. All-in-one USB controller

- “Have controller, will play”
- 3D graphics virtualized
- Peripheral plugged into guest

# Final Architecture




Digital ID/cache unlocks asset in the cloud

Carry/access everywhere (network accelerator)

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# Closing Thoughts

- **"Feel the force" (Moore's Law)**
- **Think outside the box – first in a category**
  - **there are no rules**
  - **It's fun, hair-raising, requires confidence**
- **Follow your passion:**
  **especially when starting a company**
- **Research** **Product**
  - **way out there** **bite-sized steps**
  - **right architecture** **perfection, best in class**
- **The key: people – mentors, students, team**
- **Startup:**
  **good ideas→good people→good people→good ideas**

# Computer Revolution

mainframe

mini

workstation

PC

laptop

finger tip

**Every person will carry his digital assets on a fingertip drive!**

[Software freely available at www.moka5.com]



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