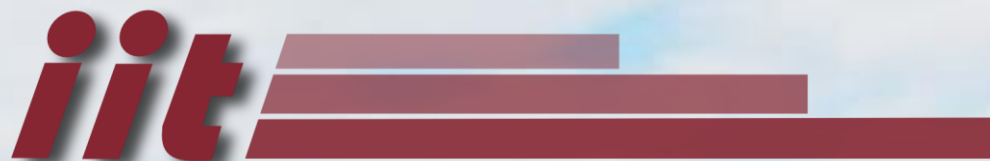


CIRCLE

IaaS for everyone

Cloud Infrastructure for Research Computing and Laboratory Environment

Bach Dániel, Geist Éva, Guba Sándor



What is CIRCLE?

- IaaS cloud manager
- A complete solution for educational cloud
- Supporting the special requirements for the education

Motivation

- Education demands dynamic environment
- Different trainings have different software requirements
- Difficult to maintain complex software dependencies on heterogeneous physical machines
- Need for multi-host environments
- Infrastructure for small projects
- Easy to deploy, portable

Motivation

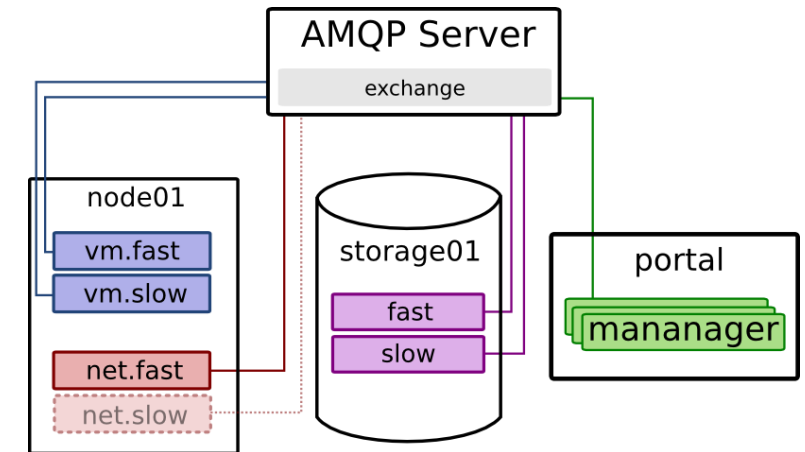
- Easy to use, easy to understand
 - Not everyone has deep knowledge about IT who want to use the cloud
- Separate main roles like teachers and students
 - Students actions need to be supervised by the teachers
- Burst virtual machine deployments
- At the start of the lecture everyone starts machine at the same time
- Effective resource usages
 - The users are not charged for their resource usage
 - Lease as a solution is the answer in CIRCLE

IaaS clouds in general

- Benefits
 - Multiple virtual environments on a single physical machine
 - Dynamic load balancing (live migrations)
 - Management tasks delegated to users
 - More efficient resource use
- Difficulties
 - Image creation needs special knowledge
 - Security risk
 - Network zone administration needs expertise and high permission
- Answer is the cloud management framework called CIRCLE.

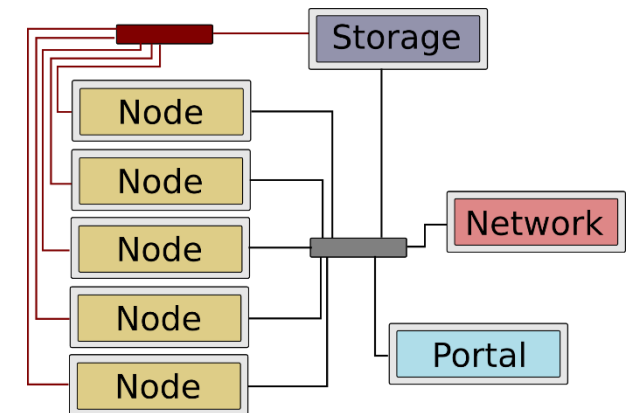
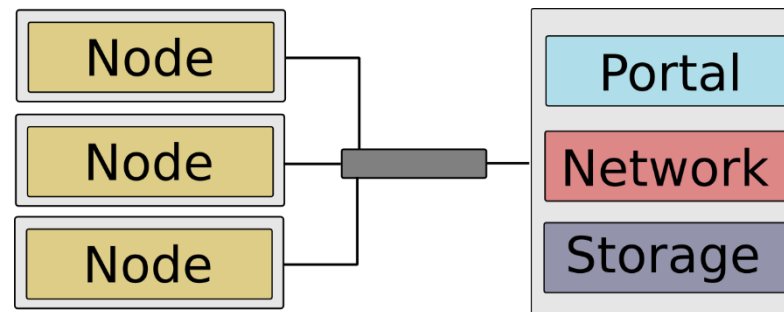
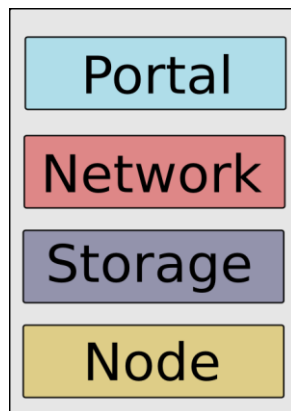
SaltStack installer

- CIRCLE based on several modules and software tools
 - Python
 - Libvirt (KVM based virtualization)
 - Django (portal)
 - Open vSwitch
 - Celery with AMQP for modul communication
- SaltStack is an easy-to-use configuration manager
- Installer is available from the git repository
- Installing node is possible from the GUI



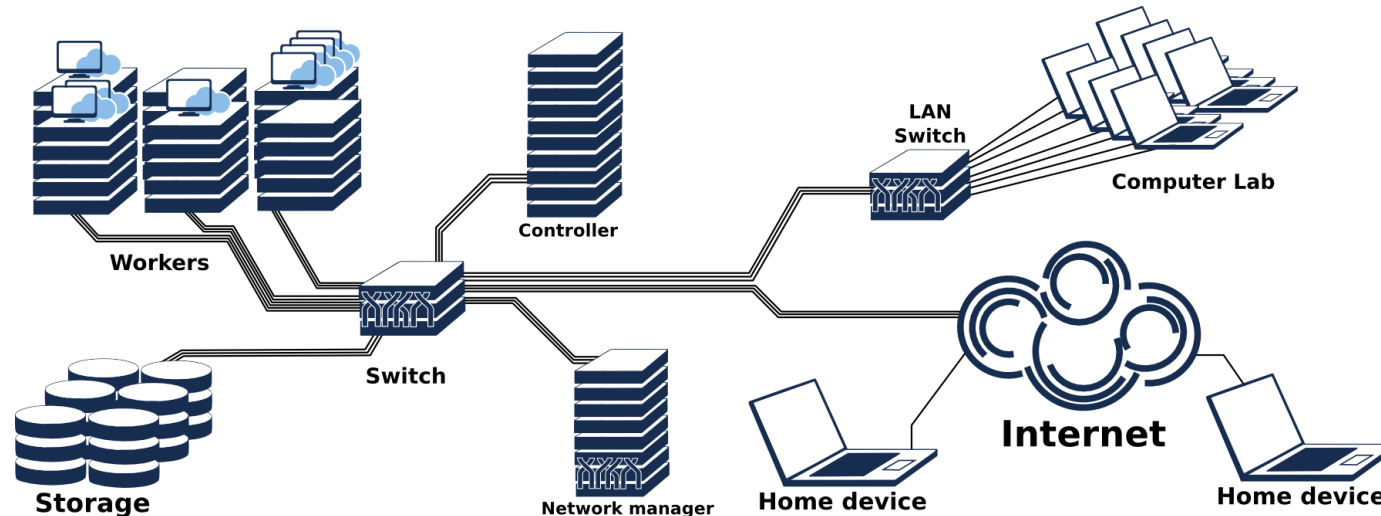
Deployment

- The deployment can be
 - Stand-alone - All components on a single node
 - Cluster - VM's run on a cluster, other services on a single head node
 - Distributed - VM's run on a cluster, all services on separate nodes



? Modules

- Storage - store the virtual images
- Network - manage complex network infrastructures
- Node - supervise virtual machine instances
- Portal - manager and web-interface for the cloud



☐ Shared storage

- NAS based image management
- CD, DVD and Disk images (raw, qemu copy-on-write) formats are supported
- Any shared file system can be used like NFS
- Shared storage – to store the virtual machine images (qemu copy-on-write file format), live migration possible between the workers nodes
- More than 100 virtual machine deployment within minutes - the virtual machine images Qcow2 format makes possible to deploy virtual machines without cloning the base disk image

☐ Shared storage

- Saving a virtual machine will create a new image from the base and the differential image. This image can be used as base image for future deployment management
- Free space managed by the storage module, can be defined in percentages
- The images are not destroyed until the specified space is available. The garbage collector checks occasionally and destroys the oldest images until there is enough free space again.
- Destroying a virtual machine on the dashboard will only move the image file in a trash folder

Networking

- Complex physical and virtual network administration
 - network management with OpenFlow rules
- Manages:
 - VLAN (Isolated networks from each others)
 - VLAN through dashboard
 - Zone management
 - DNS service
 - DHCP service
 - IPv6 supported

Hosts list of all hosts [Create a new host](#)

Filter by vlans **ALL** cporta DMZ grid HOT iitint iitlab iitman INT VPN WAR

Hostname	Vlan	MAC Address	IPv4 Address	IPv6 Address	WAN IPv4 Address	Created At	Owner
cloud-846	managed - VM-NET	02:00:0A:09:01:35	10.9.1.53	2001:738:2001:4031:9:1:53:0	152.66.243.62	08/02/2014 1:48 p.m.	48806@bme.hu
cloud-908	managed - LAB	02:00:00:38:C0:07	10.7.0.15	2001:738:2001:4031:7:0:15:0	—	04/27/2015 12:07 p.m.	48806@bme.hu
1022	managed - WAR	02:00:98:42:F3:53	152.66.243.83	2001:738:2001:4031:66:243:83:0	—	08/02/2014 1:48 p.m.	92428@bme.hu
1023	managed - VM-NET	02:00:0A:09:01:CA	10.9.1.202	2001:738:2001:4031:9:1:202:0	152.66.243.62	08/02/2014 1:48 p.m.	92428@bme.hu
1086	managed - VM-NET	02:00:0A:09:01:64	10.9.1.100	2001:738:2001:4031:9:1:100:0	152.66.243.62	08/02/2014 1:48 p.m.	92428@bme.hu
1400	managed - VM-NET	02:00:0A:09:02:1F	10.9.2.31	2001:738:2001:4031:9:2:31:0	152.66.243.62	08/02/2014 1:48 p.m.	65700@bme.hu
1470	managed - WAR	02:00:98:42:F3:40	152.66.243.64	2001:738:2001:4031:66:243:64:0	—	08/02/2014 1:48 p.m.	92428@bme.hu
1762	managed - VM-NET	02:00:0A:09:01:1B	10.9.1.27	2001:738:2001:4031:9:1:27:0	152.66.243.62	08/02/2014 1:48 p.m.	53646@bme.hu
1772	managed - VM-NET	02:00:0A:09:01:22	10.9.1.34	2001:738:2001:4031:9:1:34:0	152.66.243.62	08/02/2014 1:48 p.m.	92428@bme.hu
1807	managed - VM-NET	02:00:0A:09:01:3F	10.9.1.63	2001:738:2001:4031:9:1:63:0	152.66.243.62	08/02/2014 1:48 p.m.	5048@bme.hu
1824	managed - VM-	02:00:0A:09:01:4B	10.9.1.75	2001:738:2001:4031:9:1:75:0	152.66.243.62	08/02/2014 1:48 p.m.	92428@bme.hu

? Networking

- Manages:
 - Ipfiler – Linux based netfilter, firewall
 - Several way to connect VM to Internet
 - Public and private network using NAT → LAN, WAN
 - Prevent malicious or accidental abuse
 - ACL lists
 - Blacklist – IDS interface, monitoring tool API
 - GUI – WEB based management interface
 - With lowest permission level can do port forward for VM, low priority modifications

DMZ details of vlan

[Delete this vlan](#)

Name*

The short name of the subnet.

VID*

The vlan ID of the subnet.

Network type*

☒ Managed

IPv4

IPv4 address/prefix*

The IPv4 address and the prefix length of the gateway. Recommended value is the last valid address of the subnet, for example 10.4.255.254/16 for 10.4.0.0/16.

NAT to

managed - MAN
managed - HOT
managed - OFF
managed - WAN

Connections to these networks should be network address translated, i.e. their source address is rewritten to the value of NAT IP address. Hold down "Control", or "Command" on a Mac, to select more than one.

NAT IP address

Common IPv4 address used for address translation of connections to the networks selected below (typically to the internet).

DHCP pool

Host list

[Create a new host](#)

Hostname	IPv4 Address
backup2	10.2.0.1
backup-old	10.2.0.6
cloud	10.2.0.7
malac	10.2.0.99
monitor	10.2.0.9
monitor-kamu-dhcp	10.2.255.1
scanner	10.2.0.24
video	10.2.0.10

Unregistered hosts

MAC Address	Hostname	Requested IP
No hosts.		

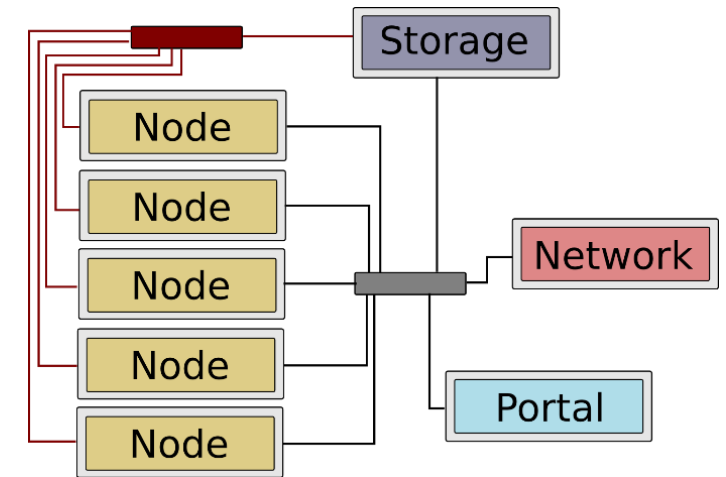
Manage access

Who	What	
+ <input type="text" value="Name of group or user"/>	<input type="text" value="user"/>	<input type="button" value="x"/>

[Save](#)

? Nodes

- Deploying and Destroying virtual machines
- Using KVM and libvirt for virtualization
- Manage Open vSwitch and Flow rules
- Monitor virtual machines
- Provide agent service

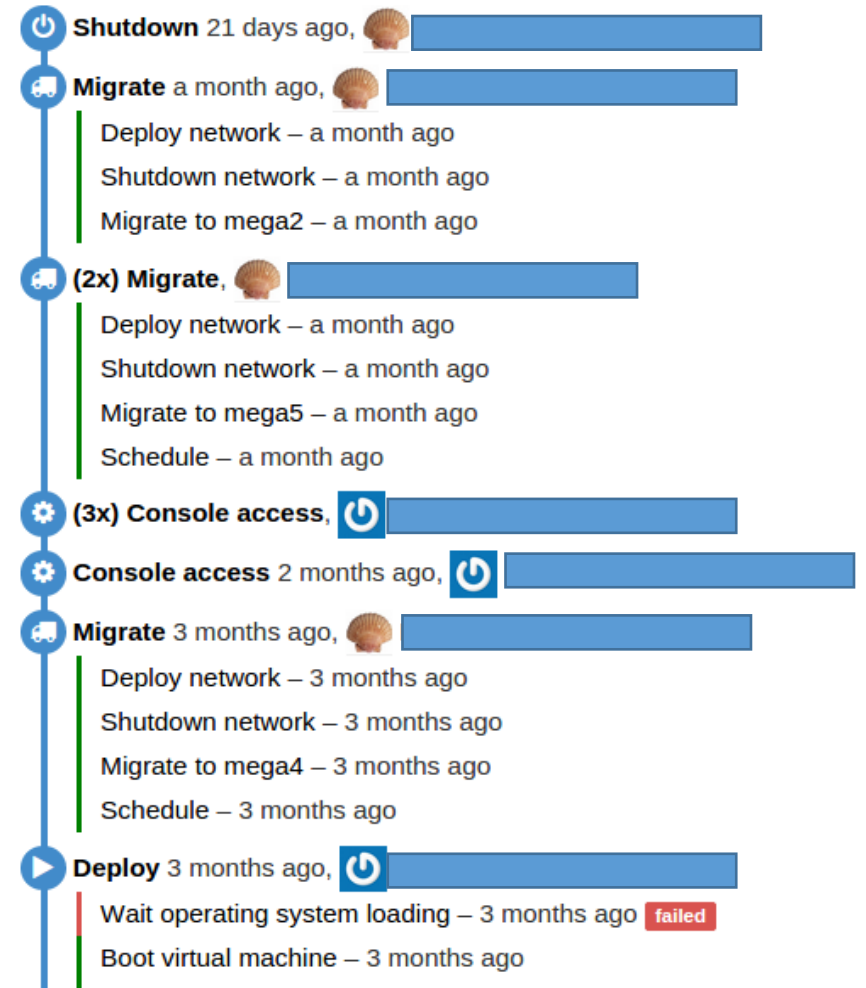


? Agent

- CIRCLE comes with an Agent support
 - Python agent
 - Communication through virtual serial port
- Agent service communicates with the agent inside the guest machine used for virtual instance customization
- Both ? Linux and ? Windows
- Customization
- Configuration:
 - Network
 - Password
 - SSH Keys
- Comfort
 - Alert for expiring lease times



Activity



Portal

- User-friendly web interface
- Support SAML2 authentication (SSO)
- Role-based ACL
- Personal filestore
- Notification about expiration times

Templates

- Possible to save any VM Instance as a Template
- Fine tune resource usage like CPU, Memory and Disk size
- Define networks suited for the exercise
- Share with ACL
- Customize your template like any other virtual machine

Templates								
<div>+ new template</div> <div>Search... owned 🔍</div>								
Name	Resources	Operating System	Access Method	Lease	Owner	Created At	Running	Actions
Circle devenv	2048MiB RAM 1 CPU core	Ubuntu 14.04 LTS Server amd64	SSH	labor (5 óra / 1 hét)	István Gergely Oláh (HN02A6)	3 months ago	3	▶ ✎ ✖
Tesztelés és minőség labor (ügynökkel)	2048MiB RAM 2 CPU cores	Windows 7 Enterprise x86_64	RDP	házi feladat (5 óra / 1 hónap)	Sándor Guba (TFDAZ6)	9 months ago	0	▶ ✎ ✖
Ubuntu 14.04 v1 régi	1024MiB RAM 1 CPU core	Ubuntu 14.04 LTS Server amd64	SSH	labor (5 óra / 1 hét)	Sándor Guba (TFDAZ6)	8 months ago	1	▶ ✎ ✖
Ubuntu 14.04 v5	1024MiB RAM 1 CPU core	Ubuntu 14.04 LTS Server amd64	SSH	labor (5 óra / 1 hét)	Dániel Bach (J11M92)	a month ago	0	▶ ✎ ✖

Leases			
<div>+ new lease</div>			
Name	Suspend Interval	Delete Interval	Actions
házi feladat (5 óra / 1 hónap)	5 hours	1 month	✎ ✖
labor (5 óra / 1 hét)	5 hours	1 week, 2 days	✎ ✖
projekt (1 hónap / 6 hónap)	1 month	6 months	✎ ✖
szerver (1 év / 10 év)	1 year	10 years, 1 month	✎ ✖

? Leases

- All virtual machine has 2 type of lease time
 - Suspension – Time until the VM go to hibernate
 - Destruction – Time until the VM is destroyed
- Renew
 - Every user can renew their own machines

Do you want to perform the following operation on **Sphinx (5830)**: **renew**?

Virtual machines are suspended and destroyed after they expire. This operation renews expiration times according to the lease type. If the machine is close to the expiration, its owner will be notified.

☐ Set expiration times even if they are shorter than the current value.

☐ Save selected lease.

Length

projekt (1 hónap / 6 hónap) (suspend: 1 month, remove: 6 months) ▼

Expiration

Suspended at:

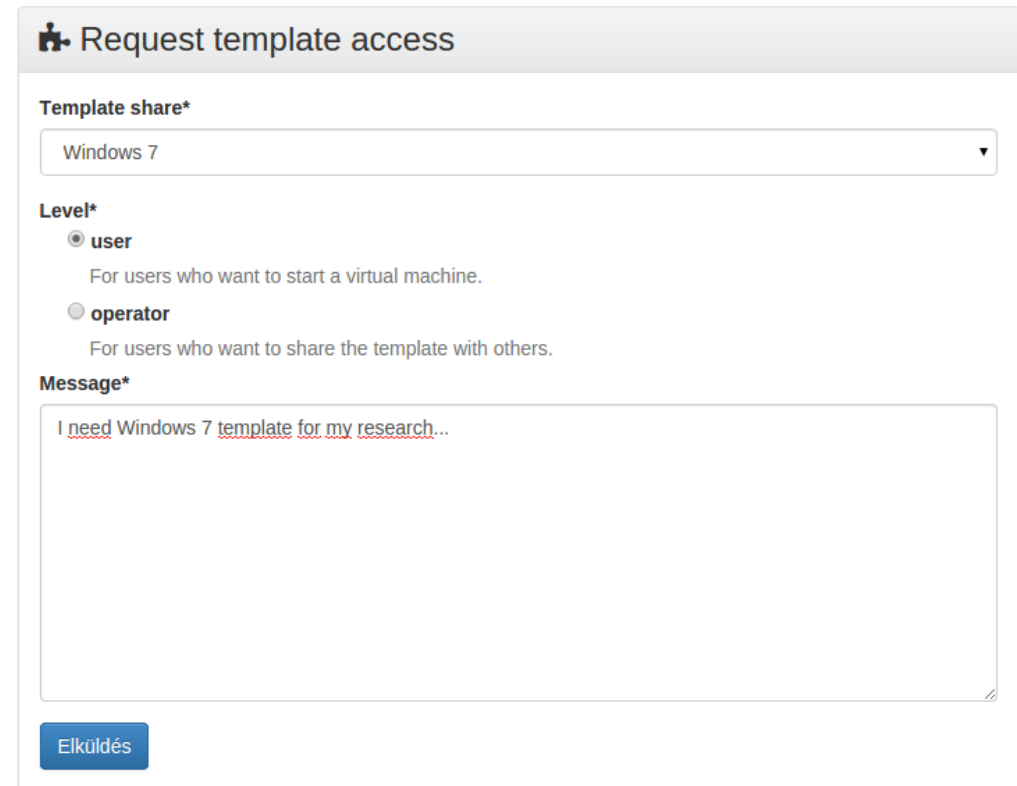
☾ in 6 days

Destroyed at:

✖ in 5 months

? Requests

- Limited resource
- Only usable after permission is granted
- Requests provide interface for the students to ask for more
 - Processor
 - Memory
 - Lease time
- Administrator can Accept / Decline with one click



The screenshot shows a web form titled "Request template access". It contains the following fields:

- Template share***: A dropdown menu with "Windows 7" selected.
- Level***: Two radio button options: "user" (selected) and "operator". Below "operator" is the text "For users who want to share the template with others."
- Message***: A text area containing the text "I need Windows 7 template for my research...".
- Elküldés**: A blue button at the bottom left of the form.

❓ Authentication/SSO

- Support SAML2 authentication
- eduID
- Pre-defined groups (ACL)
 - Based on the courses
 - Add members even before logged in



Portal – Dashboard

The screenshot displays the CIRCLE Portal Dashboard with a dark header bar. The header includes the CIRCLE logo, a building icon, and navigation links: Messages, Storage, Network, Requests, Sándor Guba (TFDAZ6), Log out, and Notifications. The main content area is divided into six panels:

- Virtual machines:** Lists VMs like CPorta teszt, Circle devenv, Sphinx, Superdev, and tarokkk. Includes a search bar, '12 more' link, and 'new' button.
- Groups:** Lists groups like hallgatók, GOP csoport, egr, brazilok, and fpga. Includes a search bar, '35 more' link, and 'new' button.
- Files:** Lists files like Kresz-Teszt-2012-v3.3.iso, 012353.pdf, letoltes.jpg, and CCNASv1.1_Ch06_Lab-A_Secur... Includes a search bar, 'show my files' link, and 'upload' button.
- Templates:** Lists templates like CentOS 7 v3, Circle devenv, Tesztelés és minősé..., Ubuntu 14.04 v1 régi, and Ubuntu 14.04 v5. Includes a search bar, 'show all' link, and 'new' button.
- Nodes:** Lists nodes like mega1, mega2, mega3, mega4, and mega5. Includes a search bar, '1 more' link, and 'new' button.
- Users:** Lists users like Dániel Bach, Máté mate Öry, Henrik Schnell, Bálint Patartics, and Balázs Simon. Includes a search bar, '1355 more' link, and 'new' button.

The footer contains links for Legal notice, Policy, Help, and Support, along with the text 'BME IK 2015'.

Portal – Virtual machines instances

Virtual machines

Group actions

Select all

owner:75558@bme.hu

all

ID	Name	State	Owner	Lease	Memory	IP address	Node
549	tarokkk	▶ running	Sándor Guba (TFDAZ6)	szerver (1 év / 10 év)	2048 MiB	152.66.243.78	mega1
4493	StoreServer	▶ running	Sándor Guba (TFDAZ6)	szerver (1 év / 10 év)	4096 MiB	152.66.243.127	mega3
4536	Test	✈ pending	Sándor Guba (TFDAZ6)	projekt (1 hónap / 6 hónap)	2048 MiB	-	-
4968	Matlab Tarokkk	suspended	Sándor Guba (TFDAZ6)	projekt (1 hónap / 6 hónap)	4096 MiB	10.9.0.169	-
5012	Tarokkk Windows Office	suspended	Sándor Guba (TFDAZ6)	projekt (1 hónap / 6 hónap)	2048 MiB	10.9.0.128	-
5122	Superdev	suspended	Sándor Guba (TFDAZ6)	szerver (1 év / 10 év)	1024 MiB	152.66.243.50	-
5151	CPorta teszt	suspended	Sándor Guba (TFDAZ6)	projekt (1 hónap / 6 hónap)	1024 MiB	10.9.0.160	-
5571	Circle devenv	suspended	Sándor Guba (TFDAZ6)	projekt (1 hónap / 6 hónap)	2048 MiB	10.9.1.148	-
5830	Sphinx	suspended	Sándor Guba (TFDAZ6)	projekt (1 hónap / 6 hónap)	1024 MiB	10.9.0.167	-

Portal – Resources of a selected VM

Windows 7 SOI v3 cloud-6103.vm.ik.bme.hu ☆



▶ RUNNING

Connection details

Protocol RDP
Host vm.ik.bme.hu:13101
Host (IPv6) cloud-6103.vm.ik.bme.hu:3389
Username cloud
Password *****

[Generate new password!](#)

Command xfreerdp -u cloud -p EnNuGMWtSf -g 1200x800 -f

[Connect \(download client\)](#)

Home Resources Console Access Network Activity

CPU priority normal ?
CPU count 2 ?
RAM amount 4096 MiB ?

[Save resources](#) Stop your VM to change resources.

Disks

[create disk](#) [download disk](#)

Windows 7 (#2972) - 60.0GB

File name: 0b21eba7-6ef2-4ac8-bd75-2742eb7225d3

Bus: virtio

[Resize](#) [Remove](#)

Required traits

gpu
mirror

A set of traits required for a node to declare to be suitable for hosting the VM. Hold down "Control", or "Command" on a Mac, to select more than one.

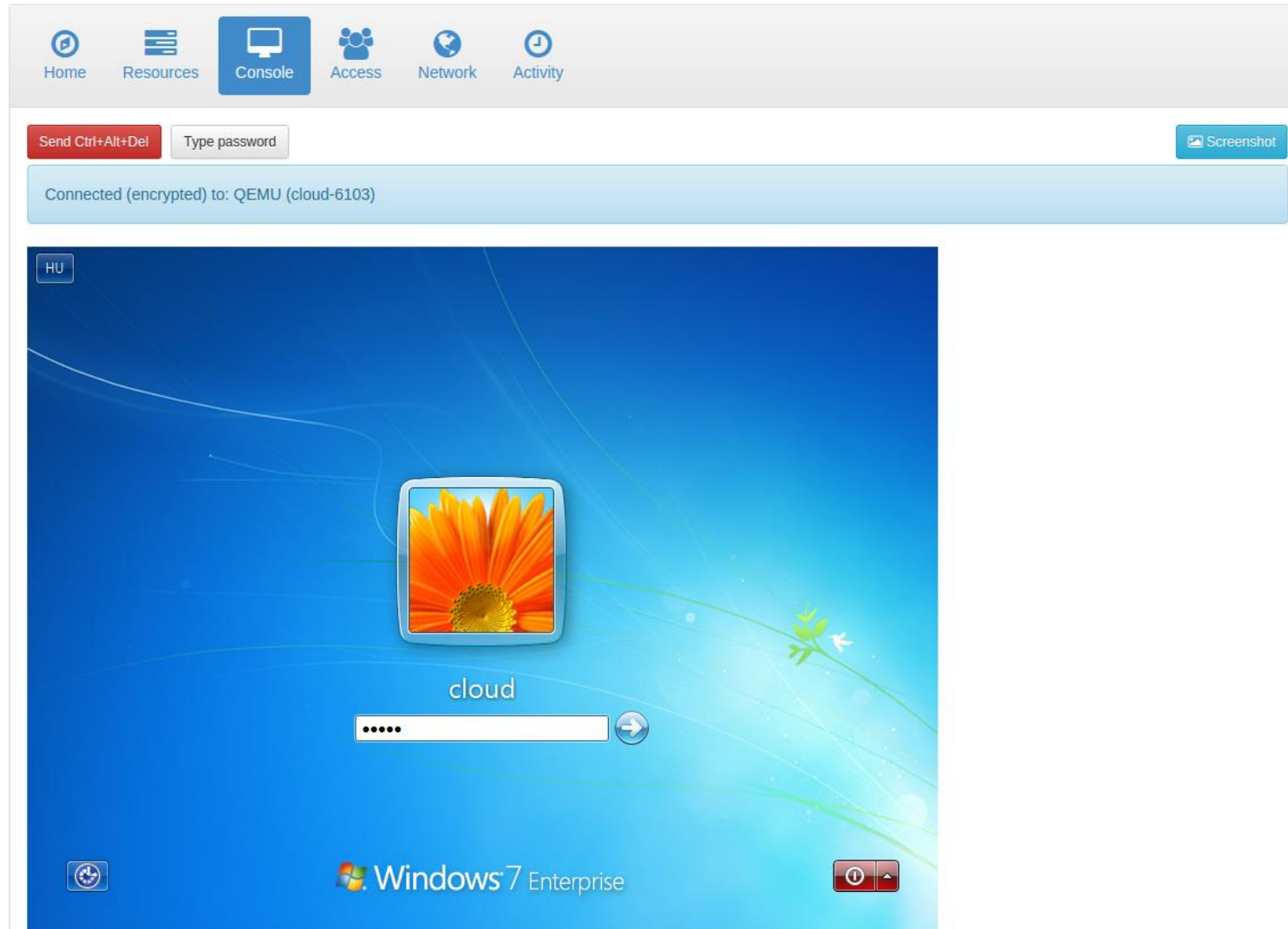
[Save](#)



ICACON'15 BUDAPEST

<https://circlecloud.org>

Portal – VNC console



Portal – ACL

- Every resource has it's owner
 - Can't be demoted
 - You can transfer this ownership
- You can share anything via 3 roles
 - User: Access the resource
 - Operator: Share to users and do modifications
 - Owner: Supervise the resource

Windows 7 SOI v3 cloud-6103.vm.ik.bme.hu ☆

▶ RUNNING

Connection details

Protocol RDP
Host vm.ik.bme.hu:13101
Host (IPv6) cloud-6103.vm.ik.bme.hu:3389
Username cloud
Password

[Generate new password!](#)

Command xfreerdp -u cloud -p EnNuGMWtSf -g 1200x800 -f



[Connect \(download client\)](#)

[Home](#) [Resources](#) [Console](#) [Access](#) [Network](#) [Activity](#)

Owner

The current owner of this instance is [Viktor Kálmán \(5048@bme.hu\)](#). [Transfer ownership...](#)

Permissions

Who	What	
 <input type="text" value=""/>	<input type="text" value="user"/>	<input type="checkbox"/>
 <input type="text" value=""/>	<input type="text" value="owner"/>	<input type="checkbox"/>
+ <input type="text" value="Name of group or user"/>	<input type="text" value="user"/>	

[Save](#)

Portal – Network

Windows 7 SOI v3 cloud-6103.vm.ik.bme.hu ☆



▶ **RUNNING**

Connection details

Protocol RDP
Host vm.ik.bme.hu:13101
Host (IPv6) cloud-6103.vm.ik.bme.hu:3389
Username cloud
Password

[Generate new password!](#)

Command xfreerdp -u cloud -p EnNuGMWrSf -g 1200x800 -f

[Connect \(download client\)](#)

[Home](#) [Resources](#) [Console](#) [Access](#) **[Network](#)** [Activity](#)

Interfaces

[add interface](#)

VM-NET [edit](#) [remove](#)

IPv4 address:
10.9.0.11
IPv6 address:
2001:738:2001:4031:9:0:11:0
DNS name:
cloud-6103.vm.ik.bme.hu
Groups:
netezhet

Port access

IPv4 IPv6



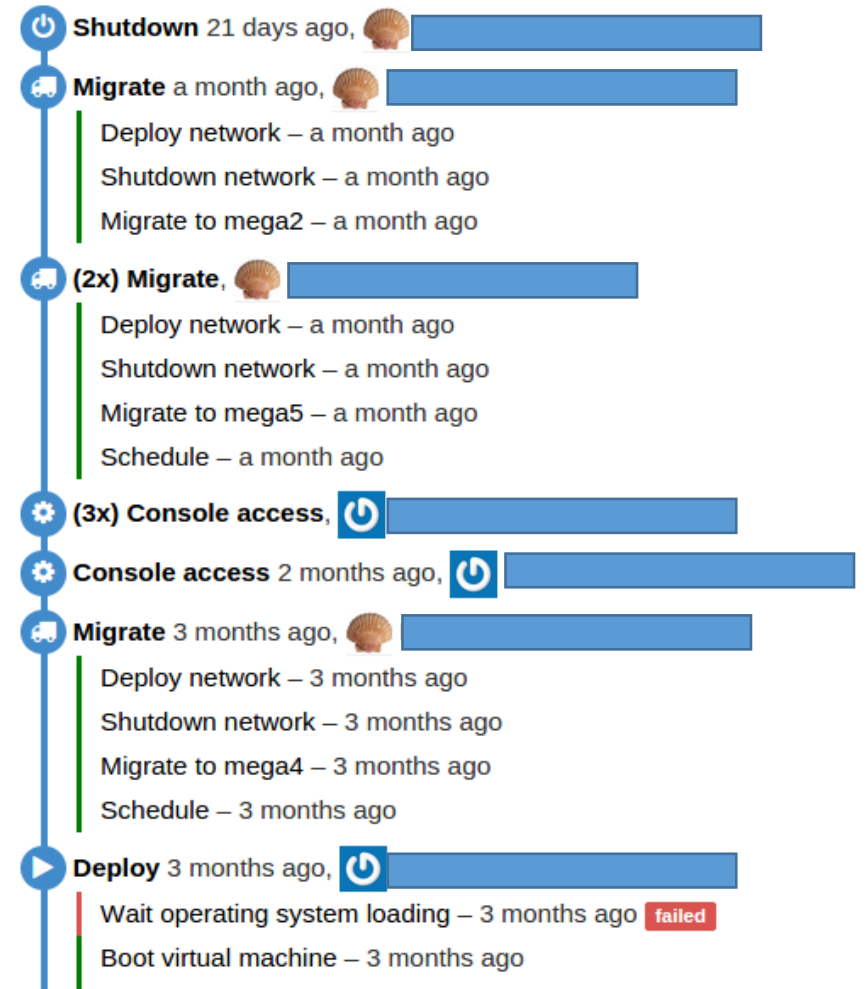
vm.ik.bme.hu:13101 → 3389/tcp

[+ →](#) / tcp [Add](#)

Portal – Activity

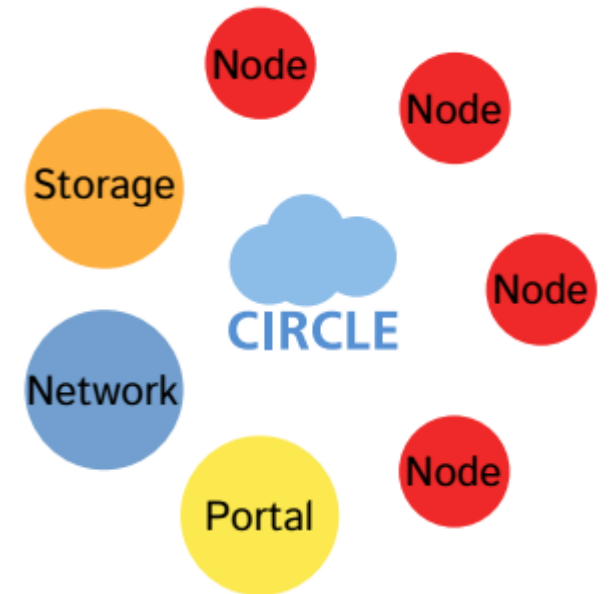
- Track your virtual machines history
- Activities are created on every action
 - User action
 - Monitoring event
 - Administrator action
- Log time, user and action type

Activity



What is CIRCLE?

- Open source based IaaS cloud manager
- Complete system ready to deploy
- Easy-to-use web interface even for non-IT users
- User-friendly interface for template customization
- Scalable
- Advanced networking
- All modules written in Python
- Easy to install with SaltStack





Cloud Infrastructure for **R**esearch **C**omputing and **L**aboratory **E**nvironment

Thank you for your attention!

<https://circlecloud.org>