



## InstantLab 2.0 - A Platform for Operating System Experiments on Public Cloud Infrastructure

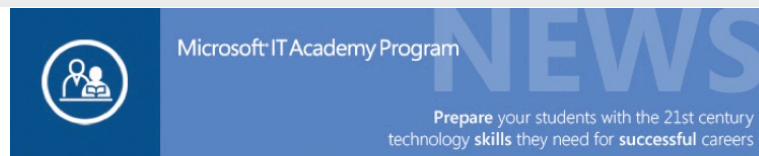
Prof. Dr. Andreas Polze / Christian Neuhaus  
with Rehab Alnemr, Lysann Kessler, Frank Schlegel

Cloud Futures, Berkeley, May 7th 2012

## InstantLab 2.0 - It's about using Cloud for Teaching (and not about teaching cloud)



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### Feature Story

#### Help Your Students Make the Shift to Microsoft Cloud-Based Certifications

Teach 21st century technology skills and follow that education with Microsoft Certification to ensure your students validate what they've learned with a reliable and trusted benchmark. ~~Microsoft technology certifications have recently evolved to include more cloud-based certifications, making them even more respected by hiring managers and increasing their value to your students. Learn more about the reinvented certifications.~~

Read about the reinvented certifications for the cloud on the Born to Learn website.

[Read the full article »](#)

Original Publication Date: 04/25/2012

### What's New/Program Updates

#### Get the Windows 8 Consumer Preview

Windows 8 is Windows reimagined and reinvented from a solid core of Windows 7 speed, security, and reliability. Windows 8 offers an all new touch interface compatible with today's devices and uses less power to transfer data faster. Take advantage of this opportunity to try Windows 8 before it's available for sale. [Download the Windows 8 Consumer Preview today.](#)

[Read the full article »](#)

Original Publication Date: 04/26/2012

### News for Administrators and Educators

#### April 2012

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Windows Operating System Internals Curriculum Resource Kit (CRK)

Microsoft Windows Academic Program

Integrate core Windows technologies into your teaching and research.

Home Curriculum Resource Kit (CRK) Windows Research Kernel Project OZ Faculty Experiences

### Windows Operating System Internals Curriculum Resource Kit

- [Overview](#)
- [Details](#)
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- [Customer Commitment](#)
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**Download CRK**

The Windows Operating System Internals Curriculum Resource Kit (CRK) materials are available via the [Academic Resource Center](#).

[Download](#)

**Overview**

The CRK is a pool of materials and resources that explain operating system (OS) concepts based on the Windows XP and Windows Server 2003 operating system family. The CRK structure follows the IEEE-CS/ACM Operating System Body of Knowledge (BOK) as defined in the Computing Curriculum 2001 project by the joint IEEE-CS and ACM Task Force (CC2001).

The CRK is based on *Windows Internals*, 4th edition (Microsoft Press, 2005) by Mark Russinovich and David Solomon. The experiments, lab descriptions, quizzes, and assignments are an integral part of the course materials and were tested over a five-year period in an OS architecture class taught by Andreas Polze at Humboldt University of Berlin and Hasso Plattner Institute at University of Potsdam, Germany.

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**Details**

16 scalable units. The CRK consists of 15 units – five core and seven elective units from the BOK and three

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## InstantLab 2.0 employs Windows Research Kernel (WRK)



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- Stripped down Windows Server 2003 sources
  - Only kernel itself, no drivers, GUI, user-mode components
  - Missing components: HAL, power management, plug-and-play
- Released in 2006
- Freely available to academic institutions
- Encouraged by license:
  - Modification
  - Publication (of excerpts)

## Structuring Experiments: The UMK Approach

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- U-phase
  - Concentrate on OS concepts
  - Introduce OS interfaces
  - Systems programming
- M-phase
  - Observe concepts at run-time
  - Introduce monitoring tools
  - System measurements
- K-phase
  - Discuss kernel implementation
  - Introduce kernel source code (WRK/UNIX)
  - Kernel programming

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## The burden of running OS experiments

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- Teaching operating systems requires chances for hands-on experience and demonstrations on live systems
- Providing these experiments is hard:
  - Changes of the underlying hardware and software make it hard to reproduce results
  - Considerable set-up work is required

Solution



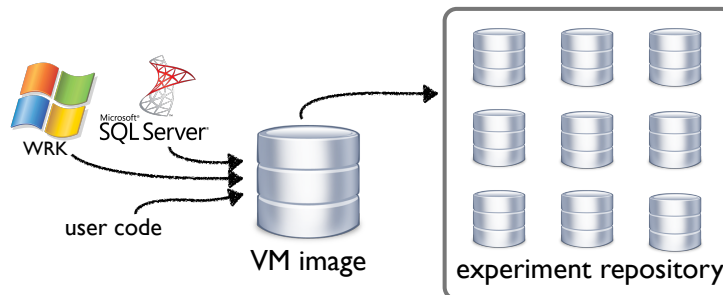
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## InstantLab 2.0: Challenges & Solutions

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- **Problem #1:**
  - Changes of hardware and software make it hard to reproduce experiment results (after more than 5 years of WRK in class)
- **Solution:**
  - Run experiments in virtualized environments
  - Set of „canned“ experiments available via MSDN AA

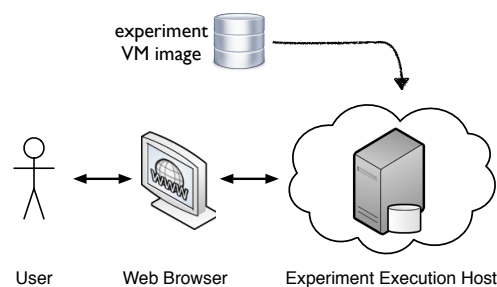


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## InstantLab 2.0: Challenges & Solutions

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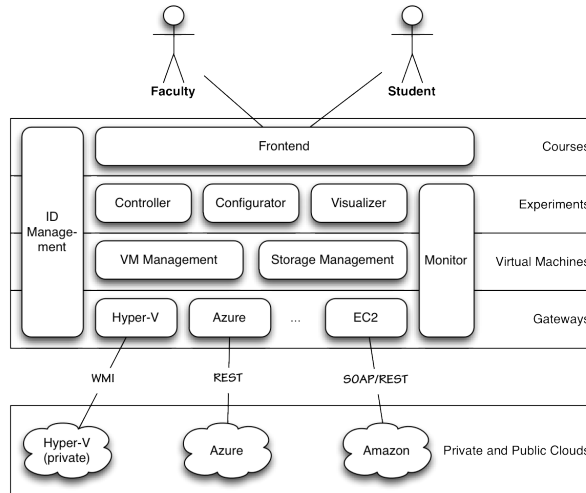
- **Problem #2:**
  - Users (lecturers/students) need to set up and maintain experiment environment
- **Solution:**
  - Experiment provisioning on cloud infrastructure
  - But: Which provider? Public/private?



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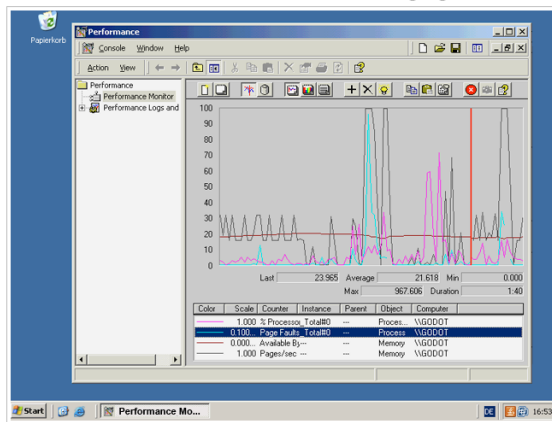
# InstantLab 2.0: Architecture Overview

9 Everything in the cloud, flexible choice of providers



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10 You are currently running the following experiment:  
Performance Monitor: Paging



## Browser-based access

- U/M experiments are easy
- K experiments are best run in private cloud
- User/Experiment management is big challenge

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**InstantLab**  
Running Operating System Experiments in the Cloud

You are currently running the following experiment:  
**WRK Manipulation and Debugging: Page Replacement**

Experiment Actions:  
Pause Shutdown  
Save Results  
Toggle Screen

Kernel Debugger

```

Command: Kernel\Compat\...\page_replacement - WinDBG6.12.0002.633 A4D64
-----
Downloadable search paths:
* Symbols can not be loaded because symbol path is not initialized.
* The Symbol Path can be set by:
  * using the _NT_SYMBOL_PATH environment variable
  * using the -r (symbol_path) argument when starting the debugger
  * using sympath and sympath*
-----
*** ERROR: Symbol file could not be found. Defaulted to export symbols for atknapi.exe -
Windows 7 Kernel Version 7601 (Service Pack 1) x64 (i386) from x64
Product: Server suite Enterprise TerminalServer SingleUserTS
Built by 7601.17640.amd64fre win7sp1_qpr.110621-1558
Machine Name:
Kernel base = 0xfffff800_01661000 PpCodeModuleList = 0xfffff800_01866670
Debug session time: Thu Dec 29 18:23:43.726 2011 (UTC - 5:00)
System Uptime: 8 days 0:23:56.609
Device: testrun.com emspsm.com - code 00000003 (first chance)
-----
You are seeing this message because you pressed either
  * CTRL+C (if you run hid.exe) or
  * CTRL+BREAK (if you run WinDBG),
on your debugger machine's keyboard.

THIS IS NOT A BUG OR A SYSTEM CRASH

If you did not intend to break into the debugger, press the "g" key
press the "Enter" key now. This message might immediately reappear
Once press "g" and "Enter" again.
-----
nt!DbgBreakPointWithStatus:
fffff800_01661000 cc
kd> g
***F*** [Debuggee is running...]
  
```

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K experiment

with two interconnected VMs -

running kernel debugger and system under test

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**InstantLab**  
Running Operating System Experiments in the Cloud

Experiment: You are currently running the following experiment:  
**AMM: Page Replacement Policies in the WRK**

Guacamole Demo  
Lab Management  
Courses  
My Settings  
PXR Documentation  
Log out

ec2-10-107-29-9.compute-1.amazonaws.com  
ec2-10-107-20-4.compute-1.amazonaws.com

Experiment Actions:  
Pause Shutdown  
Save Results  
Toggle Screen

InstantLab 2.0: Demo Video

## InstantLab 2.0: Making it public

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- So far: InstantLab accessible by invitation only
  - Our students (undergrad OS class)
  - A few connected schools
- The current trend: making teaching material available online

**Microsoft**  
Faculty Connection

**STANFORD**  
UNIVERSITY

**iTunes U**

**IBM**  
Academic Alliance

- **InstantLab 2.0:**  
Make experiment resources available to the public
  - Using public cloud infrastructure (easy)
  - On a self-service platform (tough)

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## InstantLab 2.0: Everything Self-Service

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- InstantLab „1.0“: Limited group of known users
- InstantLab 2.0:
  - Potentially thousands of users
  - Users we don't know nothing about!
- Problem:
  - How to manage and administer all these people?
  - How to decide who gets to use which resources
- Our Solution: A **self managed** version of InstantLab
  - Access control to resources based on **trust relationships**
  - **Fully-automatic provisioning** of experiments

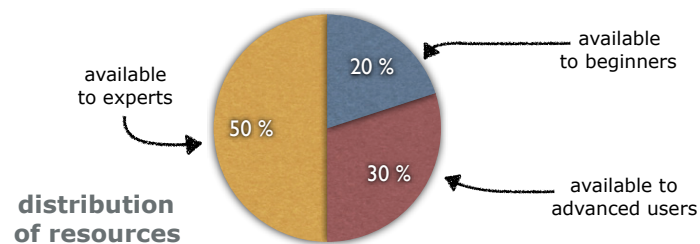
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## How to distribute resources

(sponsors may be want to address certain target groups)

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- Experiments on public cloud infrastructure consume resources and cost real money!
- Resources for a public teaching programme are limited
- Access control to experiment resources should
  - ... foster earnest and competent users
  - ... limit misuse and wasting of resources.



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## Reputation and Trust

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- How to rate a user as „beginner“, „advanced“ or „expert“?
- Behavior of user on the platform constitutes a user's reputation:
  - Evaluation of completed experiments
  - Community interactions (e.g. contribution to support forums)
  - Online lessons and quizzes
  - Referrals and recommendations
- Reputation, interpreted by one's own weighting and calculation scheme constitutes trust

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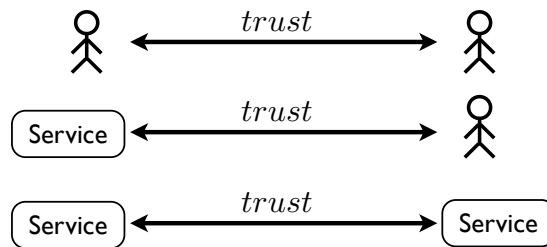


## Trust-based Access Control – the idea

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Trust:

- is real-valued: e.g.  $t = 0.73$
- multi-dimensional: correct computation, reliability, benevolence
- can be applied between machine entities and humans



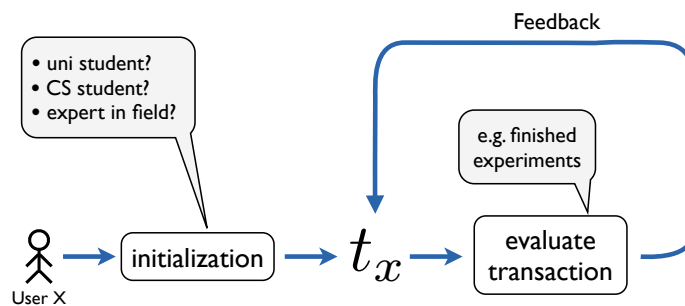
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## Building and Maintaining Trust Levels

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The trust value for every InstantLab users:

- ... is set to an initial value.
- ... is updated by transactions with this user.



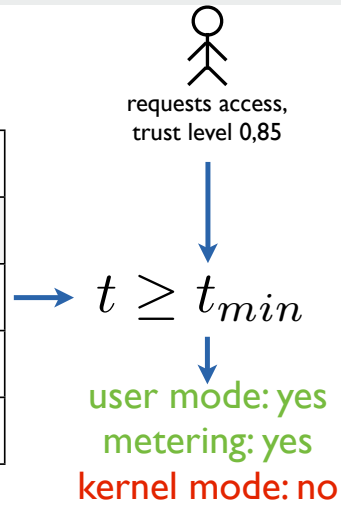
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## Making Access Control Decisions

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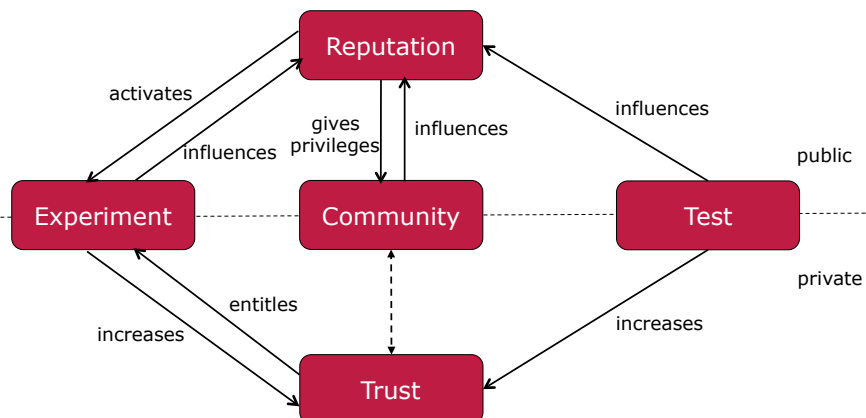
- Access to experiment resources requires a certain level of trust

Experiment Repository	
Kind of Experiment	Req. Trust
user mode experiments	0.5
metering experiments	0.8
kernel experiments	0.95



## Resource allocation – Trust revisited

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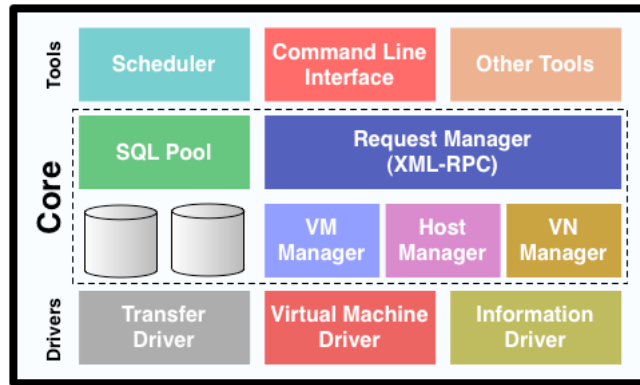


## Our private cloud – OpenNebula

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### Private + Public Cloud

- C12G Labs, Microsoft, CERN
- 4CaaS, BonFIRE, **CERN**, CESGA, D-Grid Resource Center Ruhr, Deltacloud, RESERVOR, SARA, StratusLab



InstantLab 2.

## Authentication

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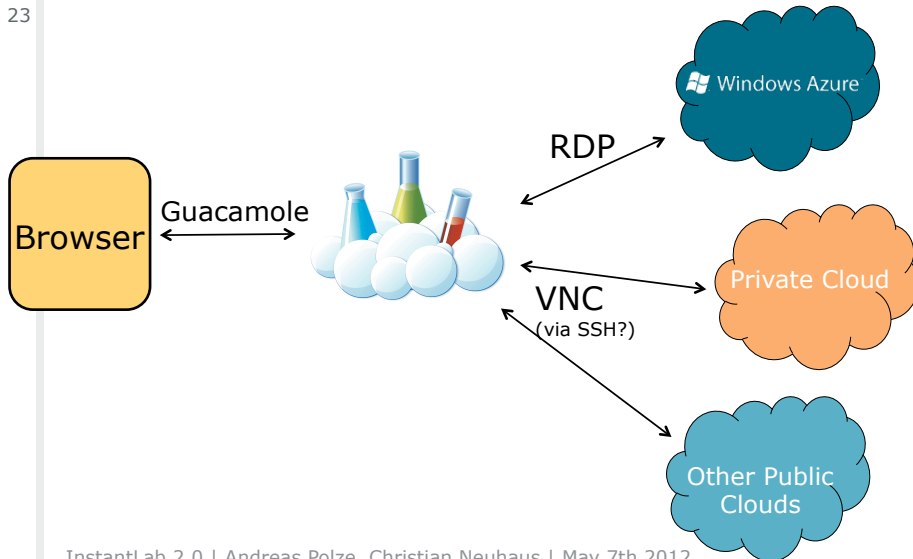
- OpenID
- OAuth
- Windows Live ID



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## Connecting with the Cloud

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## Future SOC Lab @ HPI – our private cloud

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- Vision was to establish an open research platform for tomorrow's IT landscape, start: June 2010
- Industry partners
  - Fujitsu
  - Hewlett-Packard
  - SAP
  - EMC
  - VMware
  - NetApp
  - Intel SCC

**Application areas:**

- Large Databases
- Consolidation, Virtualization
- High-Performance Computing

**Testbed:**  
MultiCore MultiThreading  
Hardware,  
huge memories, NehalemEX-  
based, GPU computing

HP ProLiant DL980 G6:  
64 Cores, 1-2TB  
Fujitsu Primergy RX600S:  
32 Cores, 1TB

Steering committee from industry  
and academia

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## The 1000 Core machine @ FutureSOC Lab

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## Conclusions – InstantLab 2.0

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- Maintaining OS experiments for teaching is cumbersome
  - Virtualization may be the answer in provider side
  - Consumer still has to maintain experiment environment
- Putting experiments on the cloud lifts burden on consumer side
- Not all clouds are equal
  - In particular, none of the public clouds allows requesting co-located VMs or even worse – co-located physical machines
  - Need generic architecture for public/private clouds
- Everything has to be self-managed – otherwise it won't scale
  - Notion of Trust and Reputation is crucial
  - Adopt techniques established for social networks