Cloud security and OpenStack

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OPERACIJO DELNO FINANCIRA EVROPSKA UNIJA
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Outline

- Cloud computing
  - General overview
  - Deployment and service models
- Security issues
  - Threats
  - CSA / NIST / ENISA
  - Data protection, privacy, cryptography, identity management
- OpenStack
  - Components overview
  - Security issues (identity provisioning, authentication, data protection)
- Conclusion and future work

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Cloud computing

- Definitions:
  - Gartner “a style of computing where massively scalable IT-enabled capabilities are delivered 'as a service' to external customers using Internet technologies”
  - NIST “a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction”

- Main characteristics:
  - Non-functional aspect (among the providers are very different)
    - flexibility, reliability, quality of service (QoS), availability, accessibility
  - Business aspect (an important reason for introducing cloud computing in business organizations)
    - reduce costs, pay-as-you-go model, return on investment (ROI), green IT
  - Technical aspect (realization of non-functional and financial aspects)
    - virtualization, several rental model, security, privacy and regulation compliance, self-service, automation, data management, APIs, software support, development, etc.

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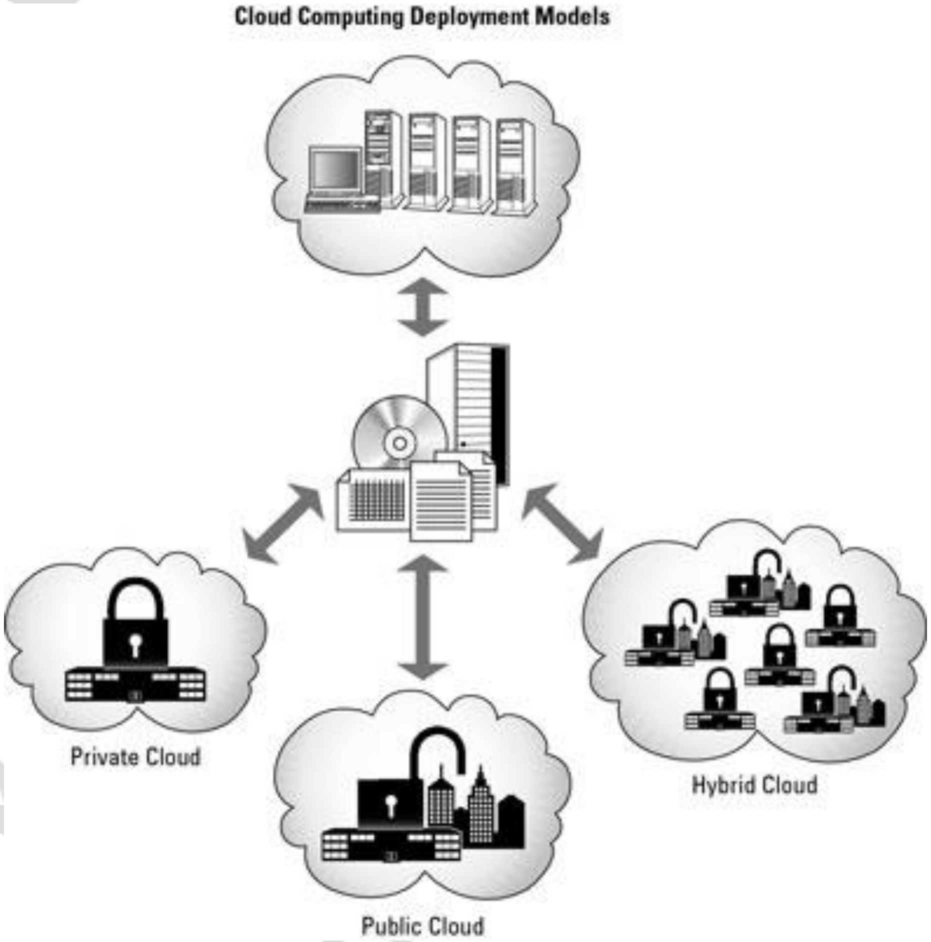
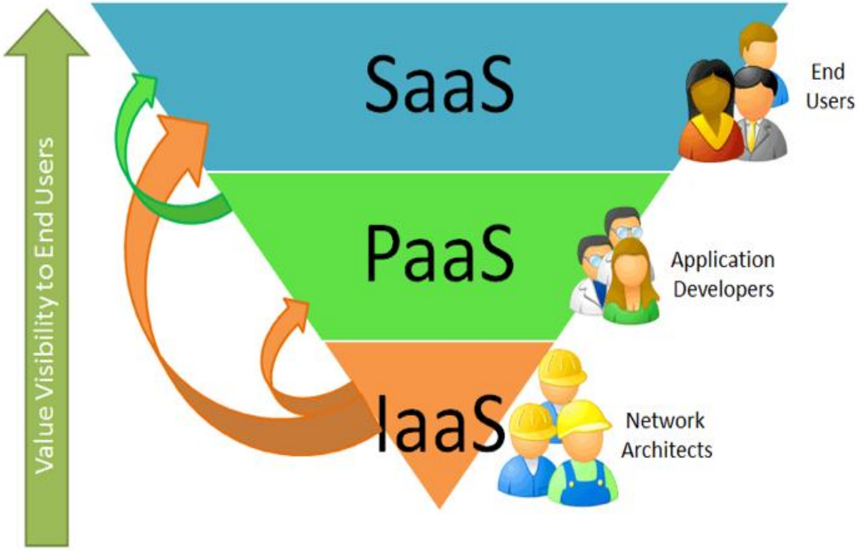
Deployment models

- Public cloud
  - services and facilities are available through the internet
- Private cloud
  - designed exclusively for a specific organization (local hosting)
- Hybrid cloud
  - composed of two or more different cloud infrastructure (linked together)



Service models

- Software as a Service (SaaS)
  - provide the consumer with the use of provider's applications running on a cloud infrastructure
- Platform as a Service (PaaS)
  - a way to rent hardware, on which cloud customers are able to develop and implement applications
- Infrastructure as a Service (IaaS)
  - the consumer can implement any software, including operating system and applications



Present time = A lot of infrastructures:

- Hyper-V, VMware, Nimbus, OpenStack, etc.

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Problem definition

- The biggest obstacle for users in use of cloud is security!
- A popular approach is to create, publish and share server images with other users
- Trust model cloud provider & user is well-defined
  - Amazon is not going to hurt you :)
- What about image provider?
  - Users can create and share images too (blurry ???)
- What about data protection?
  - Admin can access our data, unencrypted data, etc.

Security issues

- When it comes to data hosting by external companies - it is an interesting, economic model, that induces security concerns. Security issues are known, discussed but not resolved entirely.
- CSA / NIST / ENISA
- Threats:
  - Abuse in use of cloud computing
  - Insecure interfaces and APIs
  - Malicious insiders
  - Shared technology issues
  - Data loos or leakage
  - Account or service hijacking
  - Unknown security profile

Data protection

- The main data protection risks:
  - loss of data by third-party service providers
  - unauthorized access to your data
  - malicious activities targeting your service provider (hacking, viruses)
  - poor internal IT security compromising data protection
  - deletion of data

Privacy

- Data storage => Where is located?
- Is the service provider owned or controlled by a foreign company?
- Destruction => What happens when the contract is terminated?
  - Is data destroyed or can be retrieved?
- Who is responsible for protecting privacy?
- Privacy breaches
- Risk management

Cryptography

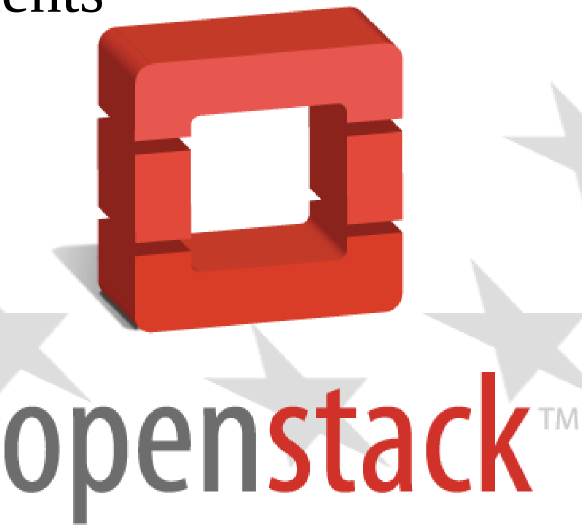
- When it comes to data encryption, cloud providers still have a long road ahead.
- Alex Staomes, an iSec Partners researcher, claimed that cloud computing should be approached from the cryptographic angle.
- Security questions for cloud providers:
  - Data on write: Are files transferred to/from cloud servers encrypted by default?
  - Data at reset: Are files stored on cloud servers encrypted by default?
  - Data retention: If files on cloud servers are encrypted and there is a request from law enforcement to decrypt data, than what do you do?

Identity management

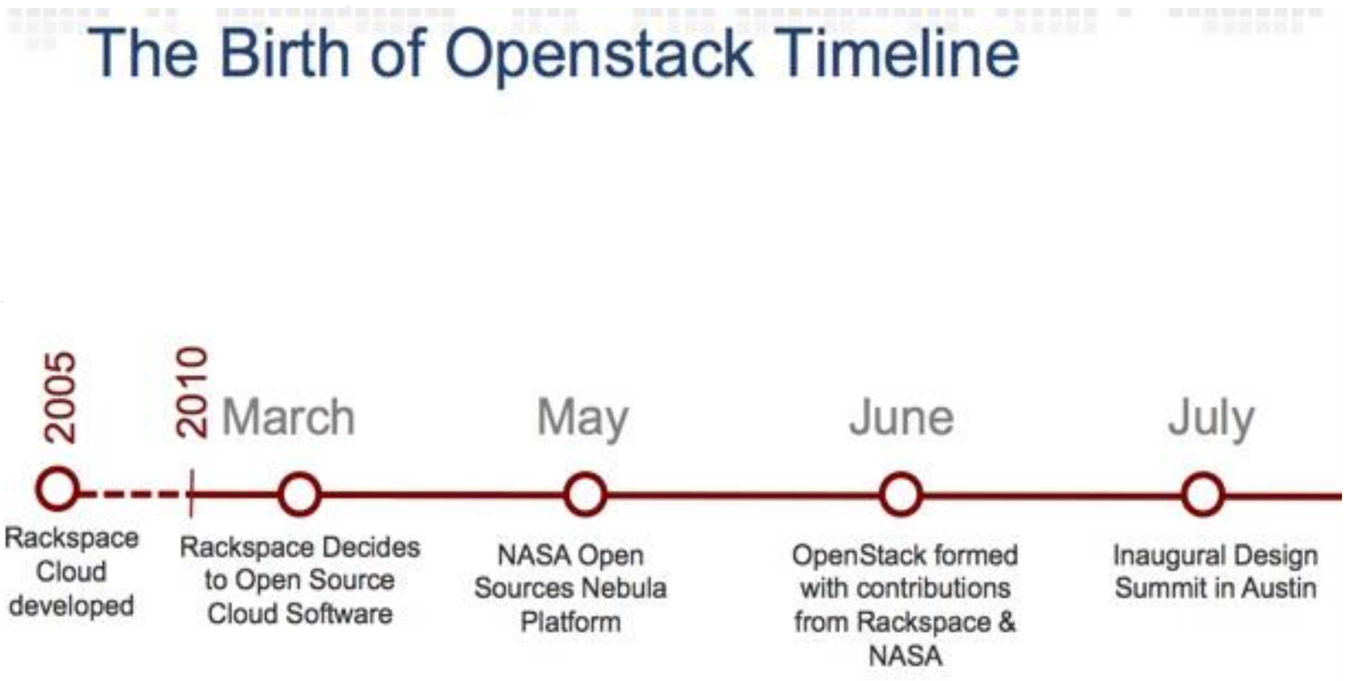
- Registration of identities
  - organizations that transfer their user accounts in the cloud must make sure to update the management of the user accounts
- Authentication
  - it is important the authentication of users should be managed and implemented in a trustworthy way (one time password or SSO - more protected; classic username and password approach - less protected)
- Authorization
  - specifies what rights every individual user account have in the cloud
- Federation of identities
  - is it possible to establish a single application (SSO)?
- Access control
  - access control requirements vary widely depending on whether the end-user is individual use or an organization.

OpenStack

- OpenSource platform to build private and public clouds.
- We will concentrate on the following:
  - Review of existing components
  - Authentication
  - Authorization
  - Recommendations



OpenStack



The Birth of Openstack Timeline

2005 — Rackspace Cloud developed

2010 March — Rackspace Decides to Open Source Cloud Software

May — NASA Open Sources Nebula Platform

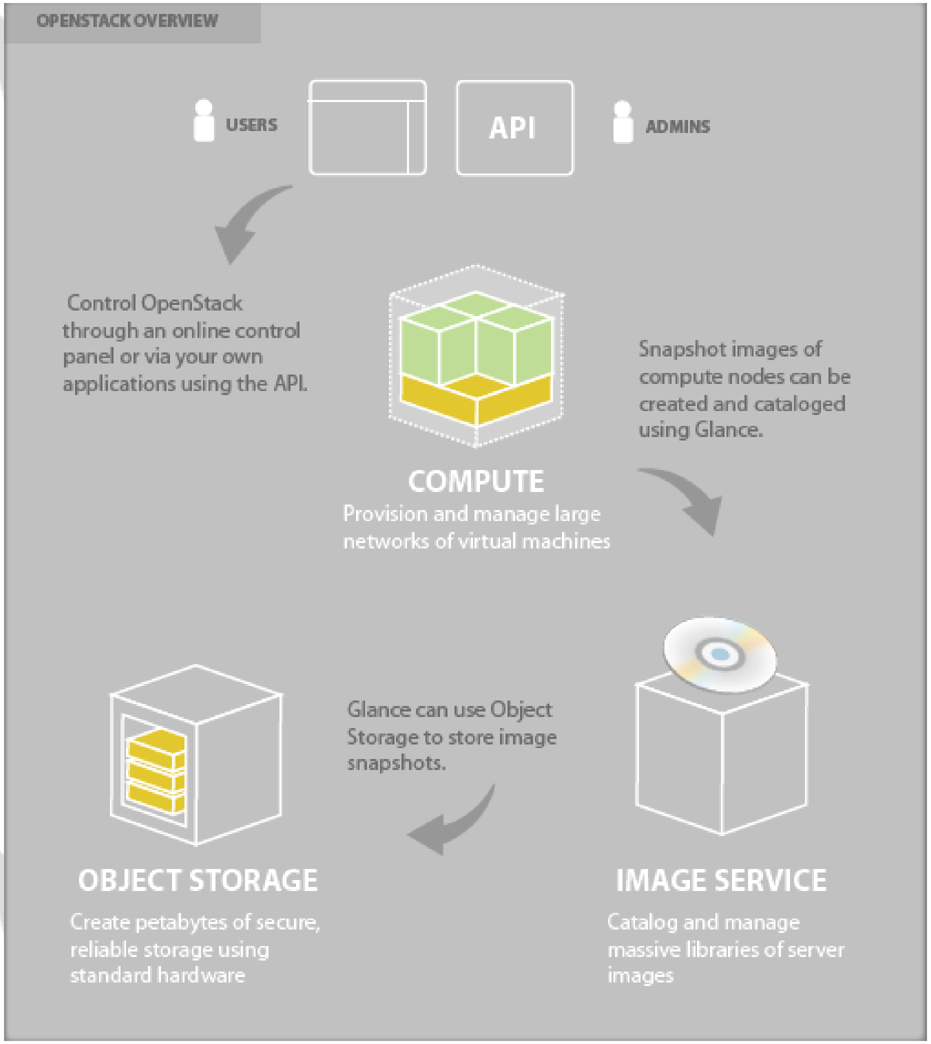
June — OpenStack formed with contributions from Rackspace & NASA

July — Inaugural Design Summit in Austin

- Overview of versions
  - Austin (21. October 2010)
  - Bexar (3. Februar 2011)
  - Cactus (15. April 2011)
  - Diablo (22. September 2011)
  - Essex (5. April 2012)
  - Folsom (Fall 2012)

OpenStack

- **Components**
  - OpenStack Compute (nova)
    - ➢ Provision and management of large networks of virtual machines.
  - OpenStack Object Storage (Swift)
    - ➢ Create petabytes of reliable storage using standardized hardware.
  - OpenStack Image Repository (Glance)
    - ➢ Catalog and manage massive libraries of server images


OPENSTACK OVERVIEW
USERS
API
ADMINS
Control OpenStack through an online control panel or via your own applications using the API.
COMPUTE
Provision and manage large networks of virtual machines
Snapshot images of compute nodes can be created and cataloged using Glance.
Glance can use Object Storage to store image snapshots.
OBJECT STORAGE
Create petabytes of secure, reliable storage using standard hardware
IMAGE SERVICE
Catalog and manage massive libraries of server images

OpenStack – General overview

DIABLO version	Authentication	Authorization	Issues	Suggestions for improvment
Compute	keystone	Token	Simple password / unprotected passwords in novarc file	Password complexity/ SSL
Object Storage	swAuth/tempAuth (keystone)	Token	Unprotected passwords/non-complex passwords	SSL / Password complexity and keystone usage
Image Service	Keypairs (key pairs)		Keys are publicly accessible, if not stored in the right location	Correct read/write permissions

OpenStack (Object Storage)

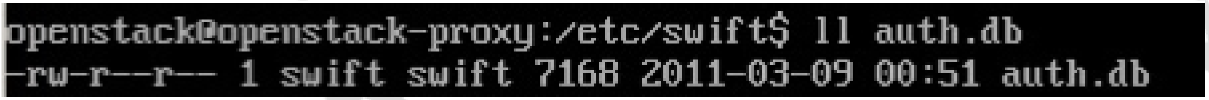
- User management is role based
  - Users are not granted to administrate any users themselves
  - Admin can add users to an account which he is allowed to administrate
  - Reseller admin has admin permissions on all of the accounts and cannot add other Reseller admins
  - Super admin is the most powerful user who can perform all user management procedures, including adding Reseller Admins

OpenStack (Object Storage)

	devAuth	swAuth	tempAuth
Admin (unprotected password)	/etc/swift/auth-server.conf	/etc/swift/proxy-server.conf	/etc/swift/proxy-server.conf
Users (unprotected passwords)	SQLite DB	JSON-encoded text files	/etc/swift/proxy-server.conf
Access to .conf and db files	Anyone	Owner of .conf file	Owner of .conf file
Used in Diablo version	Dropped	Optional	Built-in
Admin has access to all date of users	Yes	Yes	Yes

Object Storage - Passwords

- Current user authentication is not in accordance with CSA
  - Password in plain text format
  - Minimal password length is not determinited (only one character can be used)
  - Password complexity
- Weakness in tempAuth identified and reported to OpenStack community
- Solution?
  - Access rights

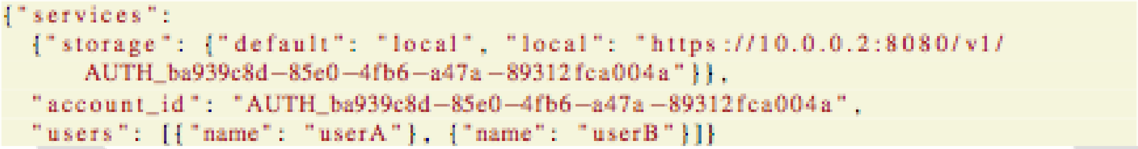


```
openstack@openstack-proxy:/etc/swift$ ll auth.db
-rw-r--r-- 1 swift swift 7168 2011-03-09 00:51 auth.db
```

  - Python module hashlib
  - Encryption of super admin password in .conf file
  - Use of SSL

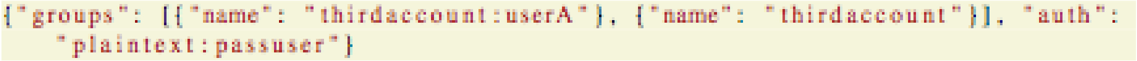
ObjectStorage – Portability of stored data

- Administrator has the possibility to retrieve authentication data of users
  - 1. step



```
{"services":
  {"storage": {"default": "local", "local": "https://10.0.0.2:8080/v1/
      AUTH_ba939c8d-85e0-4fb6-a47a-89312fca004a"}},
  "account_id": "AUTH_ba939c8d-85e0-4fb6-a47a-89312fca004a",
  "users": [{"name": "userA"}, {"name": "userB"}]}
```

  - 2. step



```
{"groups": [{"name": "thirdaccount:userA"}, {"name": "thirdaccount"}], "auth":
    "plaintext:passuser"}
```

- Different types of administrators:
  - Super Admin, Reseller Admin, Admin
  - Reseller Admin
    - ➢ can obtain the URL address of existing users
    - ➢ can download or even delete files belonging to any user on any of the accounts
- Solution? Data encryption before transmission!

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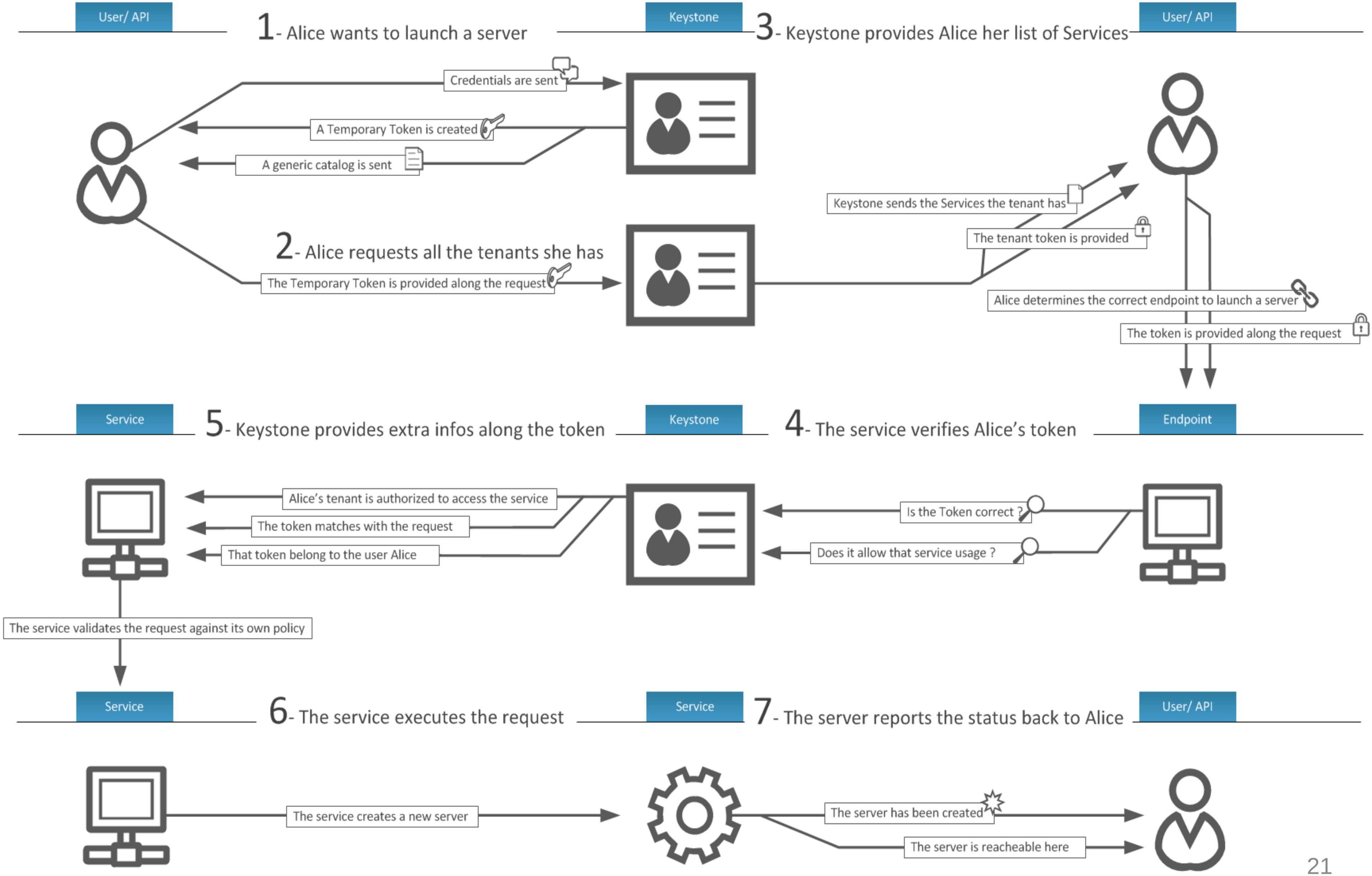
OpenStack - keystone

- OpenStack has recently added support for identity service Keystone
- Currently supports:
  - Authorization with tokens and authorization service
  - Connection with LDAP
- In future versions it will be possible to connect with:
  - OAuth (Open Authorization)
  - openID (Authentication mechanism)
- Data storage in SQLite DB or MySQL

The Keystone Identity Manager



User/ API

1- Alice wants to launch a server

Keystone

Credentials are sent

A Temporary Token is created

A generic catalog is sent

2- Alice requests all the tenants she has

The Temporary Token is provided along the request

3- Keystone provides Alice her list of Services

User/ API

Keystone sends the Services the tenant has

The tenant token is provided

Alice determines the correct endpoint to launch a server

The token is provided along the request

Service

5- Keystone provides extra infos along the token

Keystone

4- The service verifies Alice's token

Endpoint

Is the Token correct ?

Does it allow that service usage ?

Alice's tenant is authorized to access the service

The token matches with the request

That token belong to the user Alice

The service validates the request against its own policy

Service

6- The service executes the request

Service

7- The server reports the status back to Alice

User/ API

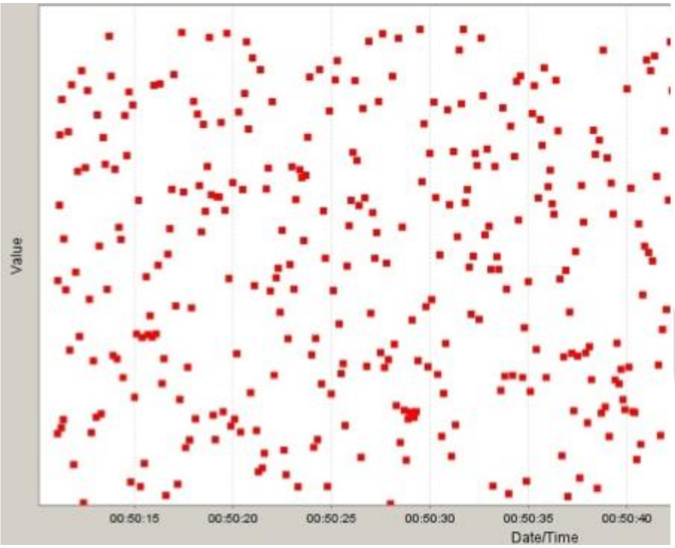
The service creates a new server

The server has been created

The server is reacheable here

OpenStack (Tokens)

- Authorization (security token generation)
  - Security tokens in OpenStack play the same role as sessions identifiers for web applications
  - Tokens are stored in /etc/swift/account.ring.gz
  - Python UUID version 4 is used to to generate tokens, which use
    - /dev/random (Ubuntu) as a source of randomness



OpenStack – Reliability

- Hazard perception?
  - Server load monitoring
  - CPU, memory etc.
- Isolation of infected
- Disabling access to an attacker
  - Network filtering (firewall)
  - Disabling user account

Recomendation

- ObjectStorage (Swift)
  - For development and testing is recommended to use tempAuth
  - For production is recommended to use swAuth or Keystone
- Password protection
- Data encryption
- Security portal (recently established)
  - http://openstack.org/projects/openstack-security/
- Subscribe to mailing list

Future work

- Cloud computing has many outstanding security concerns, some are technical, thus involving mechanisms for data processing, reliability, performance, etc.
- Therefore exploration does not STOP there and a lot of work can be done:
  - scripts for checking the security mechanisms for any deployment model in OpenStack (Swift part is done already)
  - SSL connections are set at the first install
  - Single-Sign-On for different cloud platforms and providers