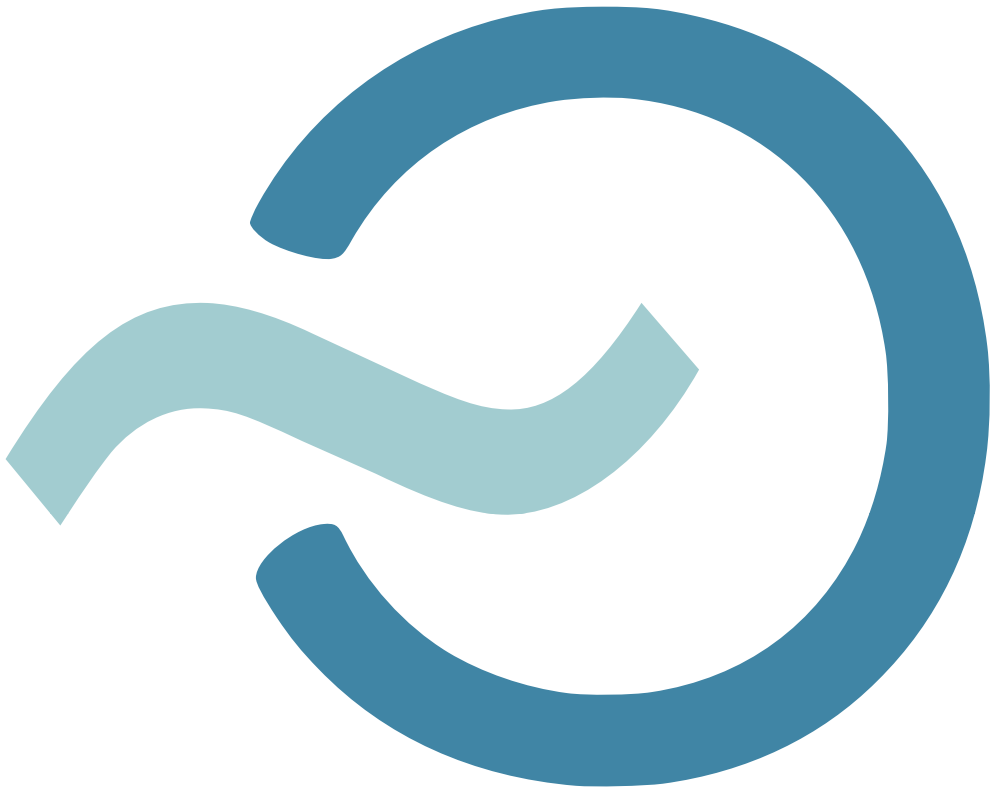

~okeanos

Delivering IaaS for the Greek Academic and Research Community

Vangelis Koukis
vkoukis@grnet.gr
Technical Coordinator, ~okeanos Project

Outline

- ~okeanos IaaS
- Compute
- Synnefo architecture
- Network
- Storage
- Upcoming goals

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Motivation

- Deliver IaaS to GRNET's customers
  - direct: IT depts of connected institutions
  - indirect: university students, researchers in academia
- Other IaaS efforts
  - Amazon EC2 not an end-user service
  - Need to develop custom UI, AAI layers
  - Vendor lock-in
  - Unsuitable for IT depts
    - persistent, long-term servers, custom networking requirements
  - Gain know-how, build on own IaaS → new services

~okeanos IaaS

- Infrastructure…
  - Compute (Virtual Machines)
  - Network (Virtual Networks)
  - Storage (Virtual Disks)
- … as a Service
- Users manage resources over
  - a simple, elegant UI, or
  - a REST API, for full programmatic control

~okeanos Project

- Goal: Production quality IaaS
  - working Alpha in coming month
- A jigsaw puzzle of many pieces
- Presentation focuses on software infrastructure
- Synnefo
  - custom cloud management software to power ~okeanos
  - Google Ganeti backend
- Current & future goals for Compute, Network, Storage

Outline

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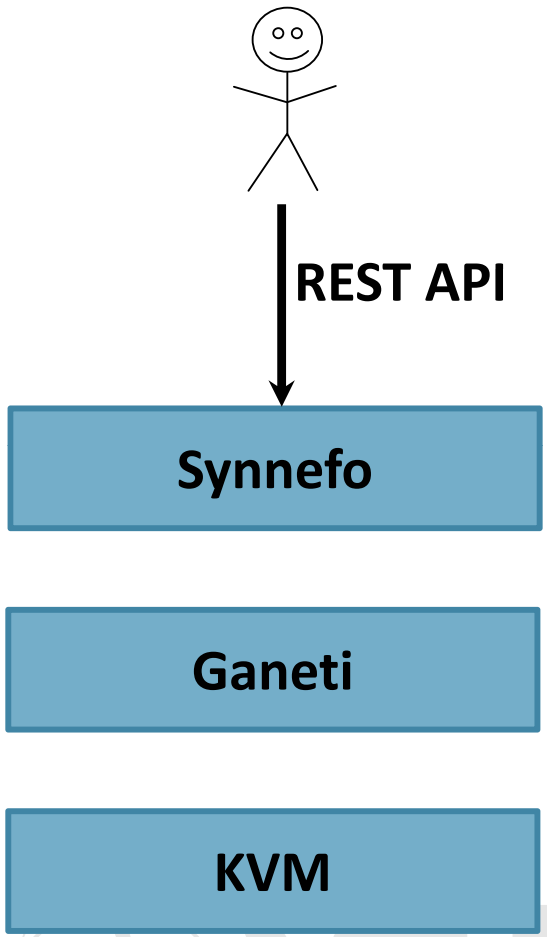
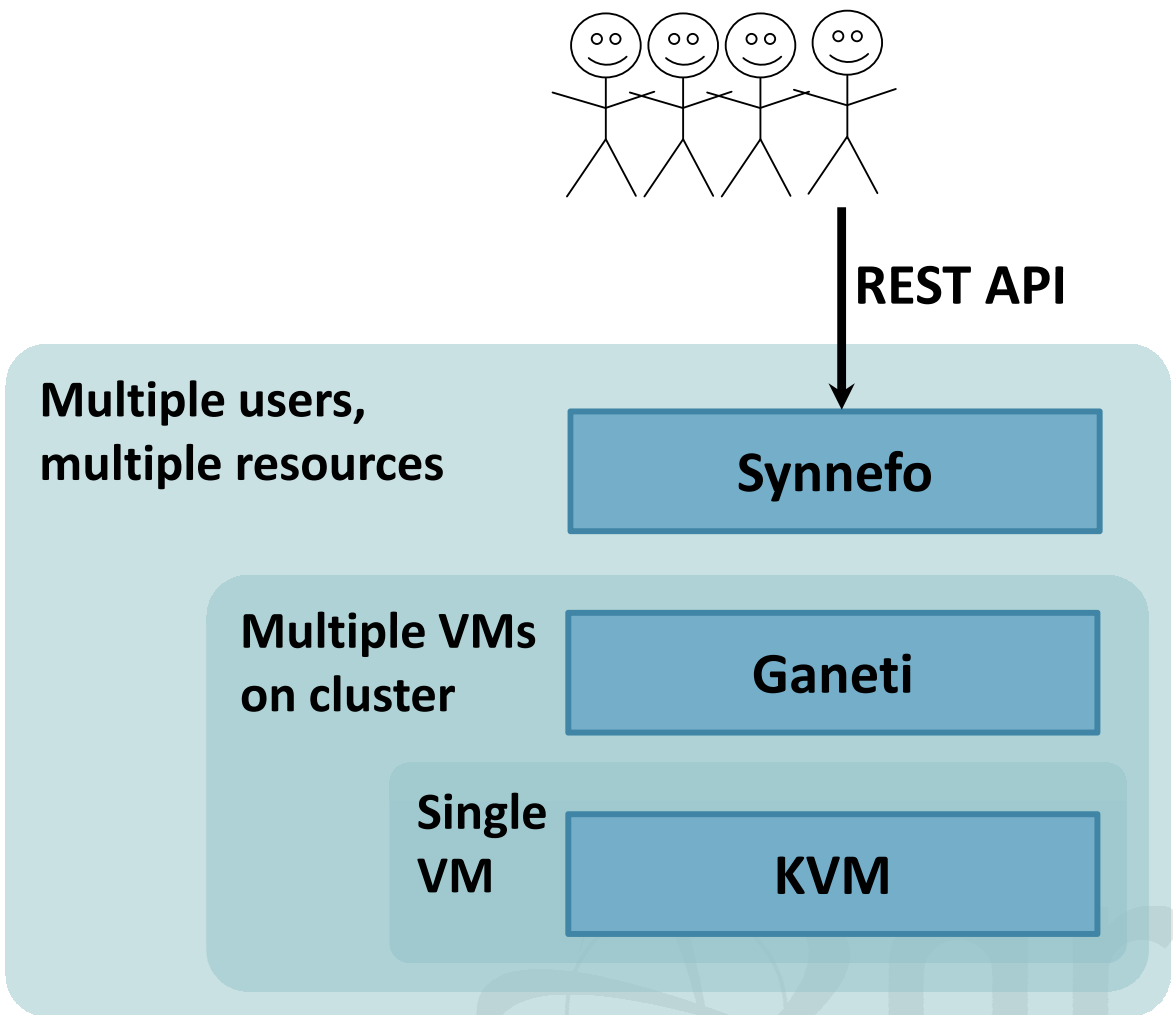
IaaS – Compute (1)

- Virtual Machines
  - powered by KVM
    - Linux and Windows guests, on Debian hosts
  - Google Ganeti for VM cluster management
  - accessible by the end-user over the Web or programmatically (OpenStack Compute v1.1)
- Initial target is longer-term, persistent VMs (students, University IT depts)

Software Stack



Software Stack



Iaas – Compute (2)

- User has full control over own VMs
  - Create
    - Select # CPUs, RAM, System Disk
    - OS selection from pre-defined Images
    - popular Linux distros (Fedora, Debian, Ubuntu)
    - Windows Server 2008 R2
  - Start, Shutdown, Reboot, Destroy
  - Out-of-Band console over VNC for troubleshooting

IaaS – Compute (3)

- REST API for VM management
  - OpenStack Compute v1.1 compatible
  - 3rd party tools and client libraries
  - custom extensions for yet-unsupported functionality
  - Python & Django implementation
- Full-featured UI in JS/jQuery
  - UI is just another API client
  - All UI operations happen over the API

Why Ganeti?

- No need to reinvent the wheel
- Scalable, proven software infrastructure
  - Built with reliability and redundancy in mind
  - Combines open components (KVM, LVM, DRBD)
  - Well-maintained, readable code
- VM cluster management in production is serious business
  - reliable VM control, VM migrations, resource allocation
  - handling node downtime, software upgrades

Why Ganeti?

- GRNET already has long experience with Ganeti
  - provides ~280 VMs to NOCs through ViMa service
  - involved in development, contributing patches upstream
- Build on existing know-how for ~okeanos
  - Common backend, common fixes
  - reuse of experience and operational procedures
  - simplified, less error-prone deployment

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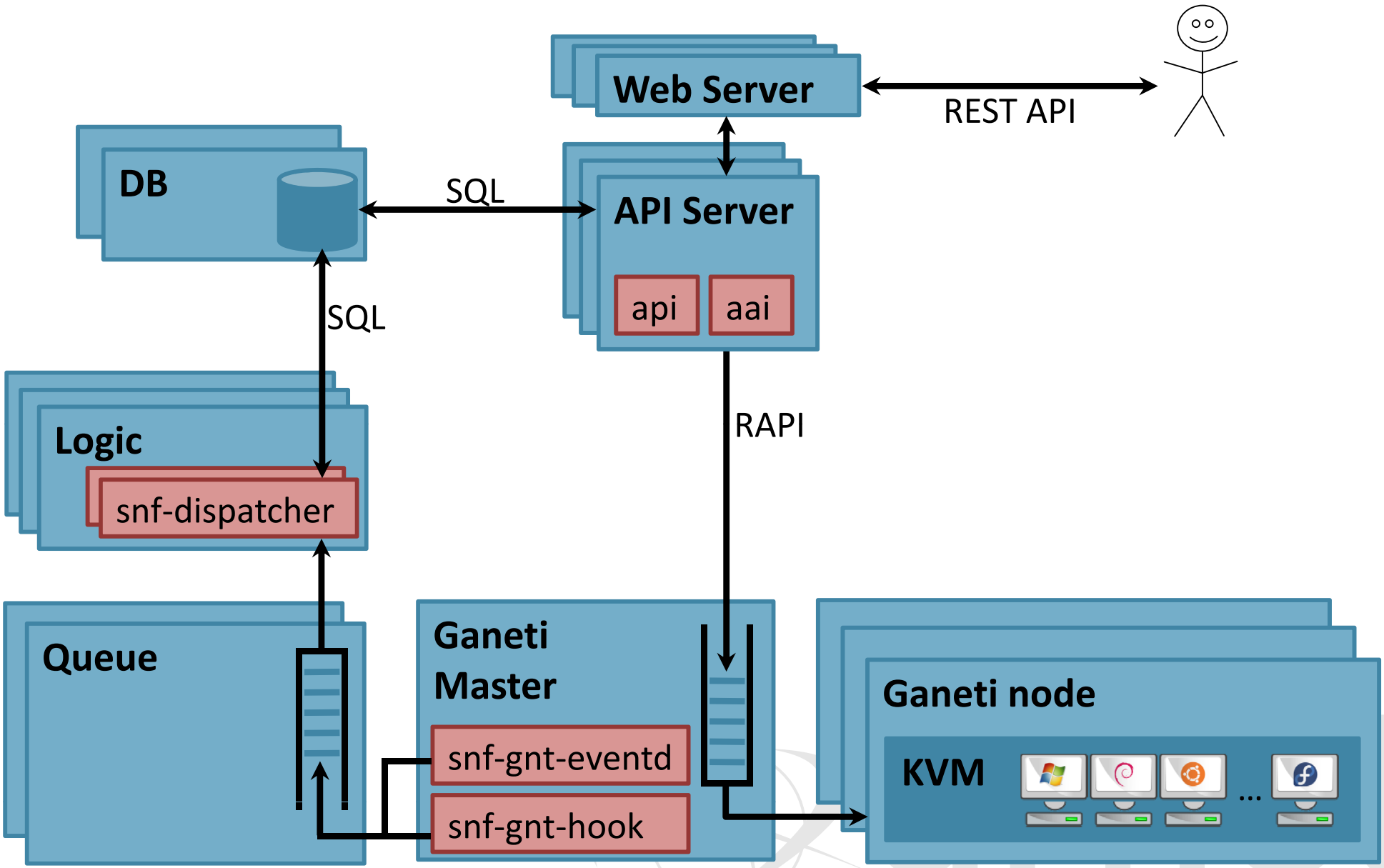
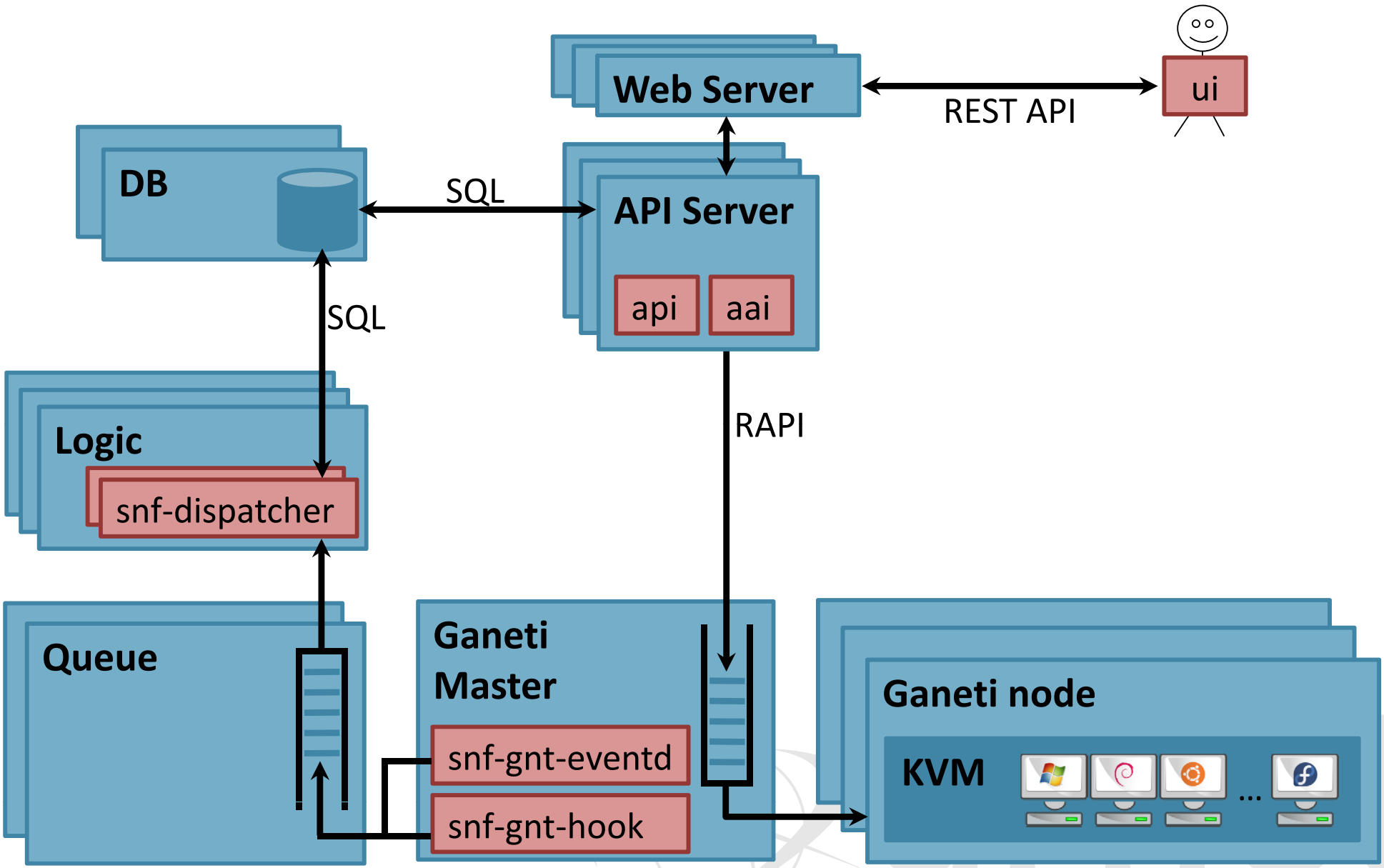
Synnefo deployment



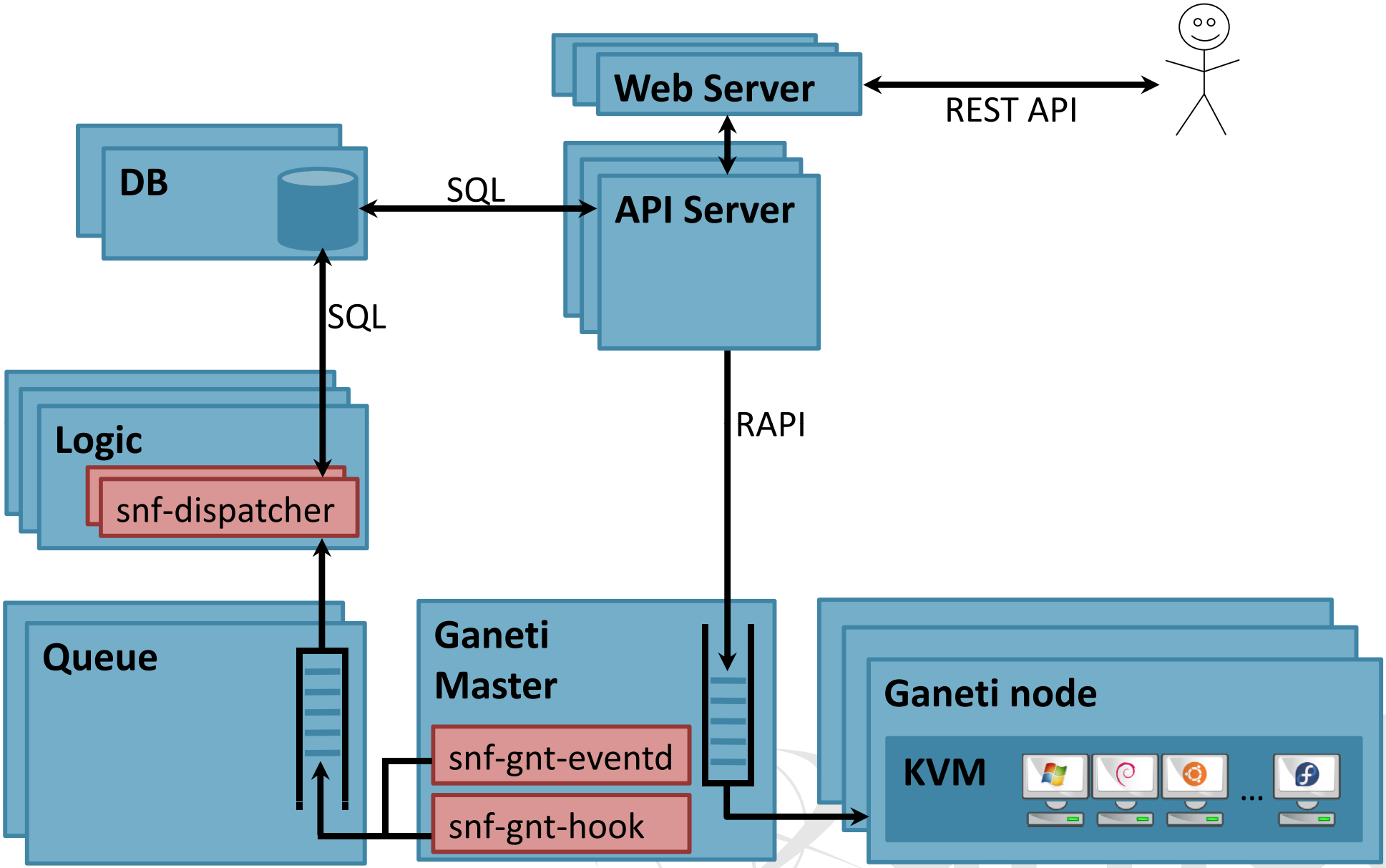
Synnefo deployment



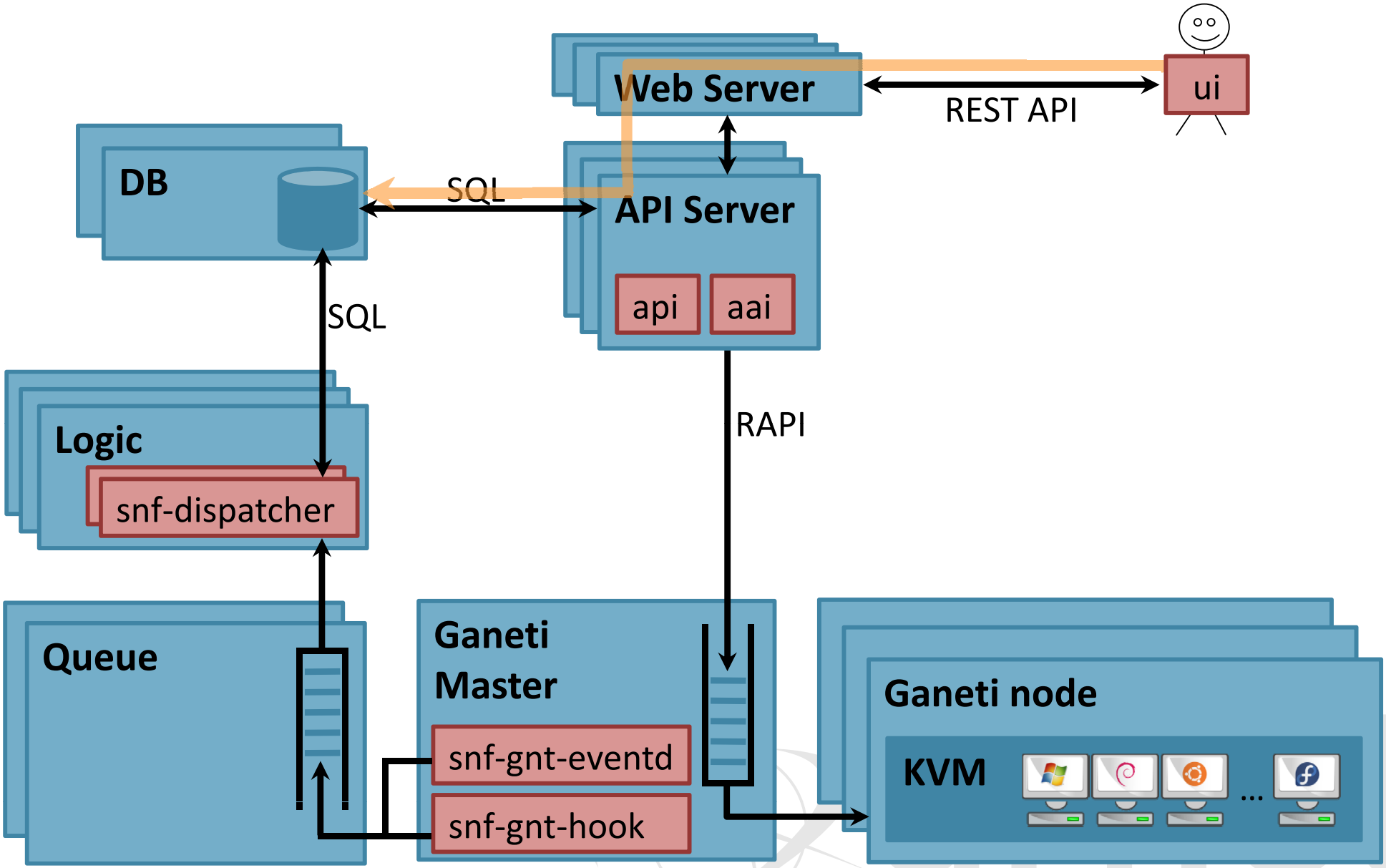
Asynchronous design

- DB contains All state needed to handle API queries
  - no need to reach the backend
  - Ganeti `GetInstanceInfo()` is a proper job, too slow
- Two distinct paths, *effect* and *update*
- *Effect* changes to VMs
  - when servicing API requests to modify VM state
  - issue commands to Ganeti backend, over RAPI
  - ACK reception of request to user
- *Update* DB, when interesting things happen
  - user or *admin* initiated
  - Queue notifications to Message Queue, over AMQP

Synnefo deployment



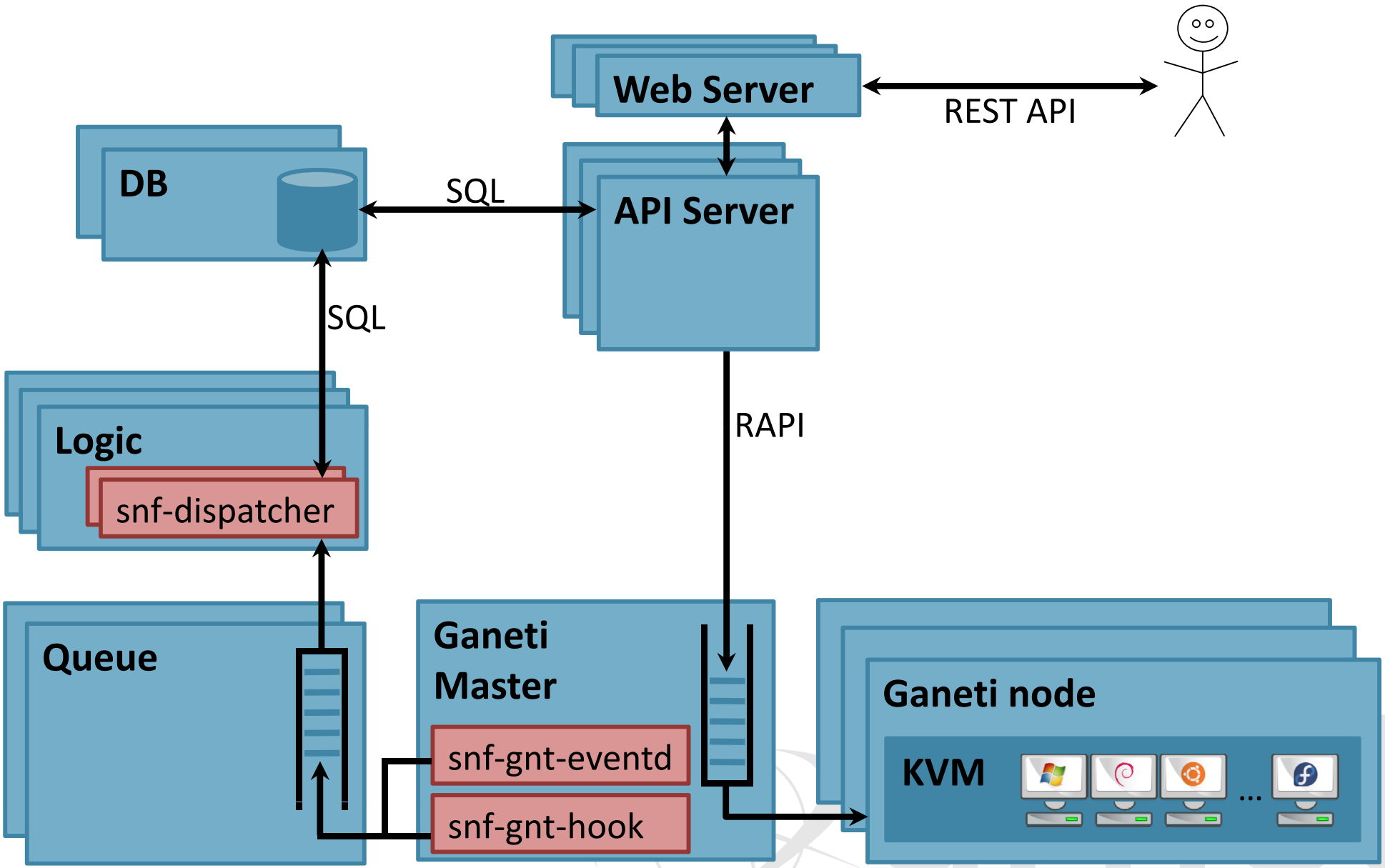
Synnefo deployment



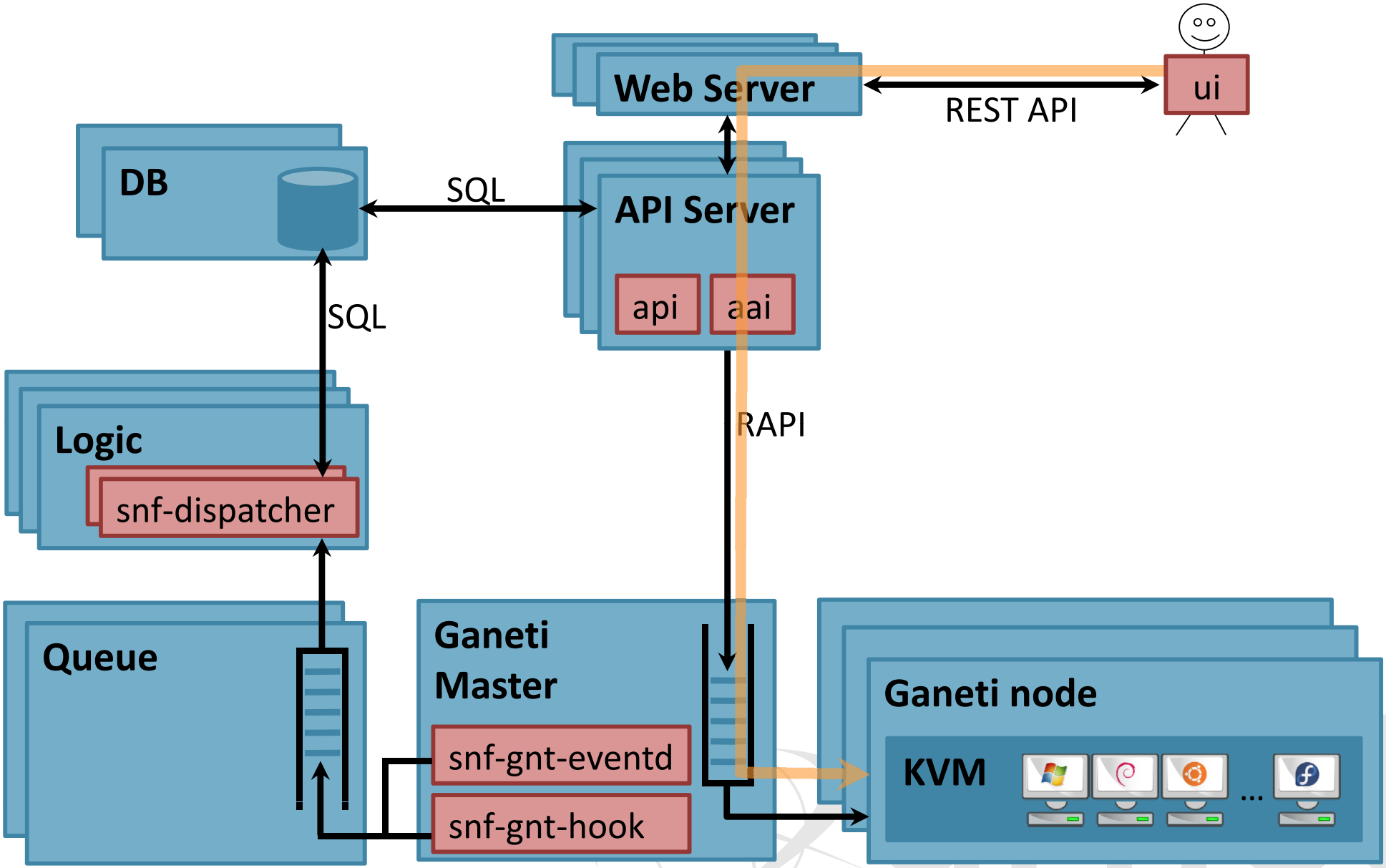
The “effect” Path

- Reception of API request to modify VM state (e.g., `PUT /servers` over HTTP)
- API enforces access rights and policy
  - Ganeti knows no cloud users or access rights
- Need to translate from Openstack Compute to backend ops (e.g., `CreateInstance()`)
- Asynchronous request processing
  - Return HTTP `202 Accepted`
  - it’s up to the API client to poll for completion

Synnefo deployment



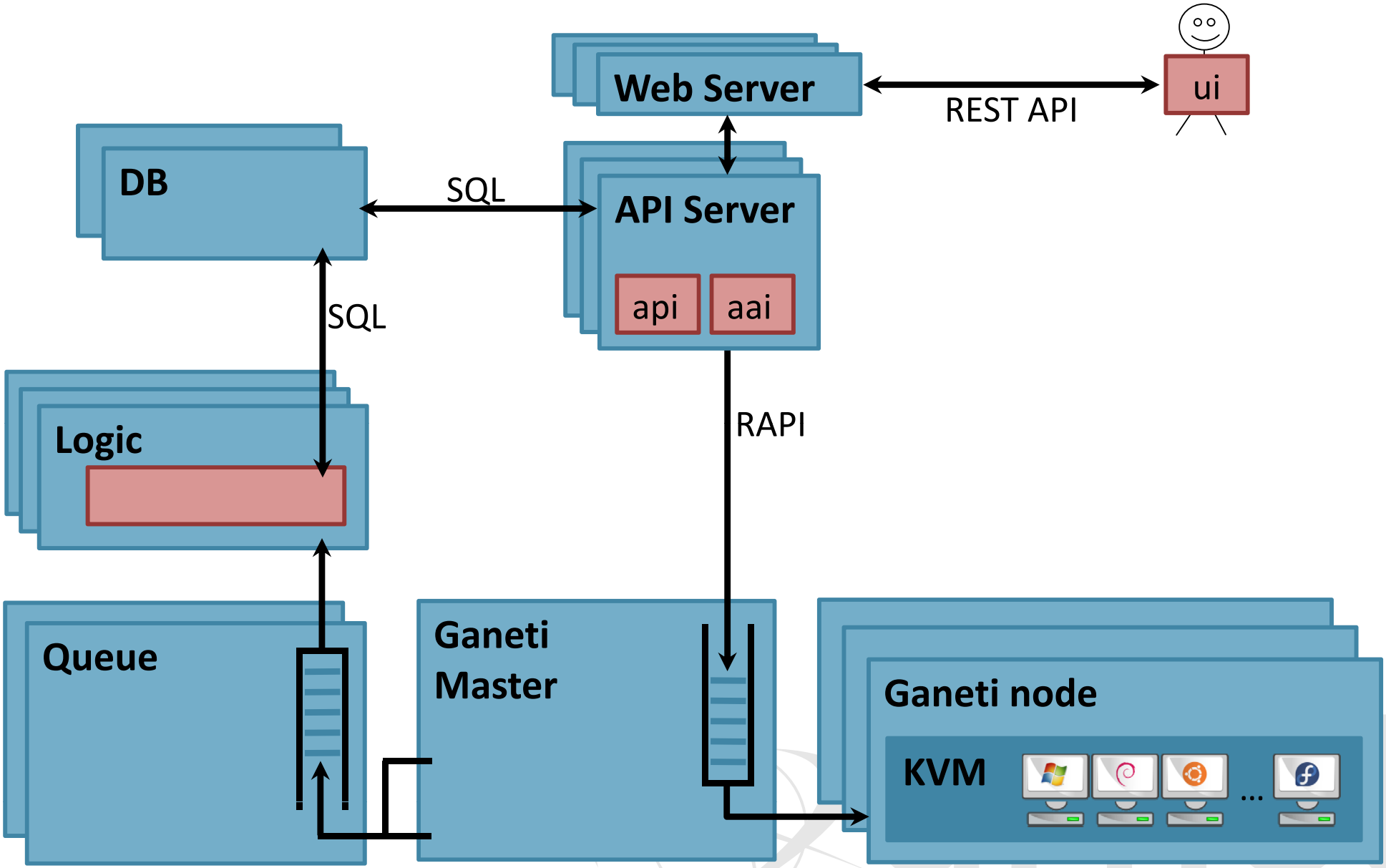
Synnefo deployment



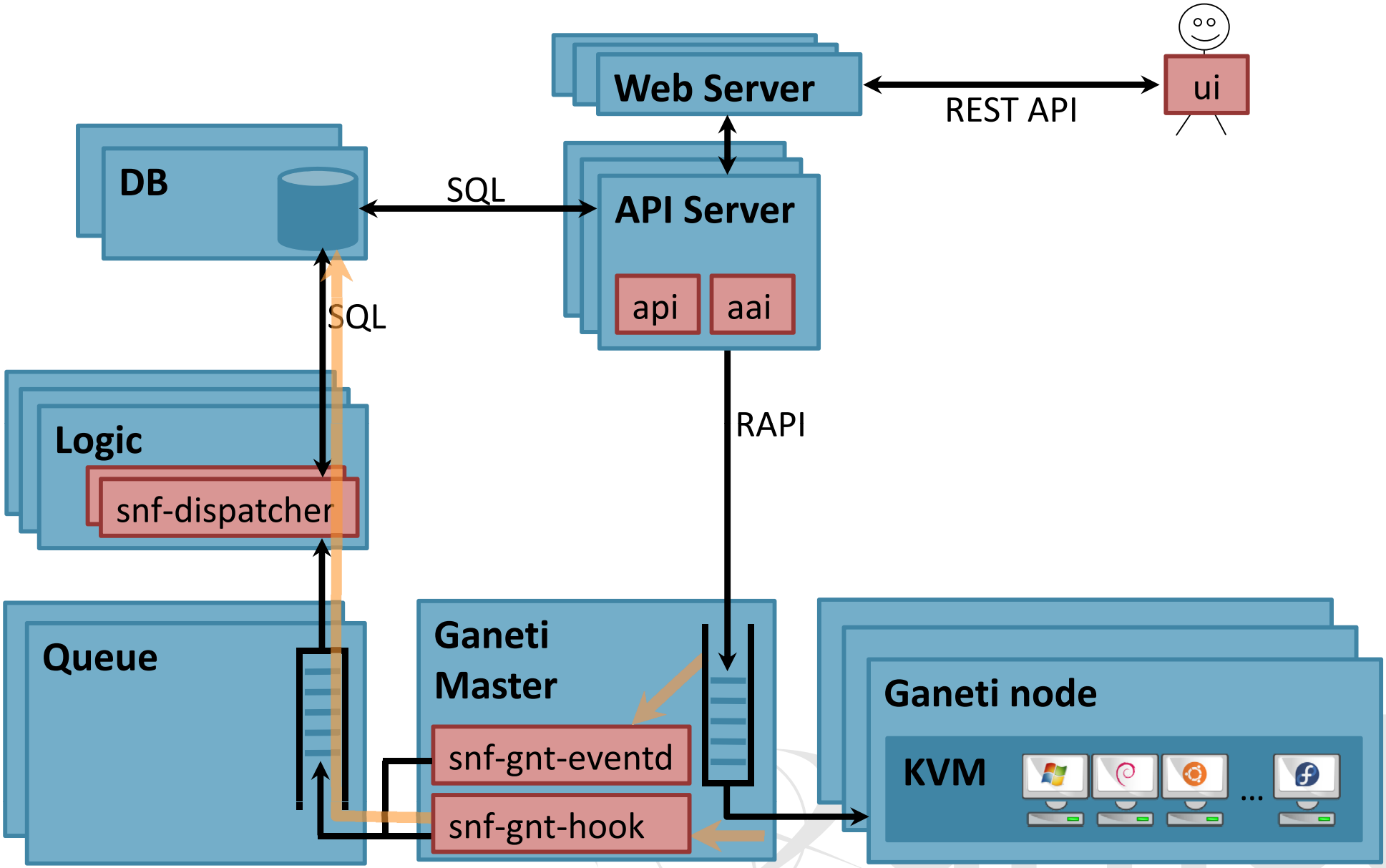
The “update” path

- May run at any time
- Completely decoupled from “effect” path
- Design goal:
  - Ganeti admins free to bypass frontend
  - Synnefo adapts
- Synnefo logic triggered on backend events
  - Ganeti operation progressing in the queue
  - Synnefo hook running inside Ganeti
    - Hooks run at various phases in a VM’s lifecycle

Synnefo deployment



Synnefo deployment



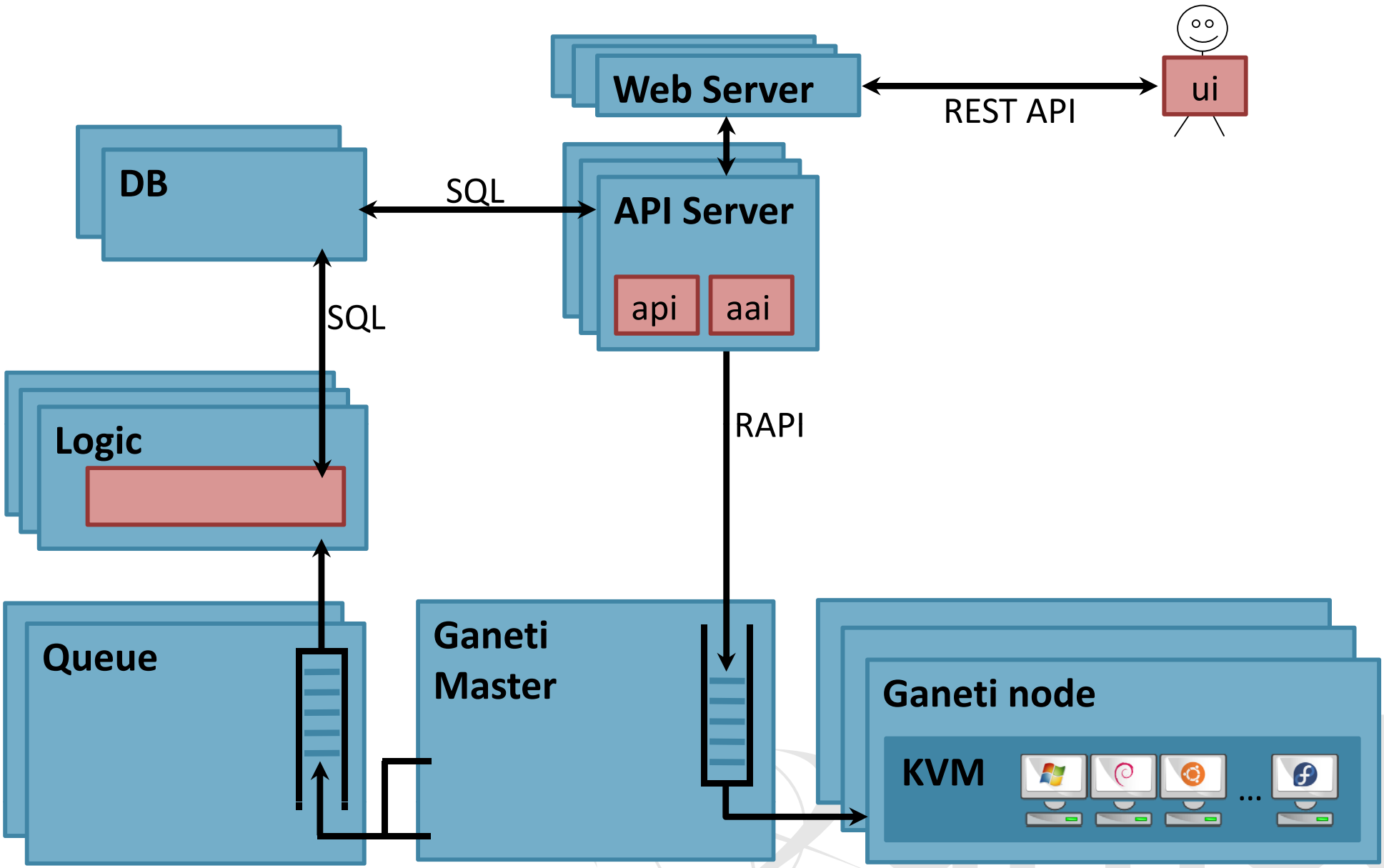
The Ganeti event daemon

- Ganeti master manages job queue
  - Jobs pass *Queued*, *Waiting*, *Running*, end up in *Canceled*, *Success, Error*.
- Need a way for Synnefo to monitor job progress
- Synnefo-specific solution: Ganeti event daemon
  - Passively monitor the Ganeti job queue
  - Notifications over AMQP on job progress
  - Synnefo logic listens to Message Queue, updates DB
  - `inotify()`-based mechanism, no code changes to Ganeti

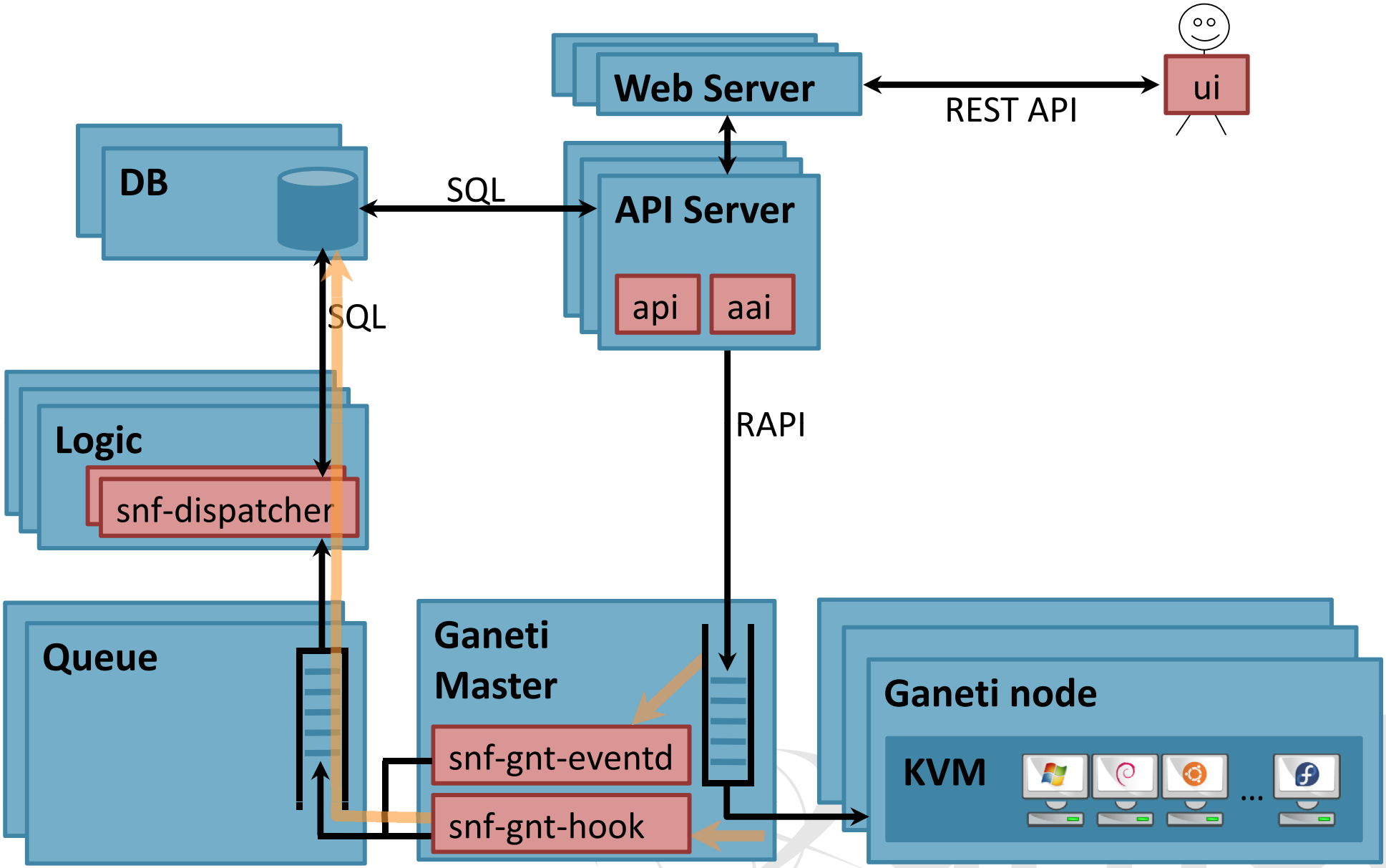
The Synnefo hook in Ganeti

- Different phases in a VM's lifecycle
  - {`pre`, `post`} – {`add`, `start`, `stop`, `reboot`, `modify`}
- Run Synnefo-specific hook in `post-*`
- Pushes VM configuration notifications to MQ
  - e.g., NIC setup

Synnefo deployment



Synnefo deployment



Reconciliation with Ganeti

- What if the MQ is down, and messages are lost?
  - Ganeti is the Single Source of Truth for VM state
- Reconcile DB state asynchronously
  - On success notification for a Ganeti `GetInstanceInfo()` op
- Triggered periodically, e.g., using `cron`
  - or even by the administrator,

    running `gnt-instance info` manually

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IaaS – Network - Functionality

- Dual IPv4/IPv6 connectivity for each VM
- Easy, platform-provided firewalling
  - Array of pre-configured firewall profiles
  - Or roll-your-own firewall inside VM
- Multiple private, virtual L2 networks
- Construct arbitrary network topologies
  - e.g., deploy VMs in multi-tier configurations
- Exported all the way to the API and the UI

IaaS – Network - Implementation

- Custom modifications to Ganeti
  - IP pool management for the public network
- Custom-written DHCP server over NFQUEUE
- Custom interface handling scripts
  - Enforce VM networking configuration
- Private Networks
  - Alpha: pre-provisioned bridges to 802.1Q VLANs
  - Later on: MAC-prefix based filtering

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IaaS – Storage (1)

- First-phase deployment
  - Ability to customize VM contents based on predefined images of common OSs
  - Redundant storage based on DRBD, VMs survive scheduled node downtime
- Currently under development:
  - Reliable distributed storage over RADOS
  - Combined with custom software for snapshotting, cloning to provide dynamic virtual storage volumes

IaaS – Storage (2)

- Multi-tier storage architecture
  - Dedicated Storage Nodes (SSD, SAS, and SATA storage)
  - OSDs for RADOS
- Custom storage layer
  - manages snapshots, creates clones over RADOS
  - OS Images held as snapshots
- VMs created as clones of snapshots

Interaction with other GRNET services

- GRNET AAI Federation
  - Provides the user base for ~okeanos
  - Once authenticated, the user retrieves a Synnefo-specific auth token for programmatic access
- Pithos storage service
  - Currently being overhauled
  - Aim is to provide the Image service for ~okeanos
  - Sharing a common storage backend

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Upcoming goals

- Credit-based resource allocation
- Abstract away the Ganeti backend, replace with backend connector behind the MQ
  - Release to community as reference implementation of OpenStack Compute v1.1
- Support live modification of VMs in Ganeti
- Snapshots, clones in storage layer
  - Dramatic decrease in VM initialization time
  - Support workloads with 100s of ephemeral VMs
    - e.g. for scientific computation, MPI jobs

okeanos

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machines | | | |

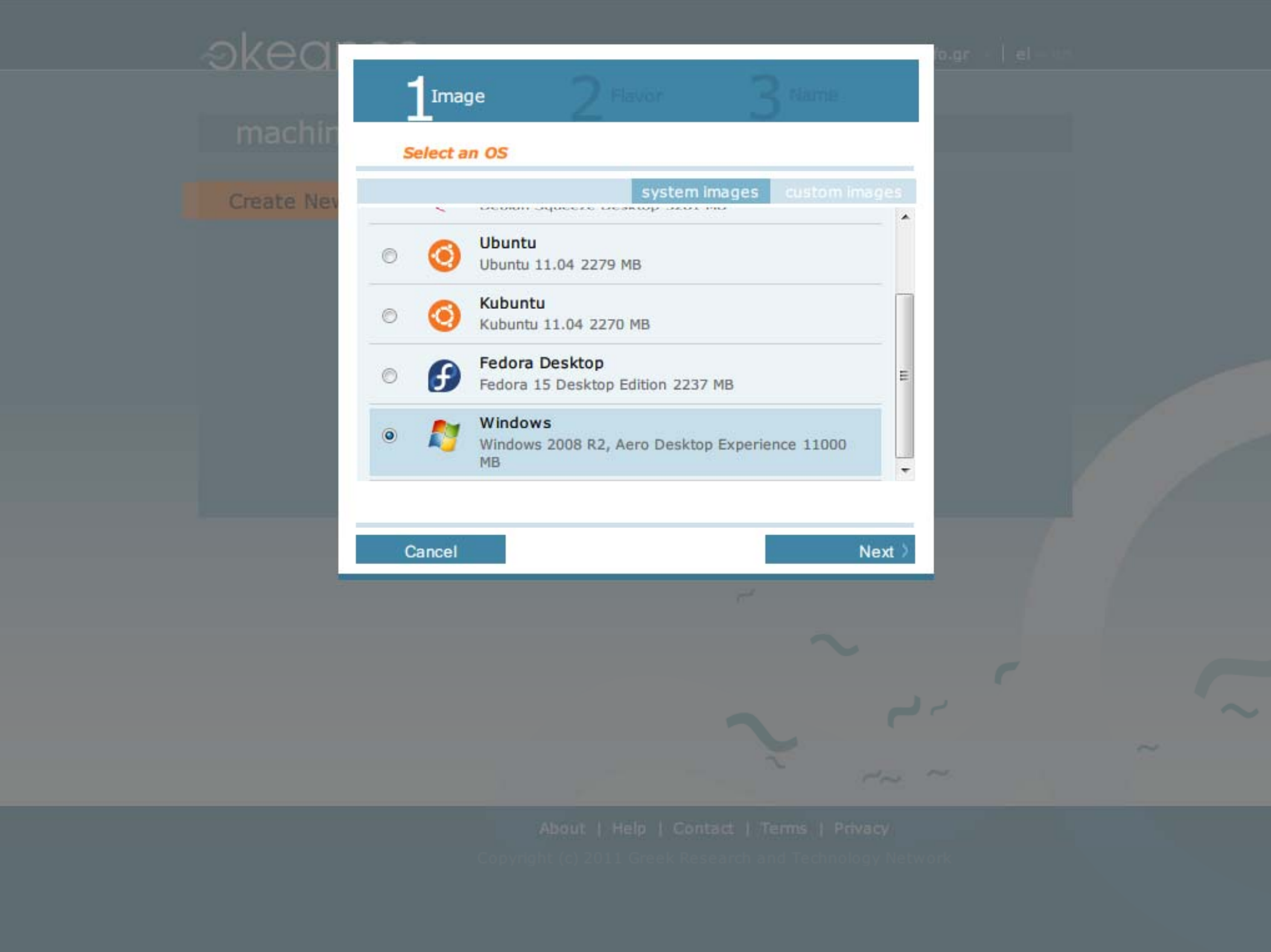
Create New +

Welcome to ~okeanos !

From this panel you will be able to manage your Virtual Machines (VMs). If you don't know what a VM is:
take the tour.

The panel is currently empty, because you don't have any VMs yet. Start by clicking the orange button on the top left. The wizard will guide you through the whole process.

For more information or help, click here.


1 Image
2 Flavor
3 Name
Select an OS
system images
custom images
Ubuntu
Ubuntu 11.04 2279 MB
Kubuntu
Kubuntu 11.04 2270 MB
Fedora Desktop
Fedora 15 Desktop Edition 2237 MB
Windows
Windows 2008 R2, Aero Desktop Experience 11000 MB
Cancel
Next
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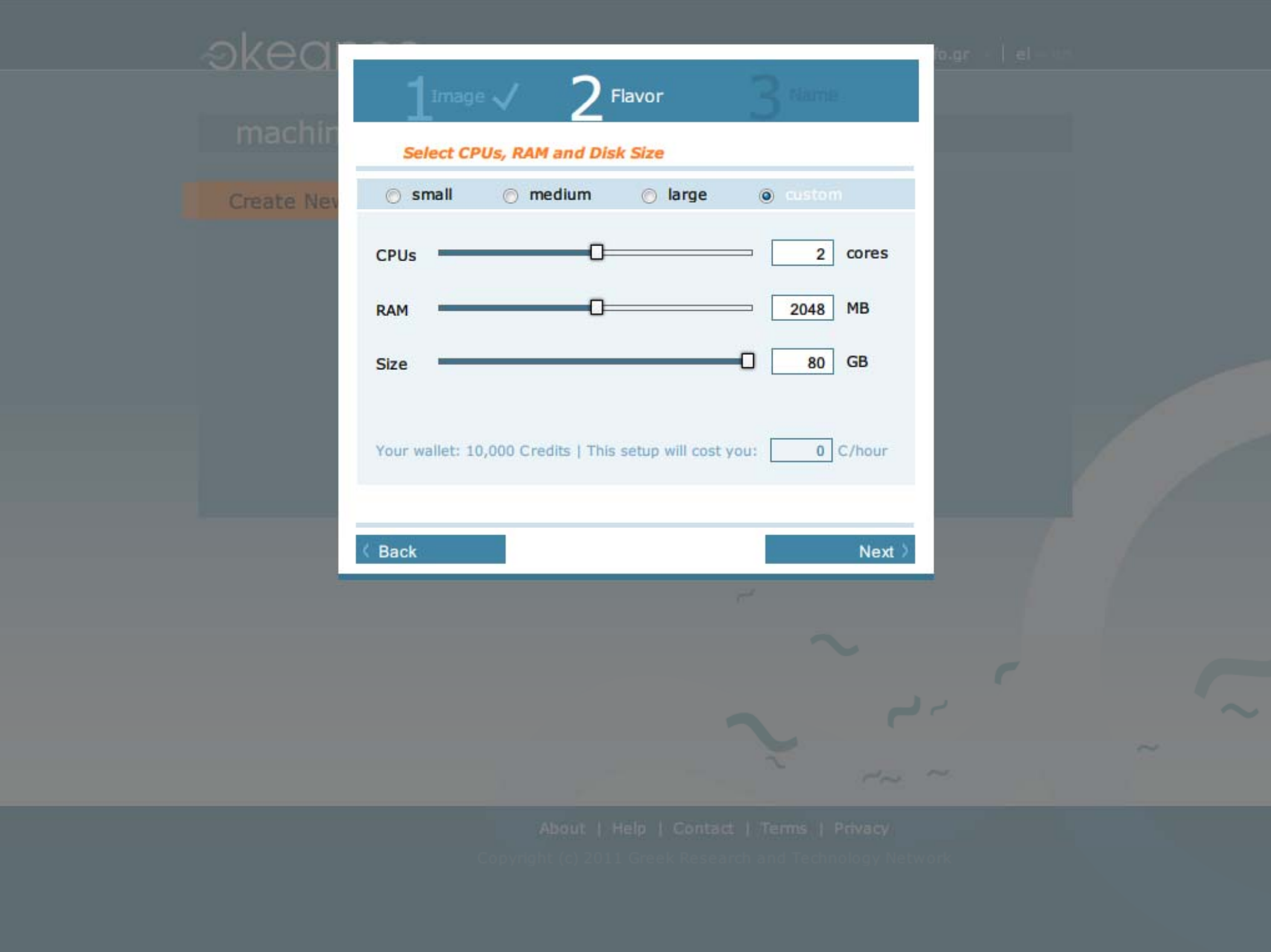
1 Image ✓
2 Flavor
3 Name
Select CPUs, RAM and Disk Size
small
medium
large
custom
CPUs
2
cores
RAM
2048
MB
Size
80
GB
Your wallet: 10,000 Credits | This setup will cost you:
0
C/hour
Back
Next
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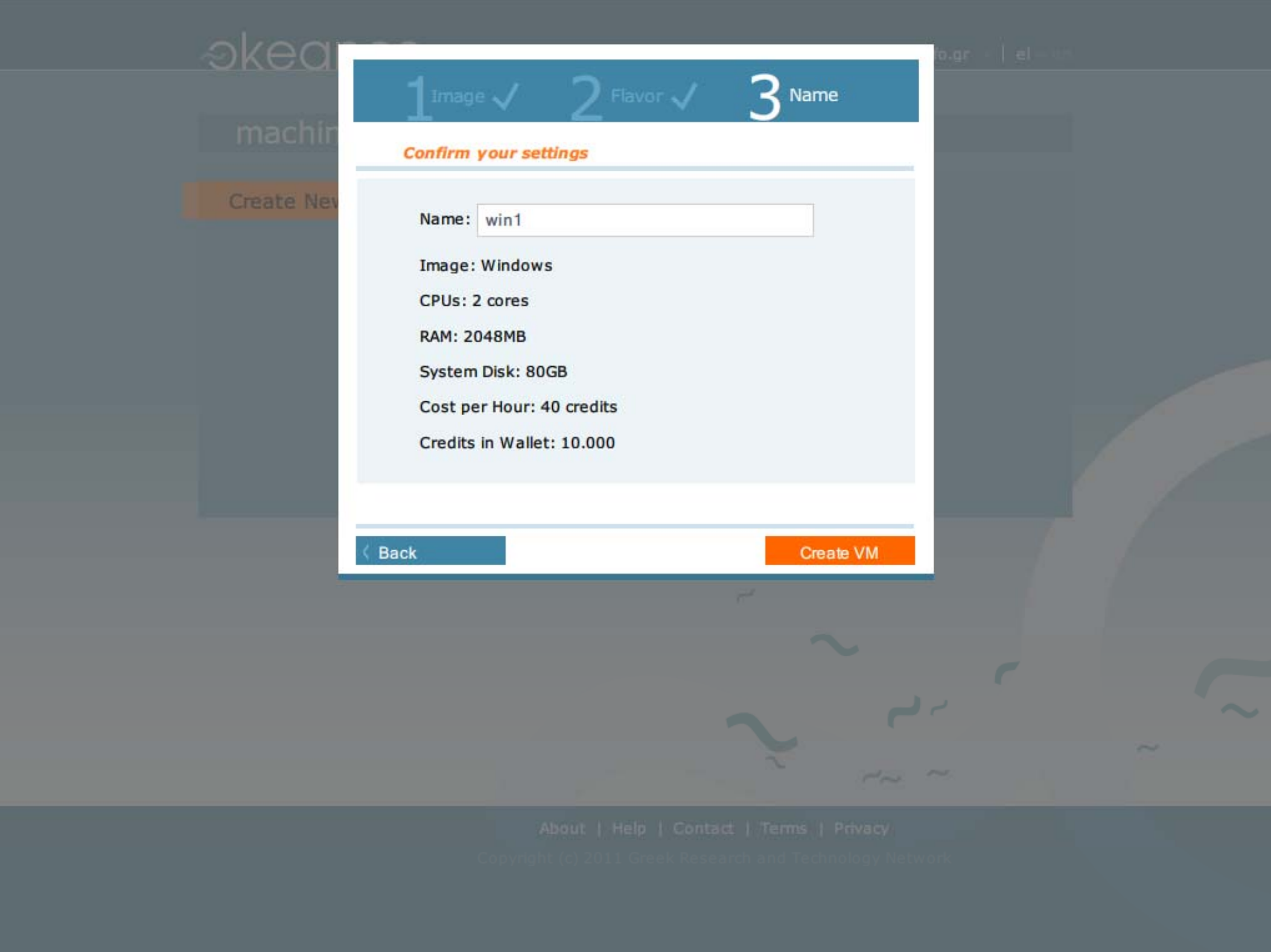
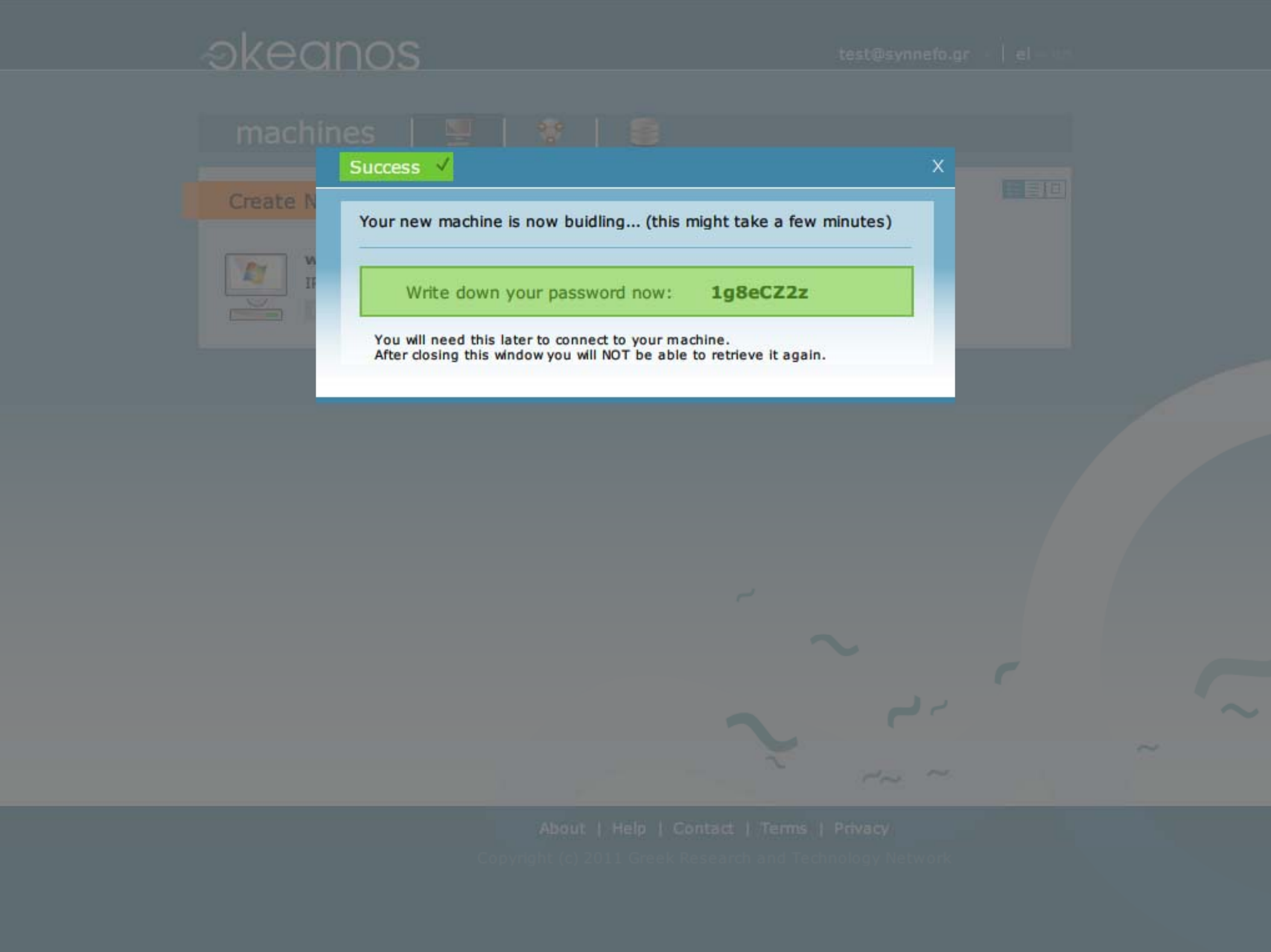

1 Image ✓
2 Flavor ✓
3 Name
Confirm your settings
Name: win1
Image: Windows
CPUs: 2 cores
RAM: 2048MB
System Disk: 80GB
Cost per Hour: 40 credits
Credits in Wallet: 10.000
Back
Create VM
About | Help | Contact | Terms | Privacy


okeanos
test@synnefo.gr
machines
Create N
Success
X
Your new machine is now buidling... (this might take a few minutes)
Write down your password now: 1g8eCZ2z
You will need this later to connect to your machine.
After closing this window you will NOT be able to retrieve it again.
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okeanos

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machines

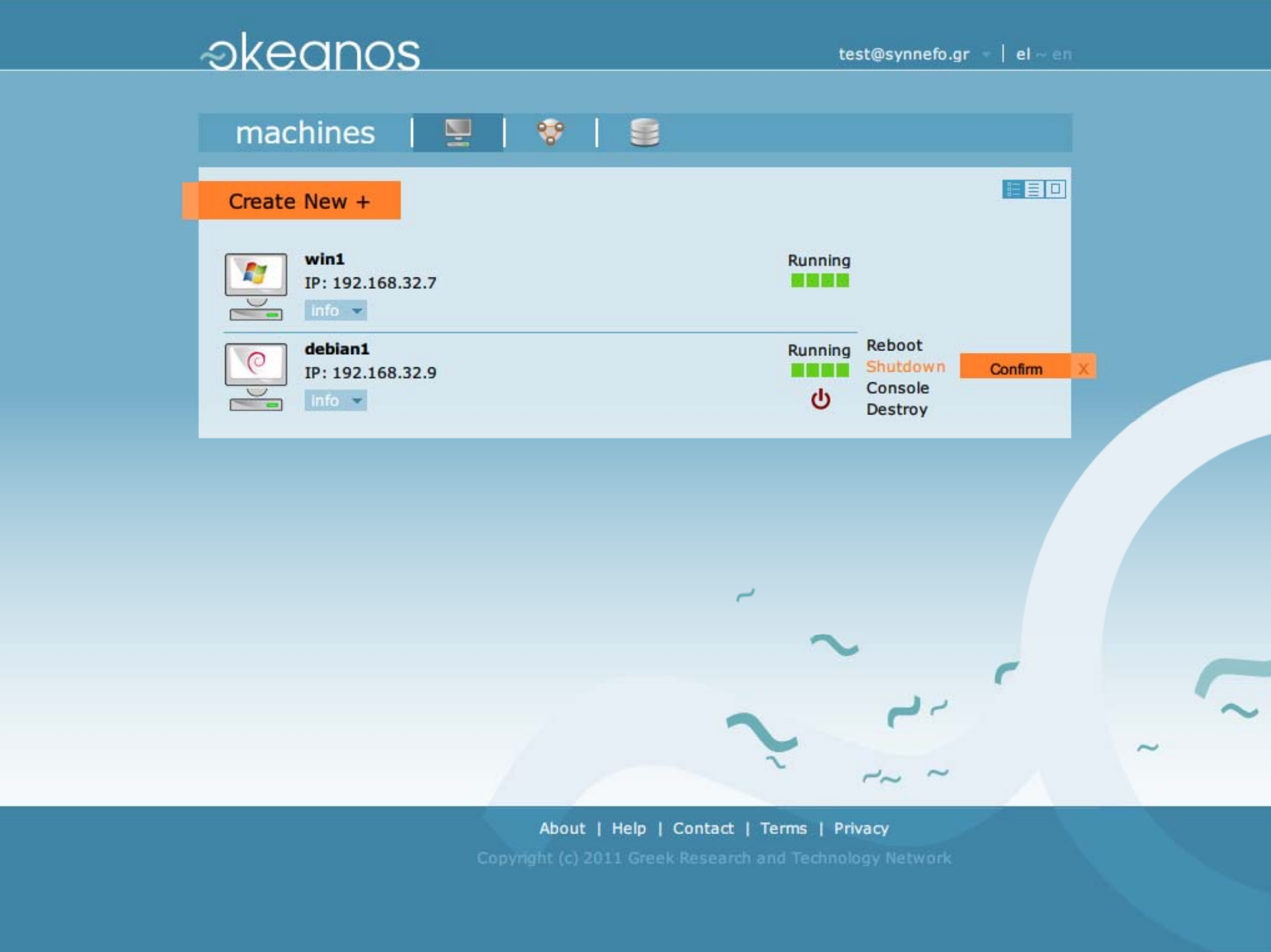
Create New +

win1

IP: undefined

info

Building


okeanos
test@synnefo.gr | el ~ en
machines
Create New +
win1
IP: 192.168.32.7
info
Running
debian1
IP: 192.168.32.9
info
Running
Reboot
Shutdown
Console
Destroy
Confirm
X
About | Help | Contact | Terms | Privacy
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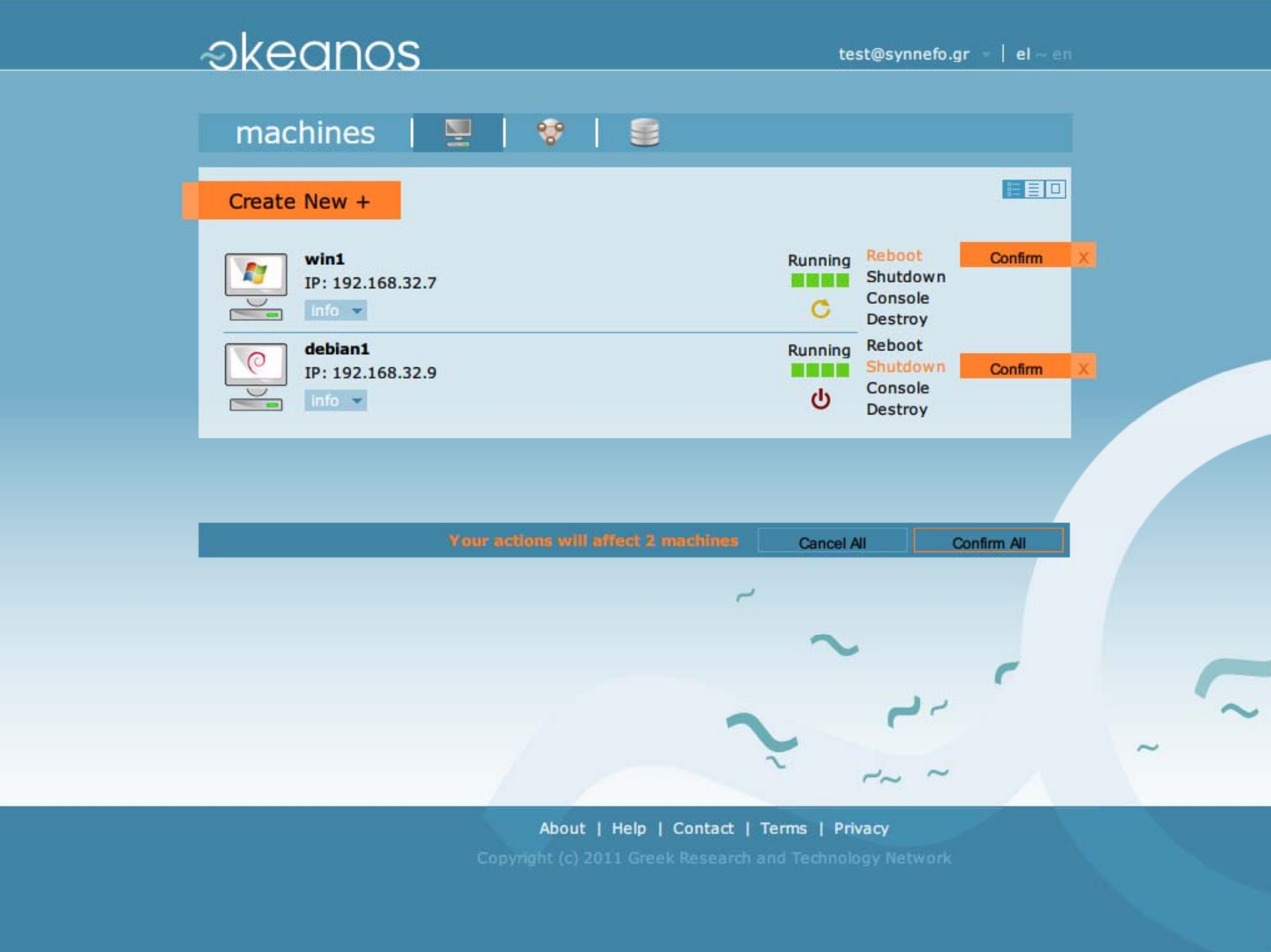
okeanos
test@synnefo.gr | el ~ en
machines
Create New +
win1
IP: 192.168.32.7
info
Running
Reboot
Shutdown
Console
Destroy
Confirm
debian1
IP: 192.168.32.9
info
Running
Reboot
Shutdown
Console
Destroy
Confirm
Your actions will affect 2 machines
Cancel All
Confirm All
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machines

Create New +

win1
IP: 192.168.32.7
info
Shutting down

debian1
IP: 192.168.32.9
info
Running

okeanos

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machines

Create New +

debian1
IP: 192.168.32.9
info

Running

win1
IP: 192.168.32.7
info

Stopped

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machines

Create New +

Search:

	OS	Name	Flavor	Status
☐		win1	2 CPUs, 2048MB, 80GB	Running
☐		debian1	1 CPU, 1024MB, 20GB	Running

Start
Reboot
Shutdown

Destroy

Show Details

Console
Connect

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machines

Create New +

Running

Name:	win1
CPUs:	2
RAM (MB):	2048
System Disk (GB):	80
Image Name:	Windows
Image Size (GB):	11000
Public IPv4:	192.168.32.7
Public IPv6:	2001:db8::a800:ff:fe7c:3d80

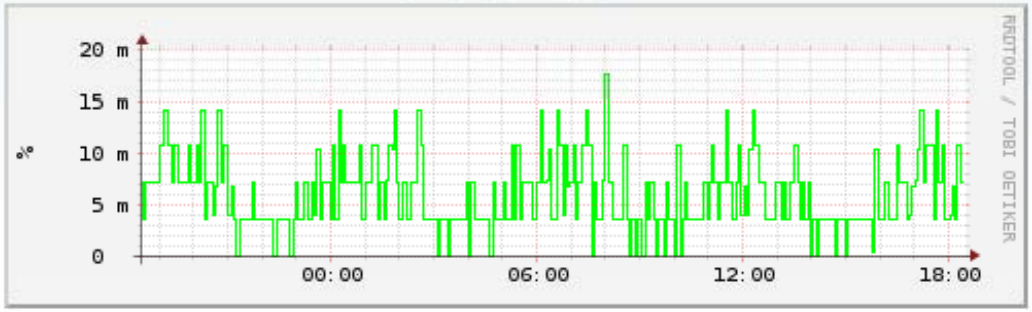
Tags

Reboot
Shutdown
Console
Destroy

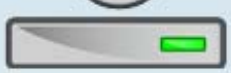
previous next

win1
debian1

CPU Utilization



Network Utilization



Running

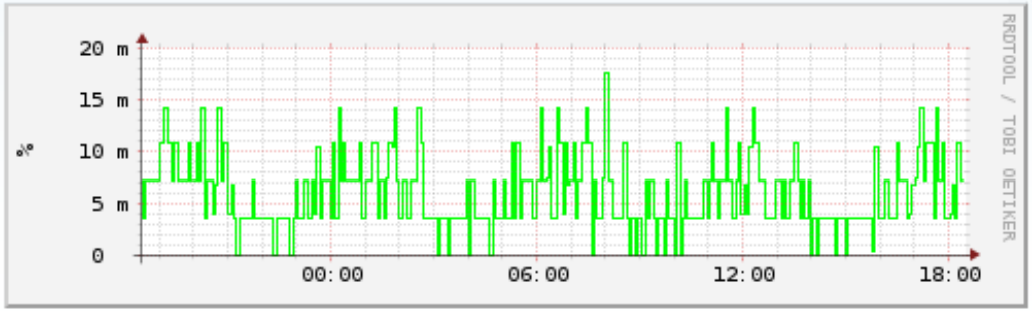
Image Name:	Windows
Image Size (GB):	11000
Public IPv4:	192.168.32.7
Public IPv6:	2001:db8::a800:ff:fe7c:3d80

Tags

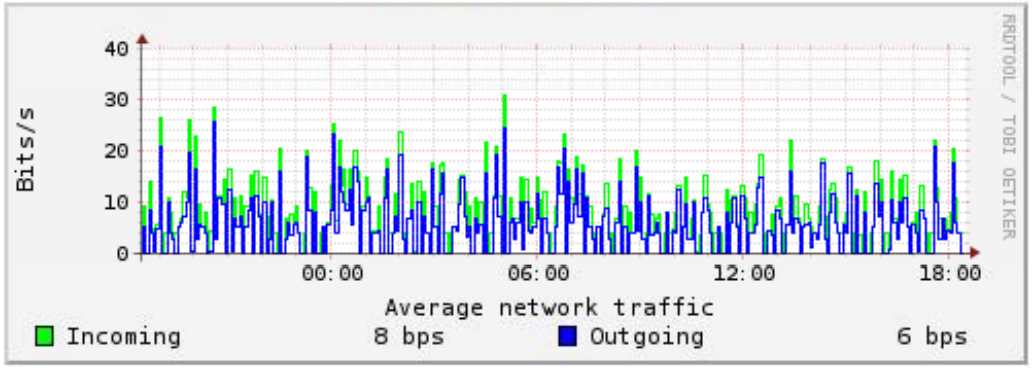
win1

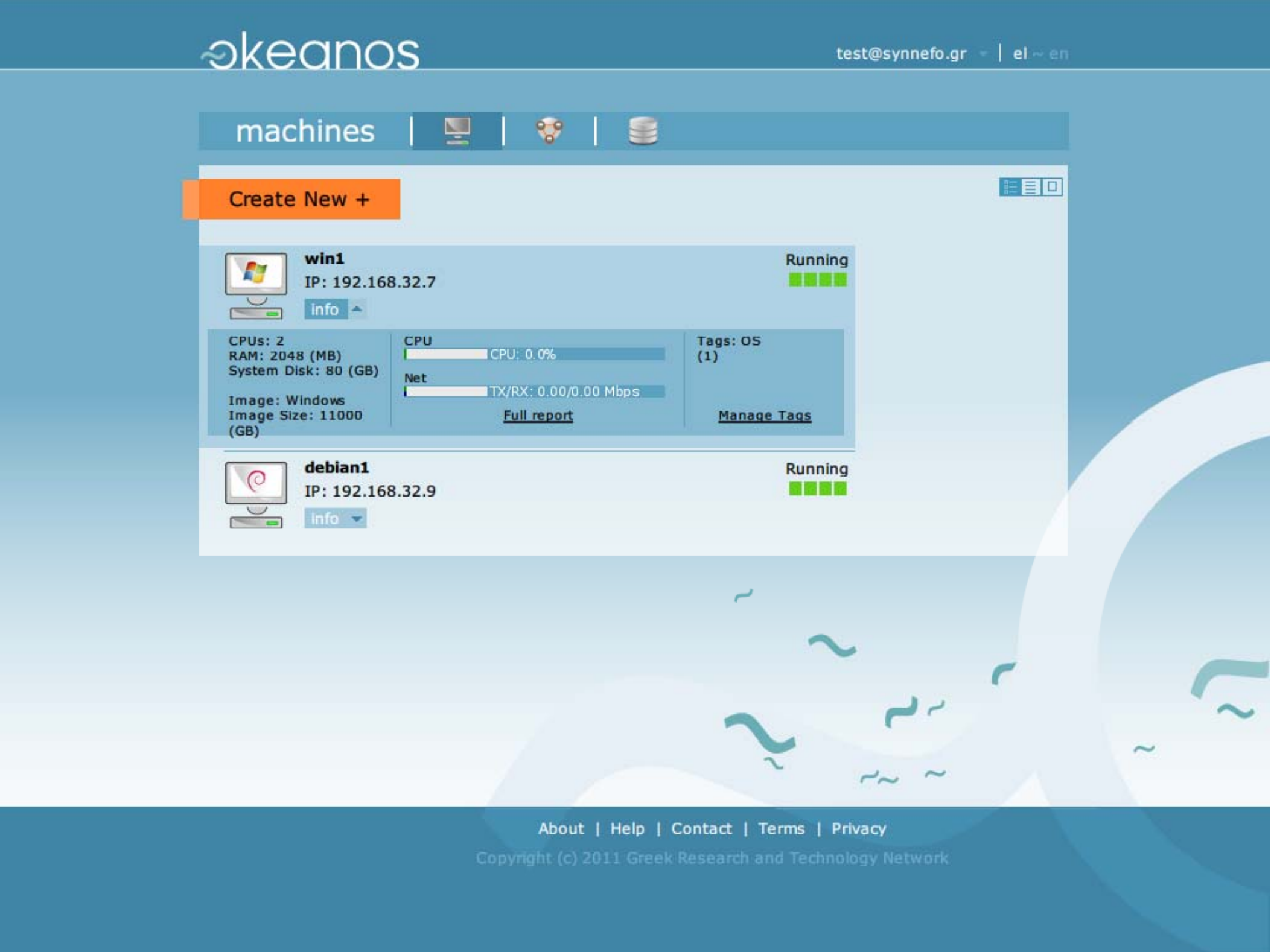
debian1

CPU Utilization



Network Utilization




okeanos
test@synnefo.gr | el ~ en
machines
Create New +
win1
IP: 192.168.32.7
Running
info
CPUs: 2
RAM: 2048 (MB)
System Disk: 80 (GB)
Image: Windows
Image Size: 11000 (GB)
CPU
CPU: 0.0%
Net
TX/RX: 0.00/0.00 Mbps
Full report
Tags: OS (1)
Manage Tags
debian1
IP: 192.168.32.9
Running
info
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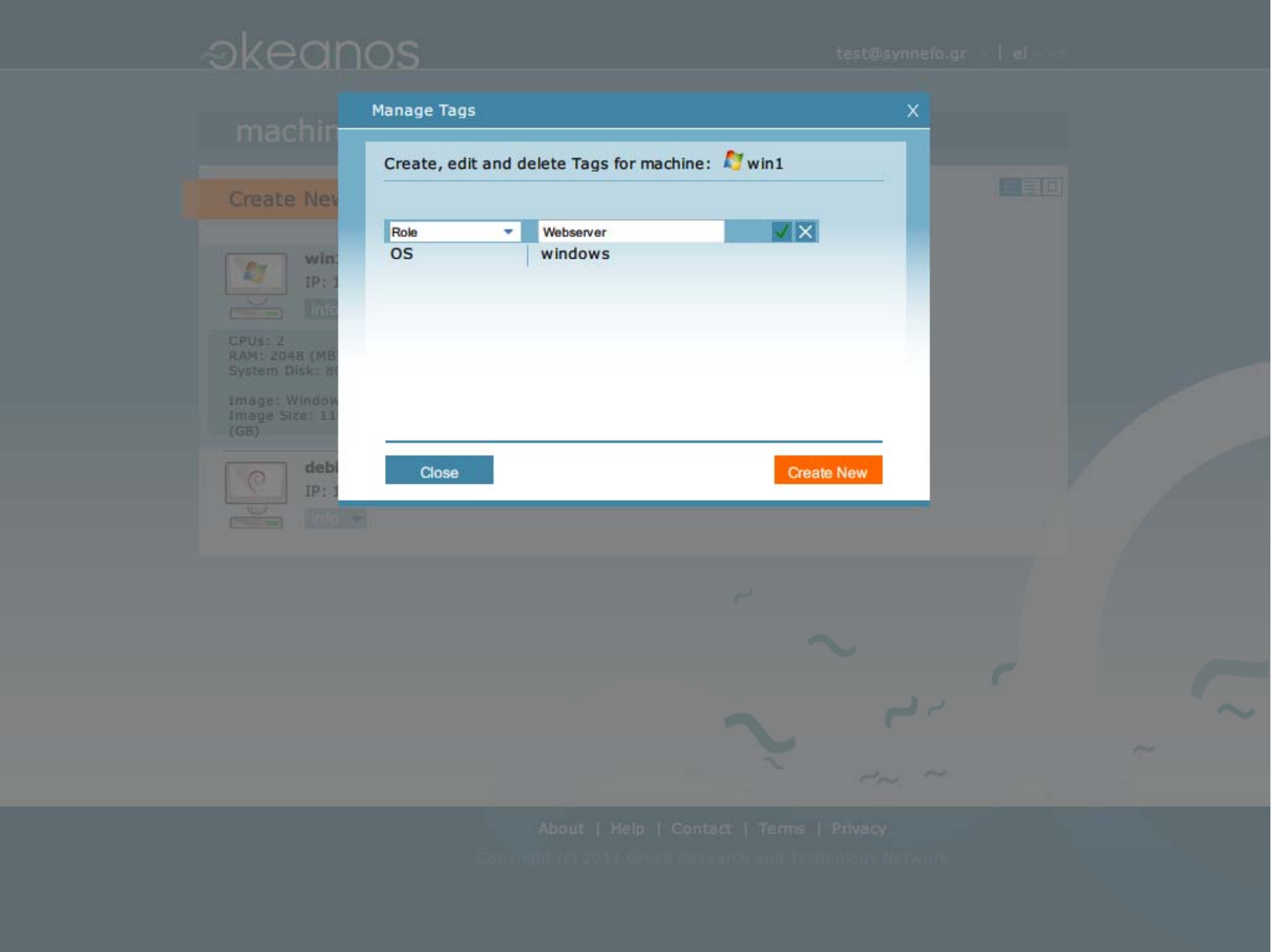
okeanos
test@synnefo.gr
Manage Tags
Create, edit and delete Tags for machine: win1
Role
Webserver
OS
windows
Close
Create New
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networks | | | |

Create New +

Internet

machines (2)

Public Network

okeanos

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networks

Create New +

Internet

Public Network

machines (2)

win1

IPv4: 192.168.32.7
IPv6: 2001:db8::a800:ff:fe7c:3d80

Firewall (Off)

debian1

IPv4: 192.168.32.9
IPv6: 2001:db8::a800:ff:fe81:cd6a

Firewall (Off)

okeanos

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networks

Create New +

Internet

Public Network

machines (2)

win1

IPv4: 192.168.32.7
IPv6: 2001:db8::a800:ff:fe7c:3d80

Firewall (Off)

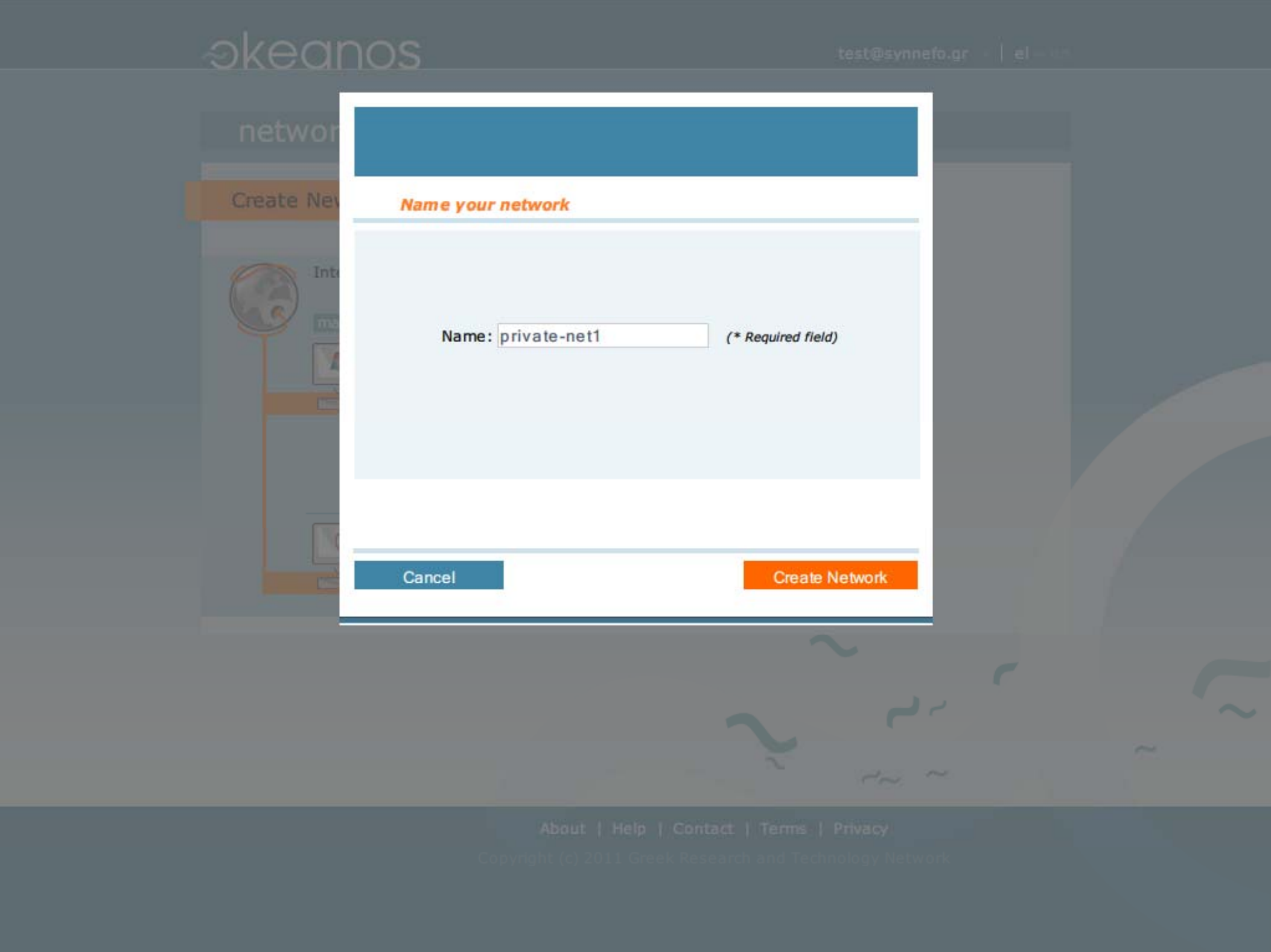
- Unprotected mode (Firewall off)
- Fully protected mode (Firewall on)
- Basically protected mode (Firewall on)

Apply

debian1

IPv4: 192.168.32.9
IPv6: 2001:db8::a800:ff:fe81:cd6a

Firewall (Off)


okeanos
test@synnefo.gr
Create New
Name your network
Name: private-net1
(* Required field)
Cancel
Create Network
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networks

Create New +

Internet

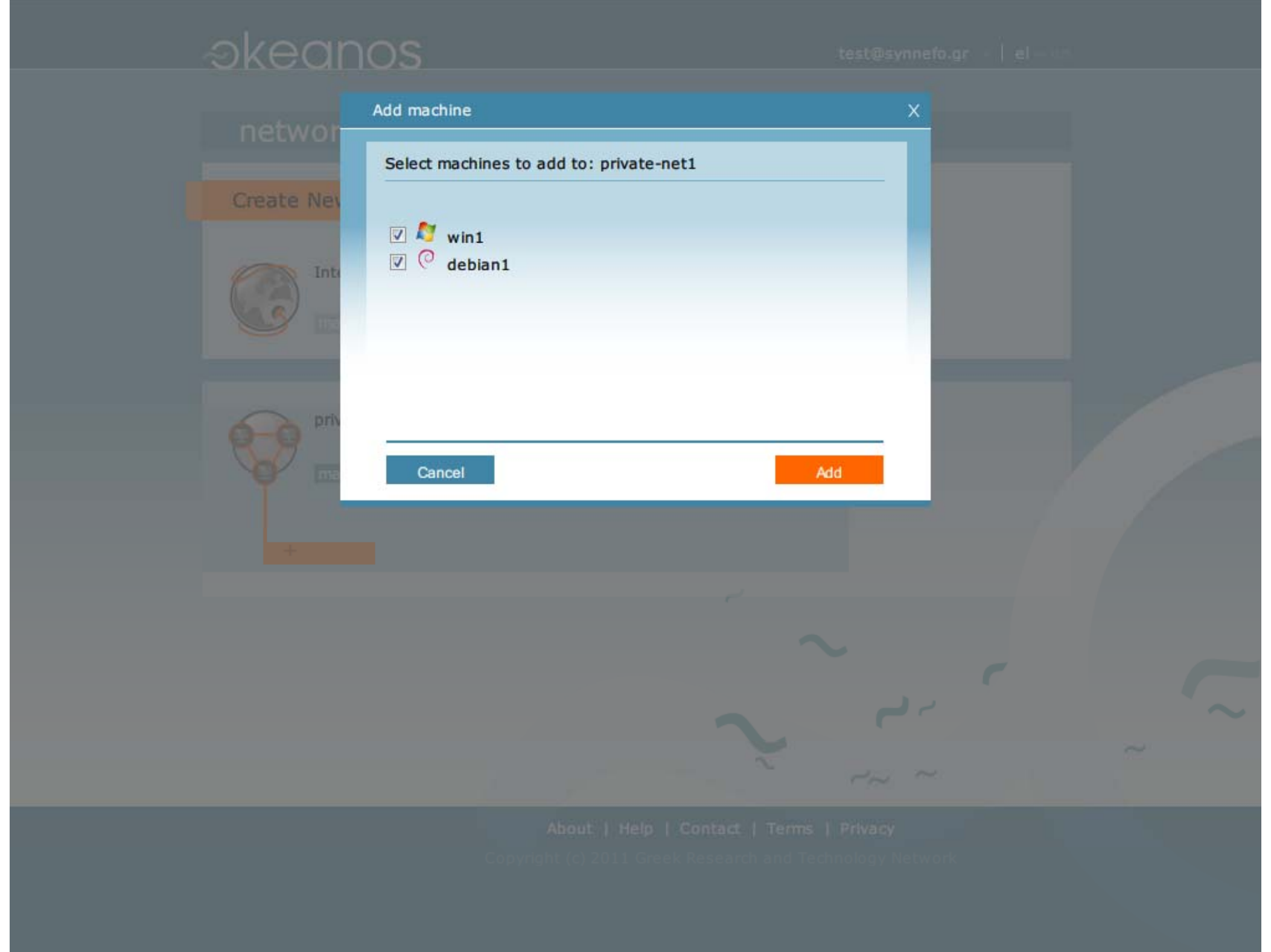
machines (2)

Public Network

private-net1

machines (0)

Private Network


okeanos
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Add machine
Select machines to add to: private-net1
win1
debian1
Cancel
Add
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networks

Create New +

Internet

machines (2)

Public Network

private-net1

Private network

machines (2)

win1

Connect to manage private IPs

debian1

Connect to manage private IPs

For the network changes to take effect you need to reboot all affected machines: Reboot All

debian1 Reboot

win1 Reboot

okeanos

test@synnefo.gr | el ~ en

machines

Create New +

win1
IP: 192.168.32.7
info
Rebooting

debian1
IP: 192.168.32.9
info
Rebooting

Thank You!

Questions?