Programme FORMATION : Mise en œuvre d'Equipes Système :

# Projets CREE : Coopération Recherche Etudiants - Entreprise

Pluridisciplinaires

Equipe Système

Innovation Technologique

Coopération

4 à 5 étudiants / Equipe
1 référent Technique Entreprise /Etudiant
1 référent SystemX pour l'équipe
Validation du Projet Fin d'Etude (PFE) des étudiants
Objectif : ~10 Equipes/an

# CREE Cloud: Challenges, Objectives and Perspectives


**Presented by :**

Mouad IDRI

Lamine SAMB

Yassine SBAI

Anca ZANFIR

Supervised by:

Makhlouf HADJI

Gaelle BERTHOMIEU



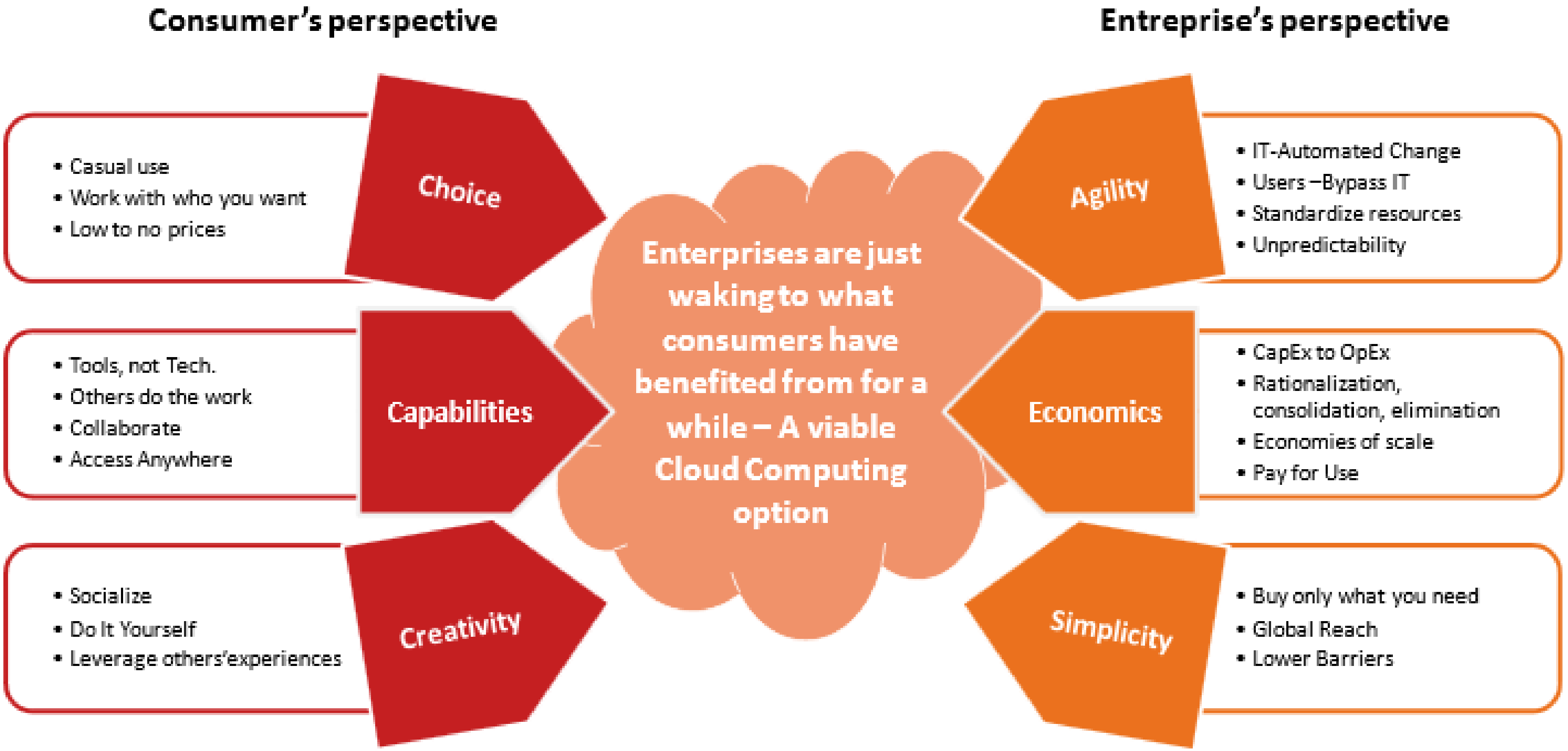
Projet porté par | Labellisation principale | Labellisations secondaires | Soutien de collectivités territoriales

# Cloud Readiness and Architecture

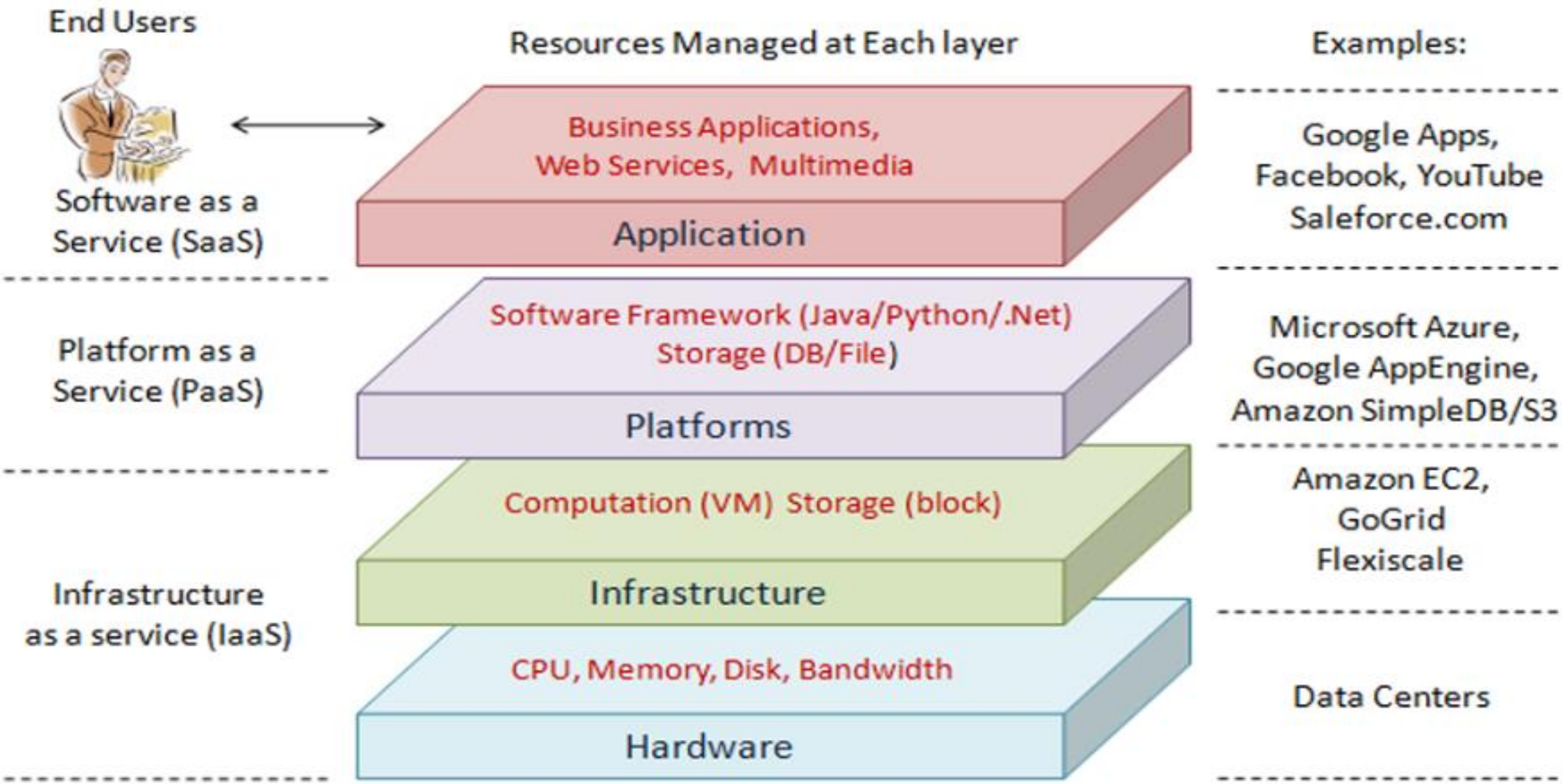
**Mouad IDRI**

## Cloud Computing: “Consumer” Versus “Enterprise” Viewpoints

Source : Gartner

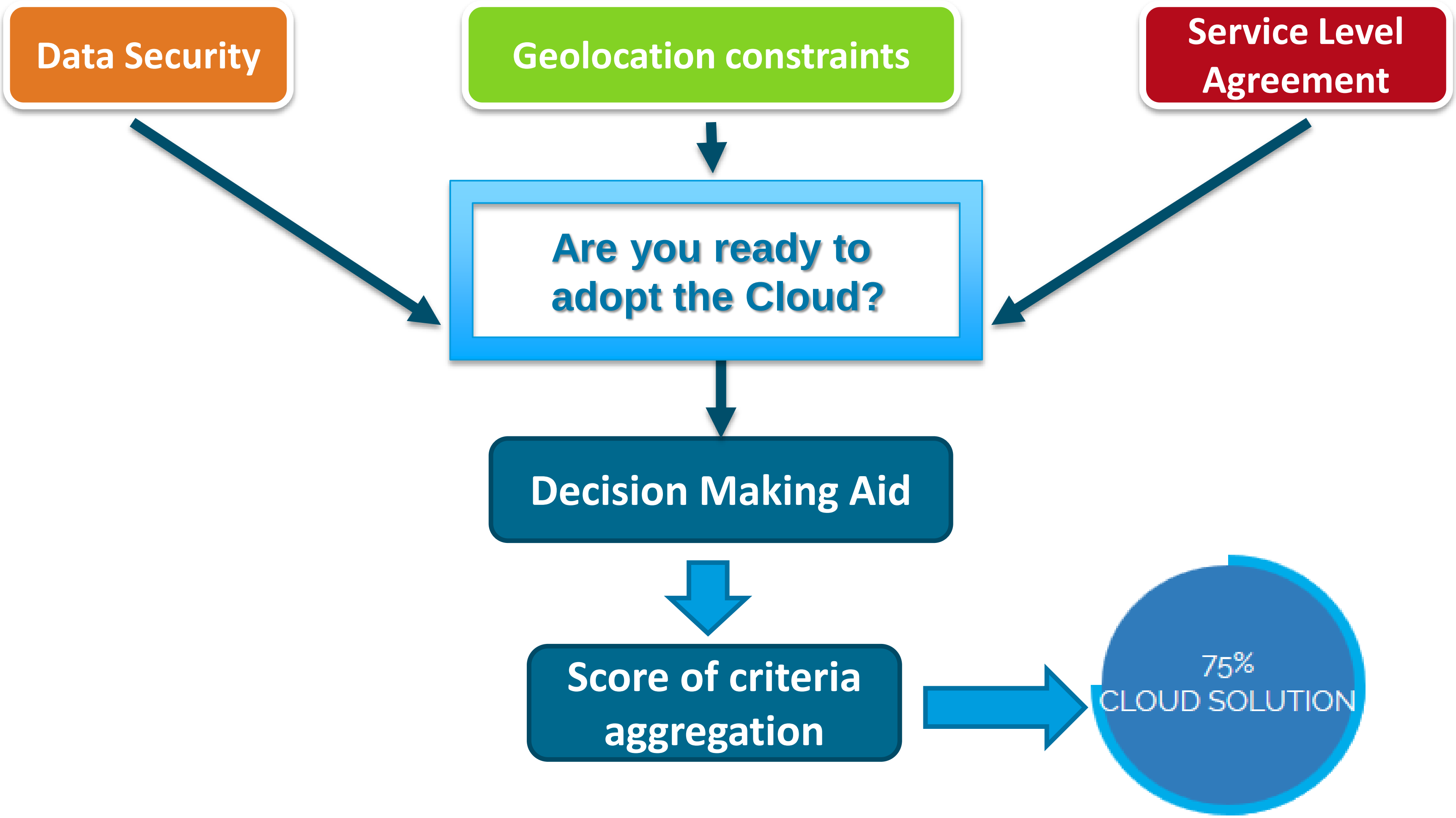


# Internship no. 1 – Cloud Readiness and Architecture



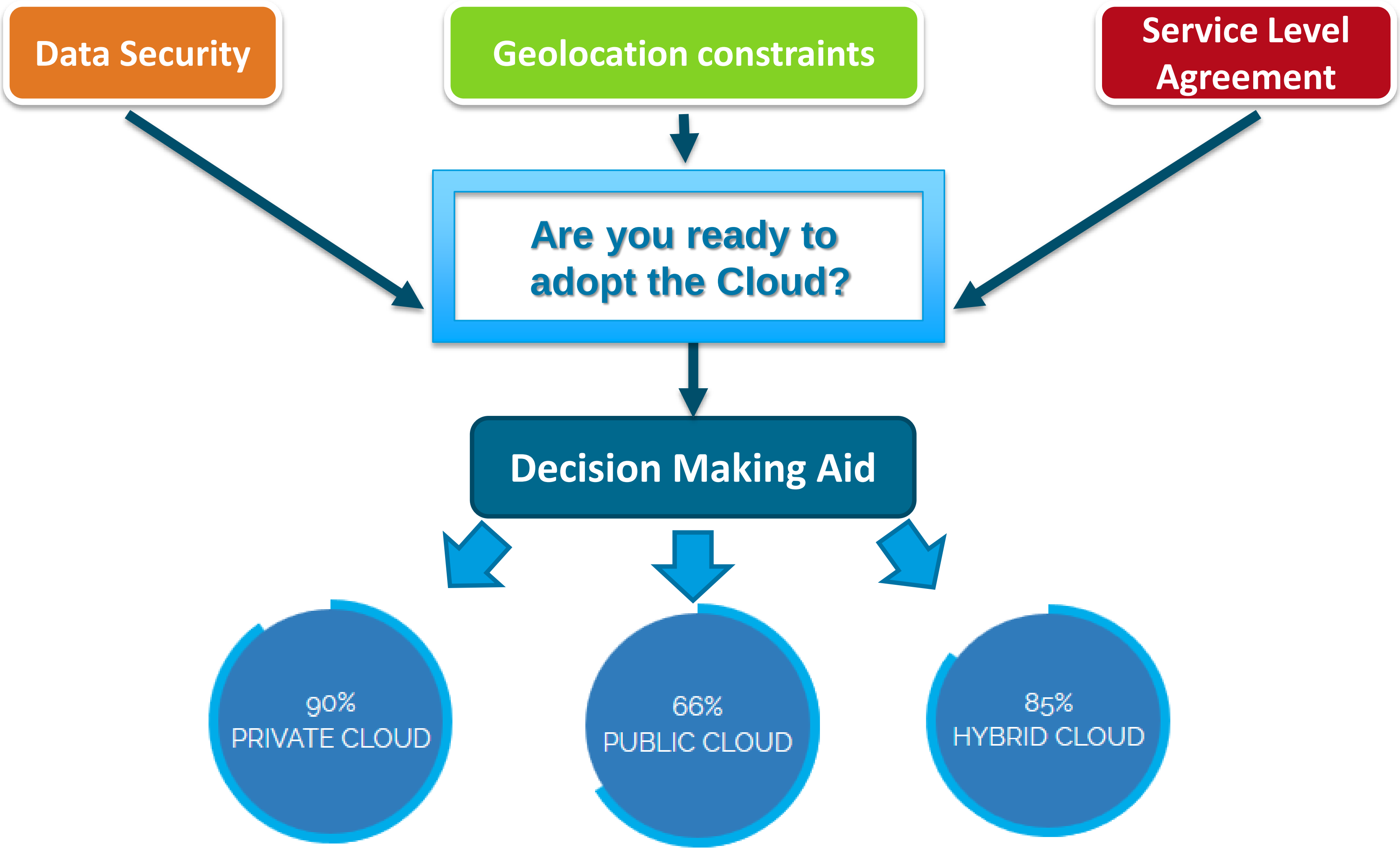

Source :Original paper : 'Cloud computing: state-of-the-art and research challenges.' Qi Zhang, Lu Cheng, Raouf Boutaba

# Internship no. 1 – Cloud Readiness and Architecture




Cloud readiness and Architecture - Mouad | Cloud Intra and Interoperability - Lamine | Security in the Cloud - Yassine | Business Plan - Anca

# Internship no. 1 – Cloud Readiness and Architecture




Cloud readiness and Architecture - Mouad | Cloud Intra and Interoperability - Lamine | Security in the Cloud - Yassine | Business Plan - Anca

SystemX
INSTITUT DE RECHERCHE TECHNOLOGIQUE

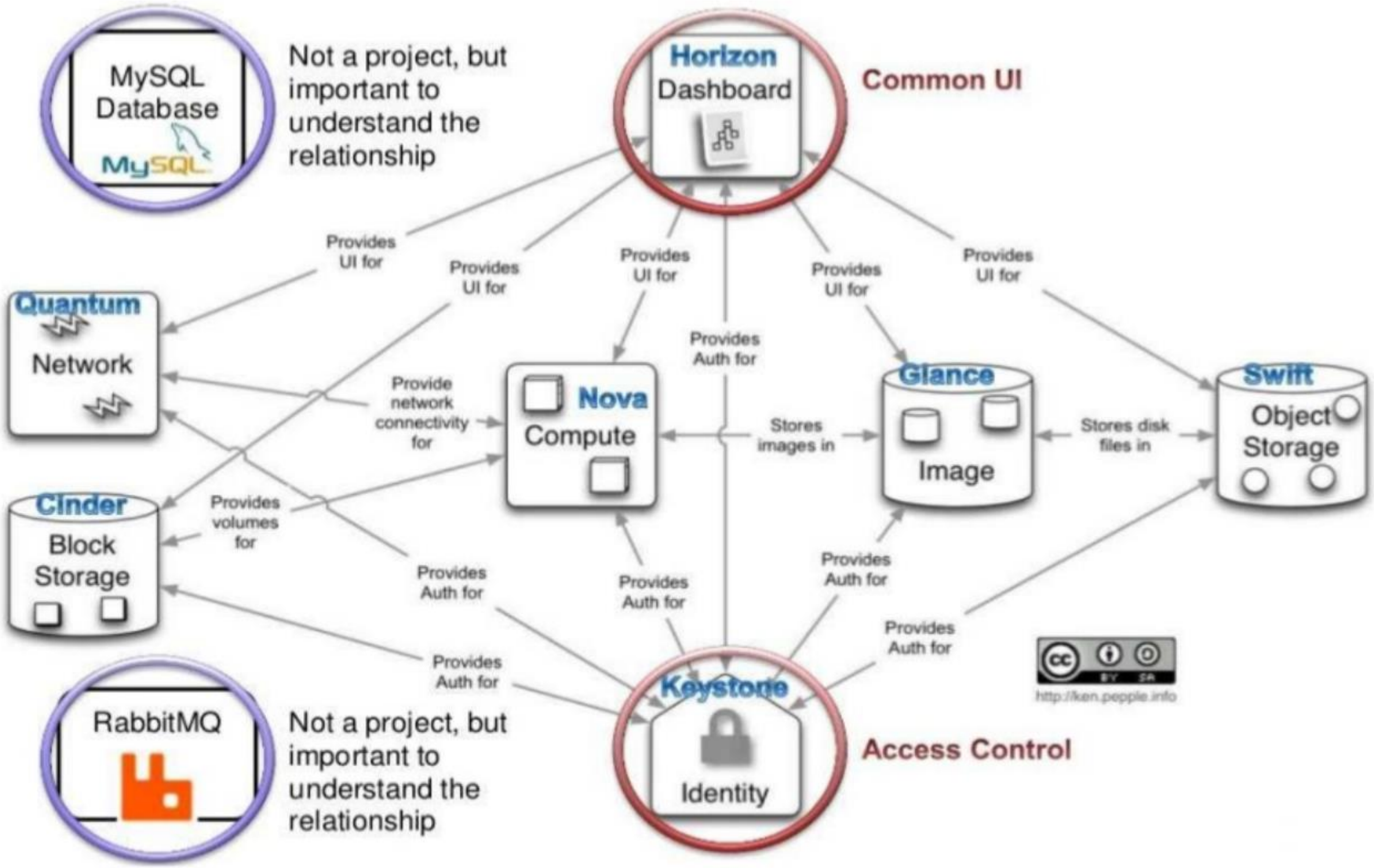
# Cloud intra and inter-Operability

Lamine SAMB

## Context

- Smart placement of VMs and Networks
- Energy efficiency : repacking and migration
- Enable interoperability between different federated cloud providers

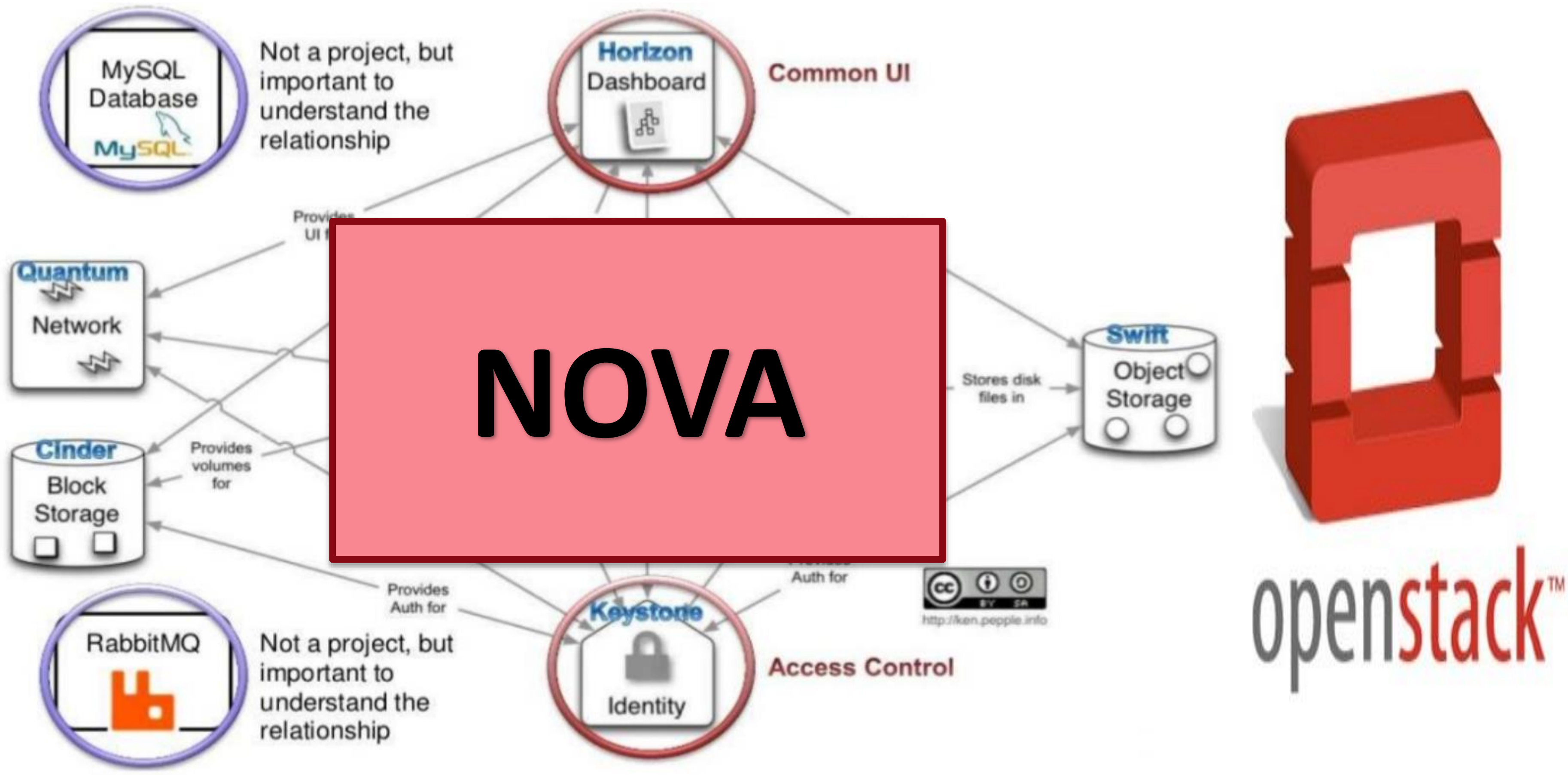
## Openstack Architecture



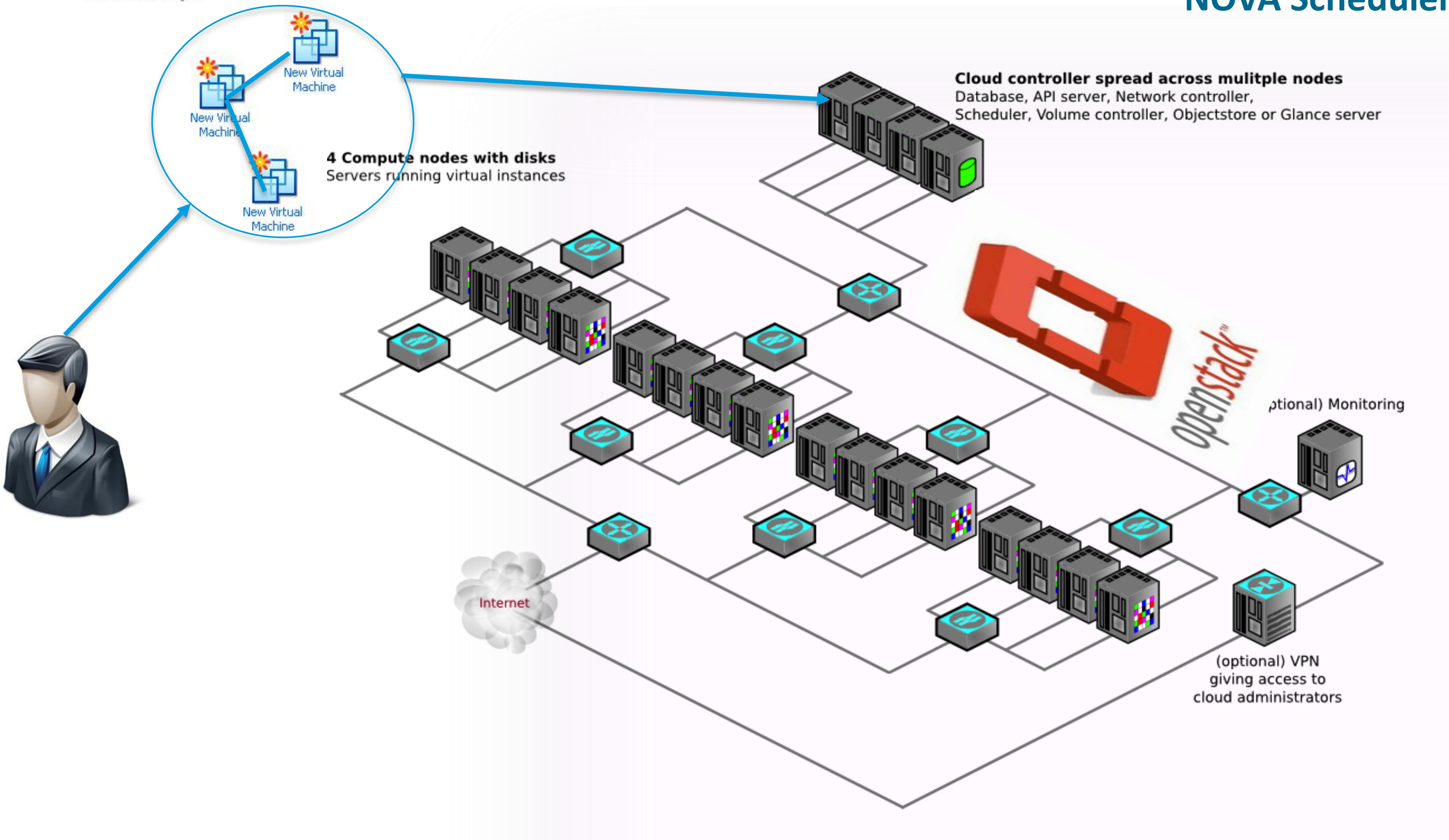

openstack™

| Cloud readiness and Architecture - Mouad | Cloud Intra and Interoperability - Lamine | Security in the Cloud - Yassine | Business Plan - Anca |
|---|---|---|---|

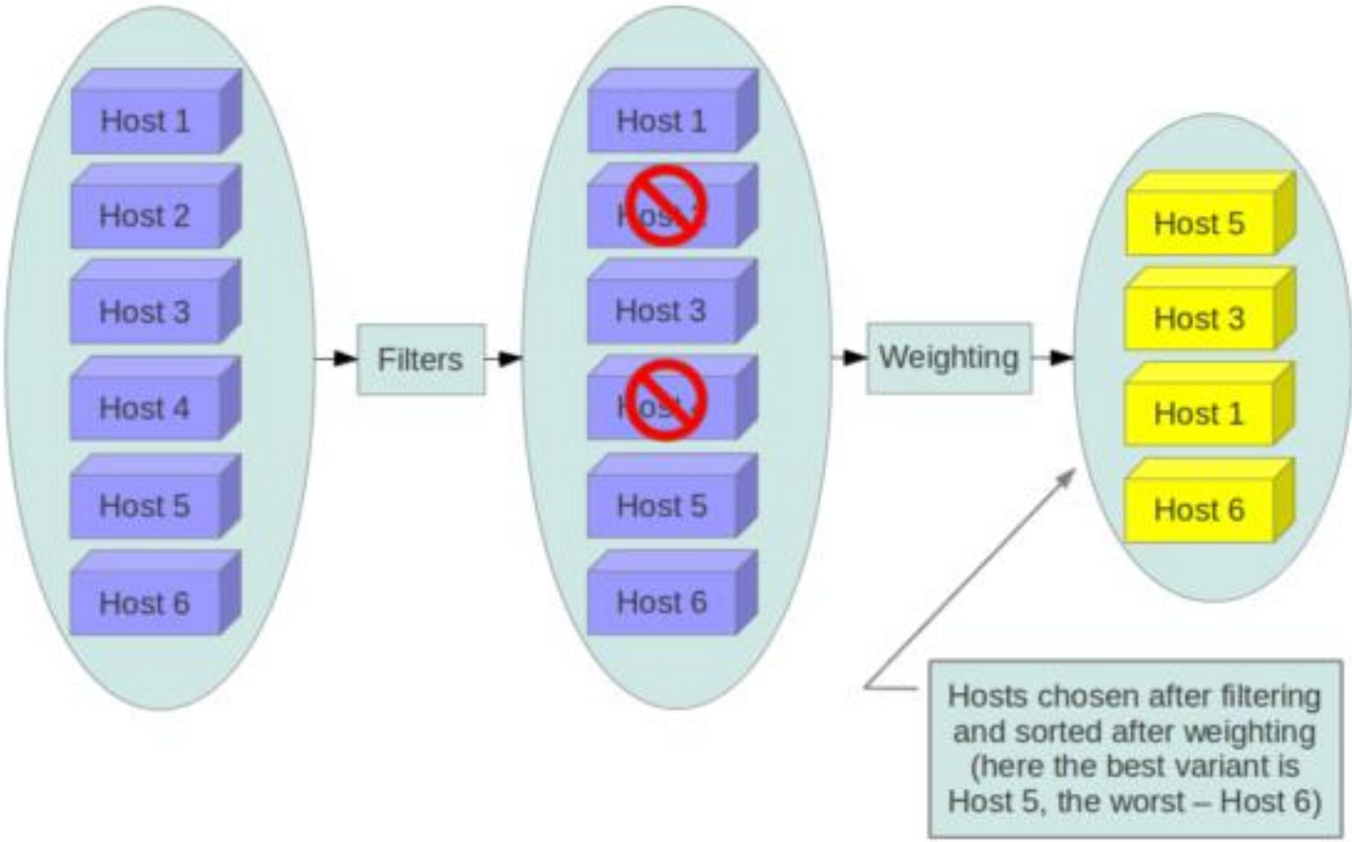
## Openstack Architecture



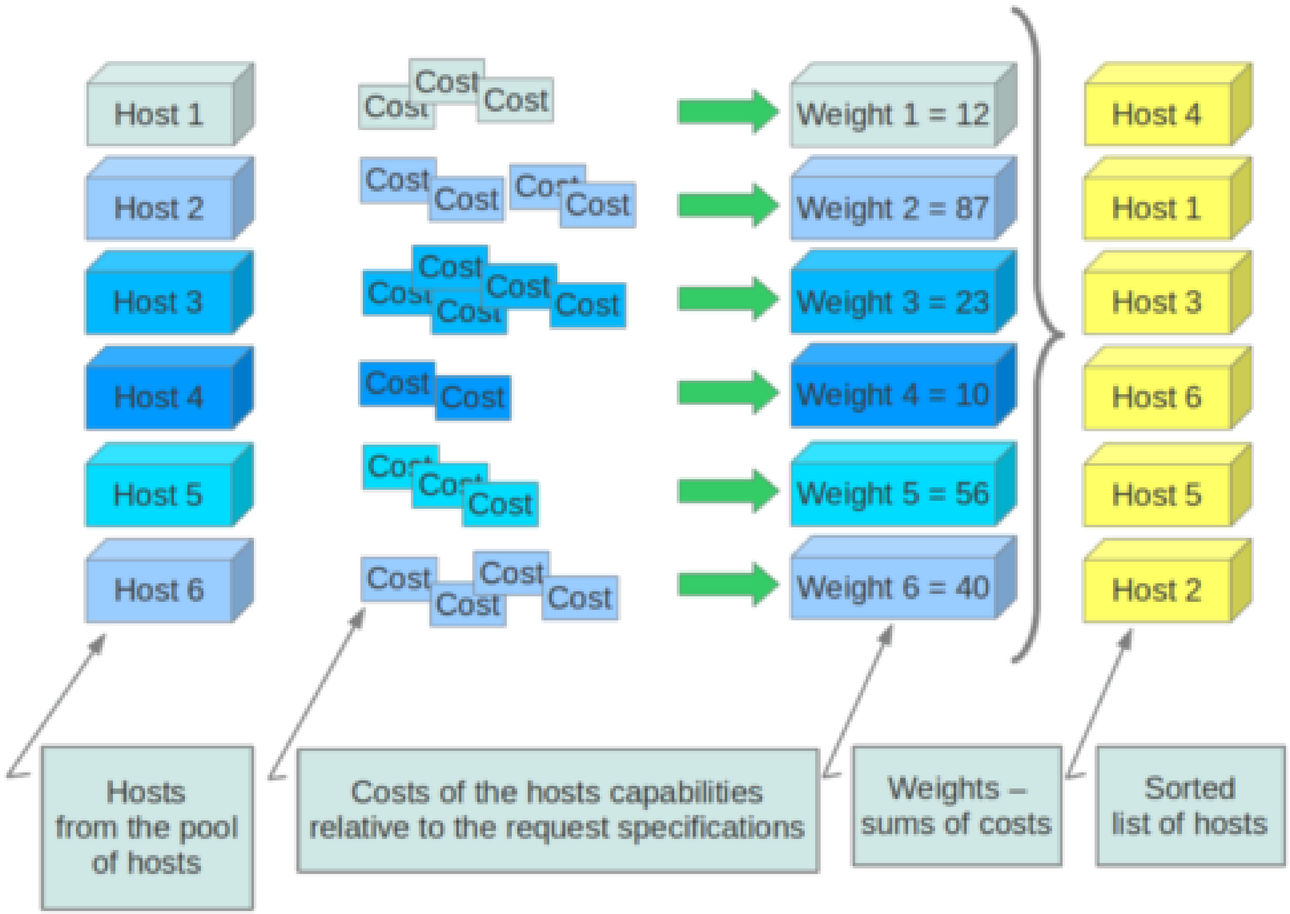
## NOVA Scheduler



## NOVA Scheduler: Example



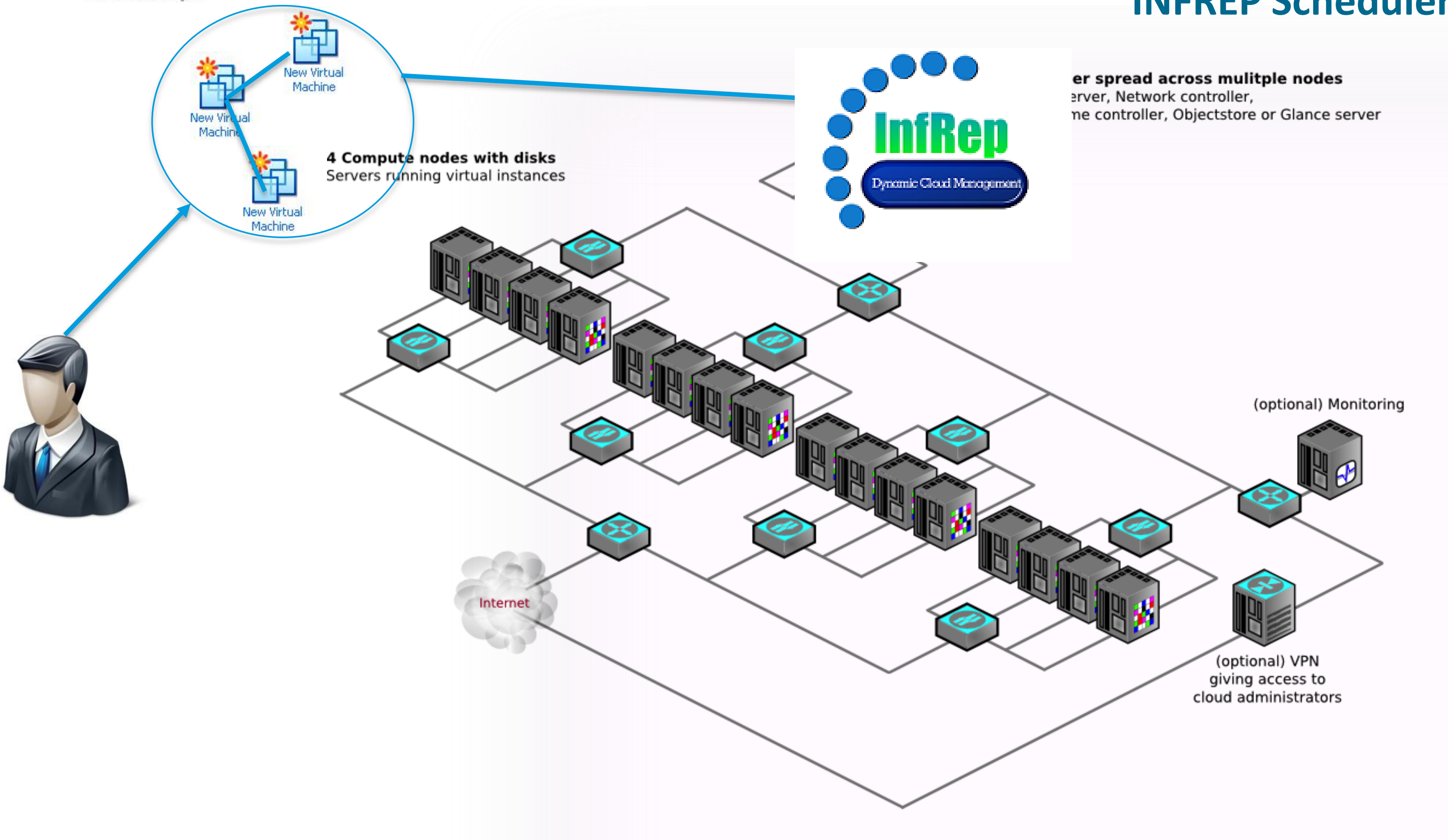
## NOVA Scheduler: Example



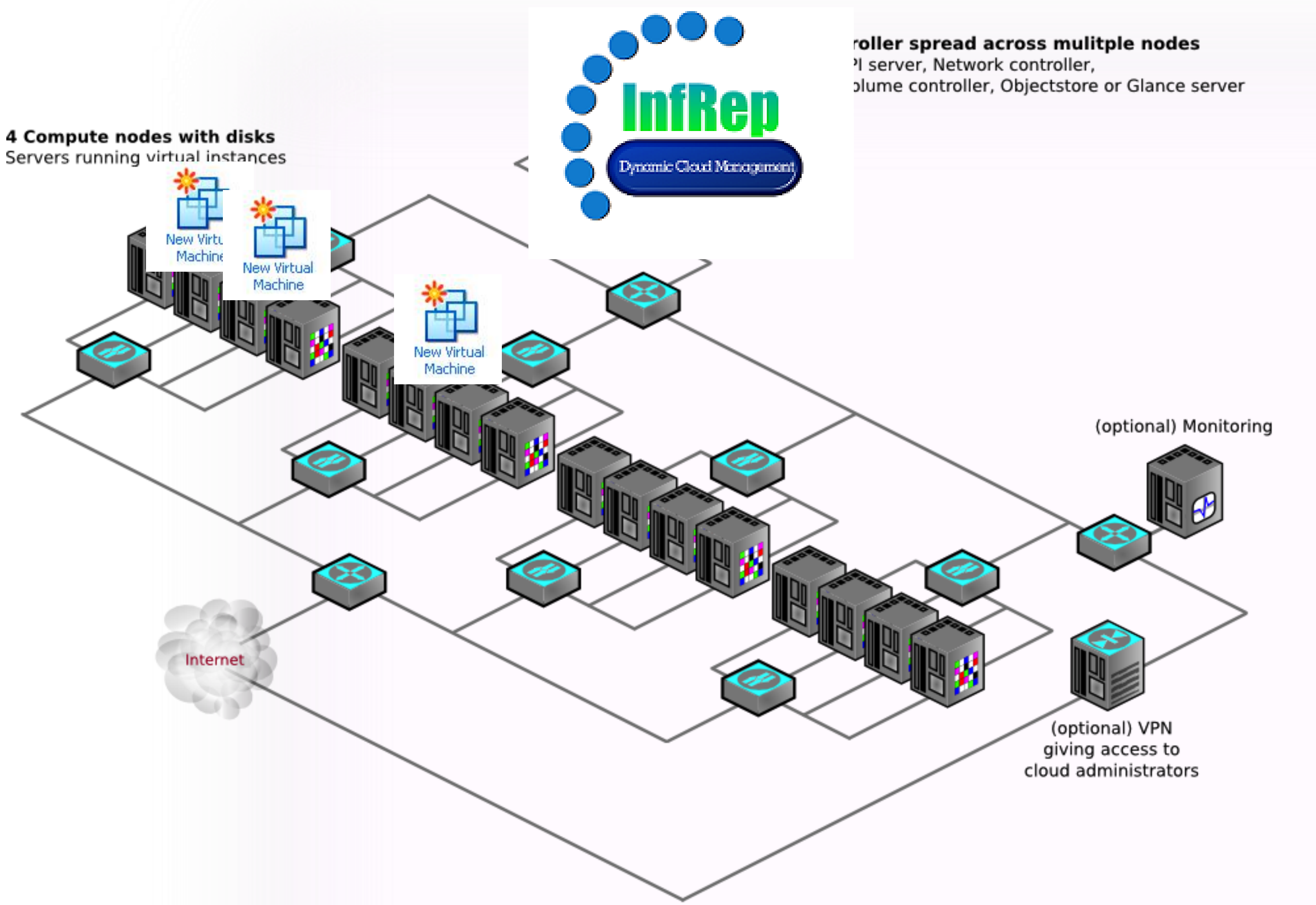
## Project Goals

- **Get a Handle on OpenStack architecture and components**
- **Propose new scalable optimization algorithms for :**
  - **Vms placement**
  - **Vms repacking**
  - **Network placement**
  - **Network re-mapping**

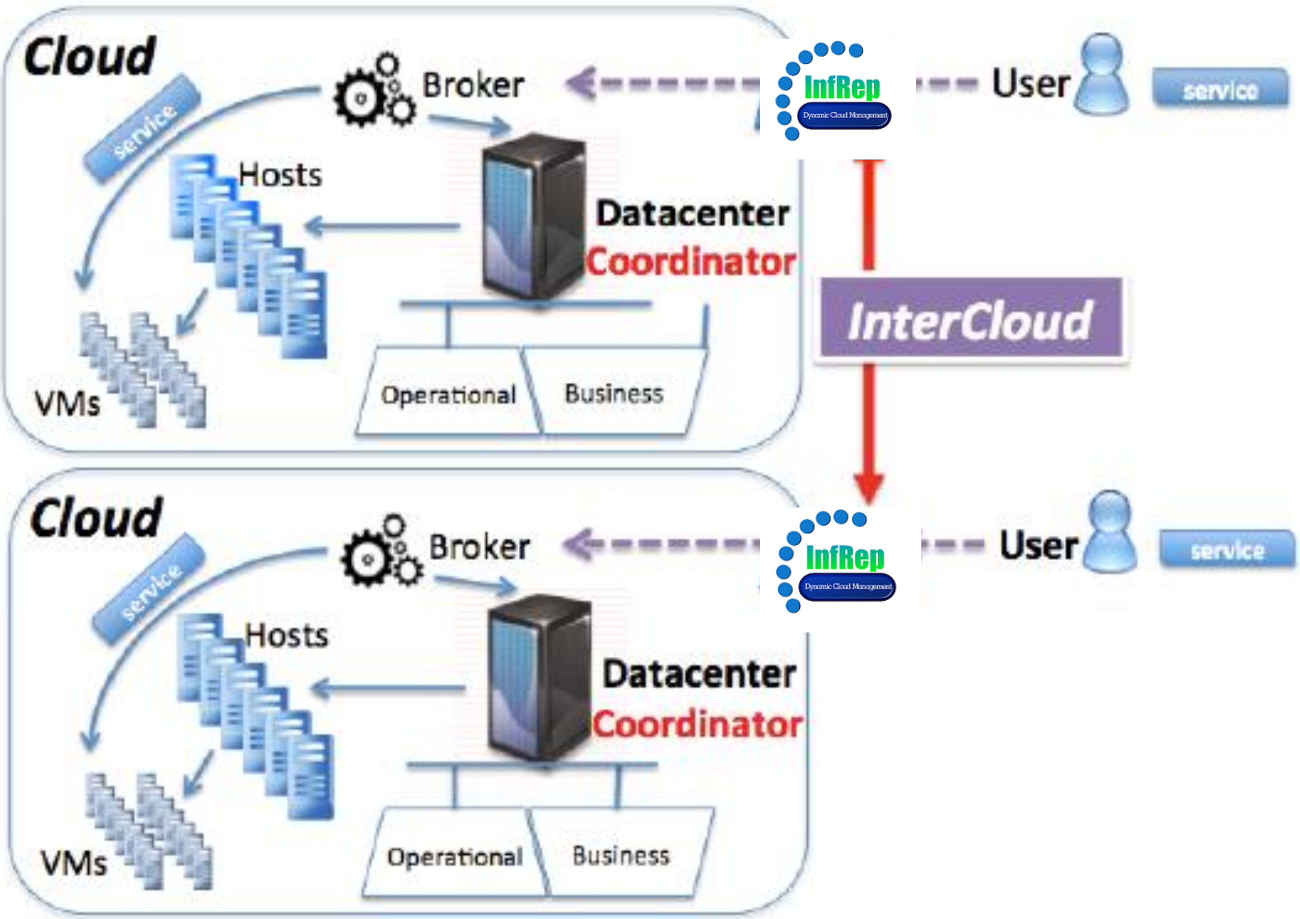
## INFREP Scheduler



## INFREP Scheduler



## INFREP Scheduler



# Cloud Security

Yassine SBAI

## How to secure a cloud ?

### Five important criteria :

- ✓ Confidentiality
- ✓ Integrity
- ✓ Availability
- ✓ Non-repudiation
- ✓ Authenticity

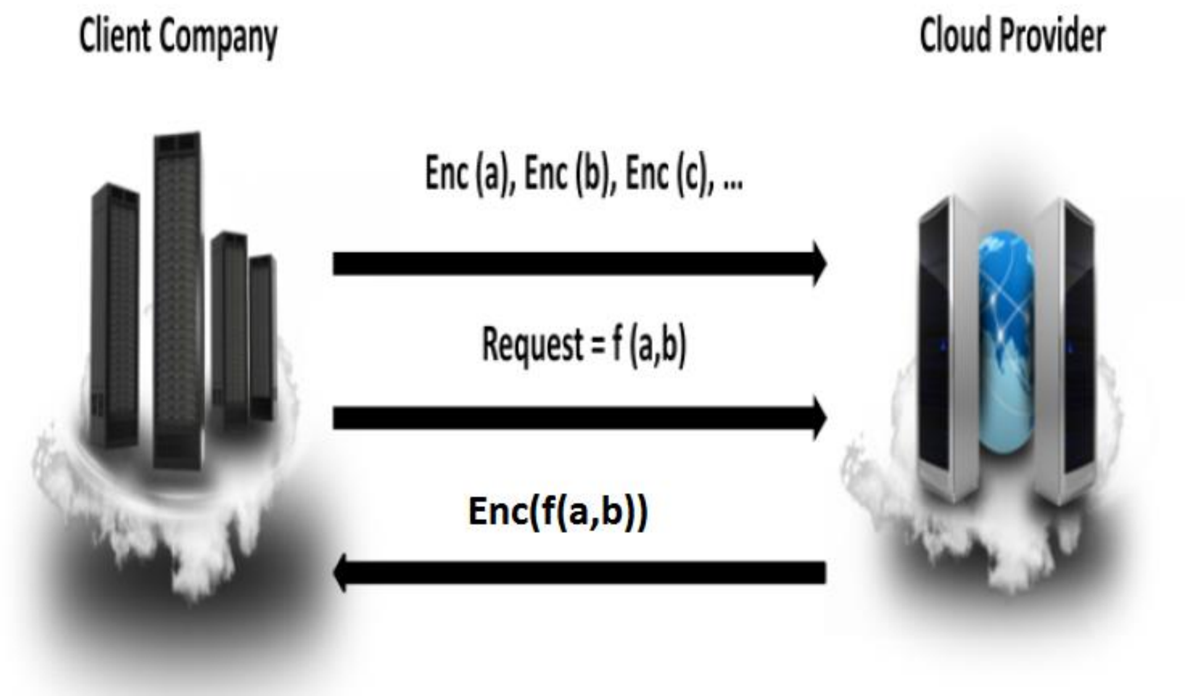
**Cloud computing needs more security : data segregation, data breach, web application security …**

## Example of security services in AWS

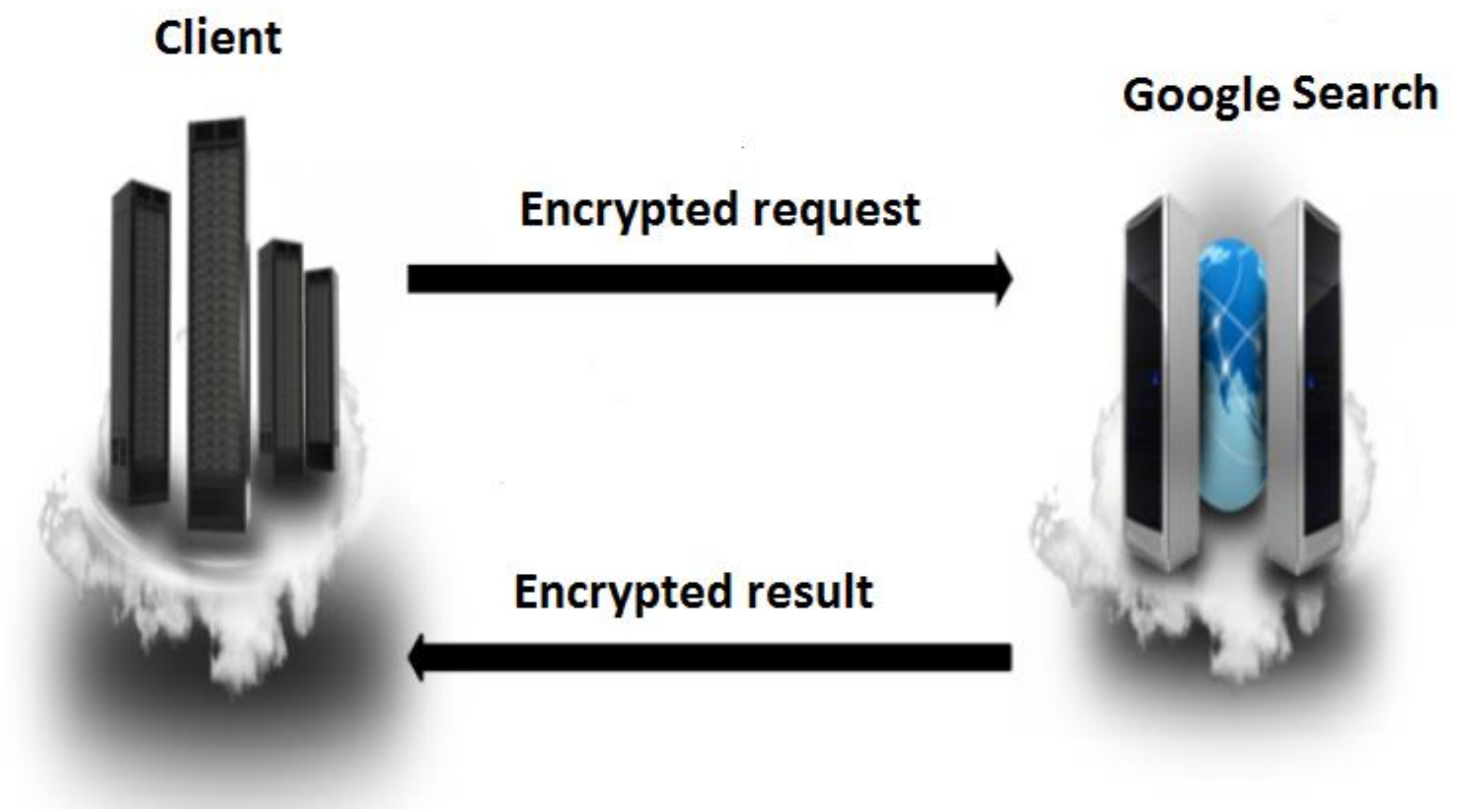
- Secured access
- Firewalls
- Authentication
- Virtual Private Cloud (VPC)
- Dedicated connection

## Fully homomorphic encryption

Allows to do compute operations on encrypted data (C1,C2, …, Cn) corresponding to the clear data (P1,P2,…,Pn) using an algorithm noted by « *Evaluate* » with an input (f , (C1,C2, …, Cn), pk) and outputs Enc(f(C1,C2, … , Cn)).



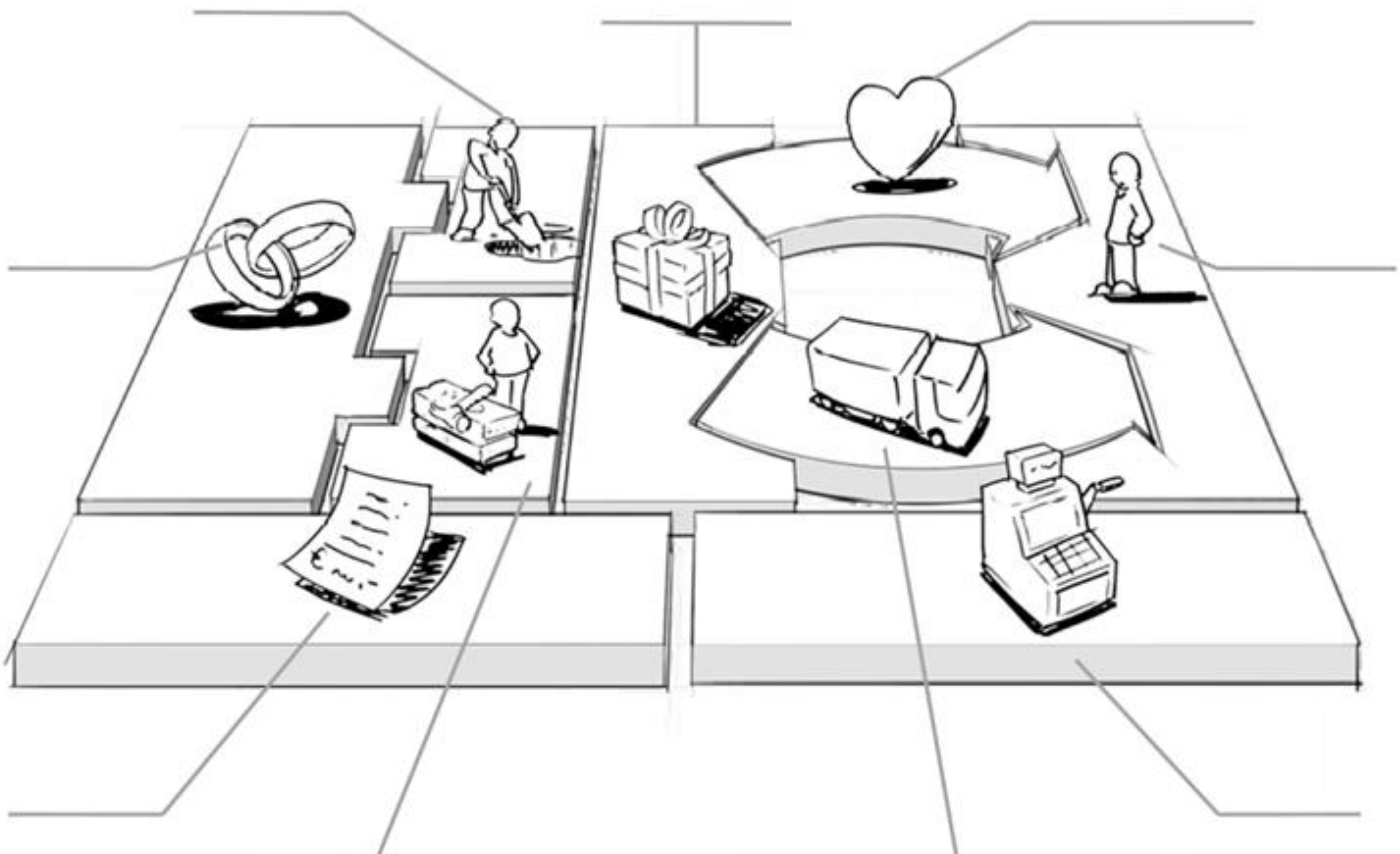
## Fully homomorphic encryption



# Business Plan

Anca ZANFIR

Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009



Cloud readiness and Architecture - Mouad

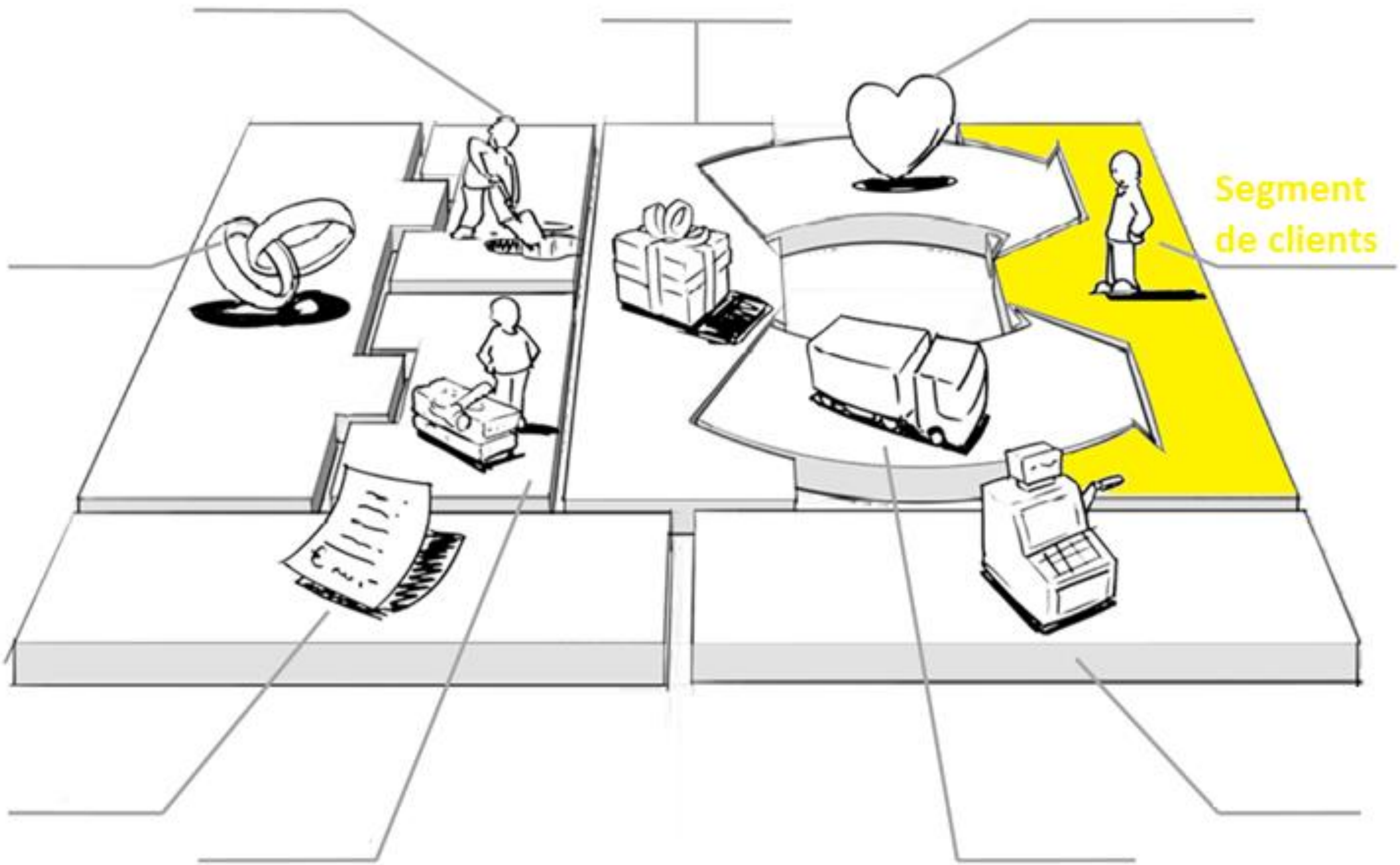
Cloud Intra and Interoperability - Lamine

Security in the Cloud - Yassine

Business Plan - Anca

## Clients

Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009




Cloud readiness and Architecture - Mouad

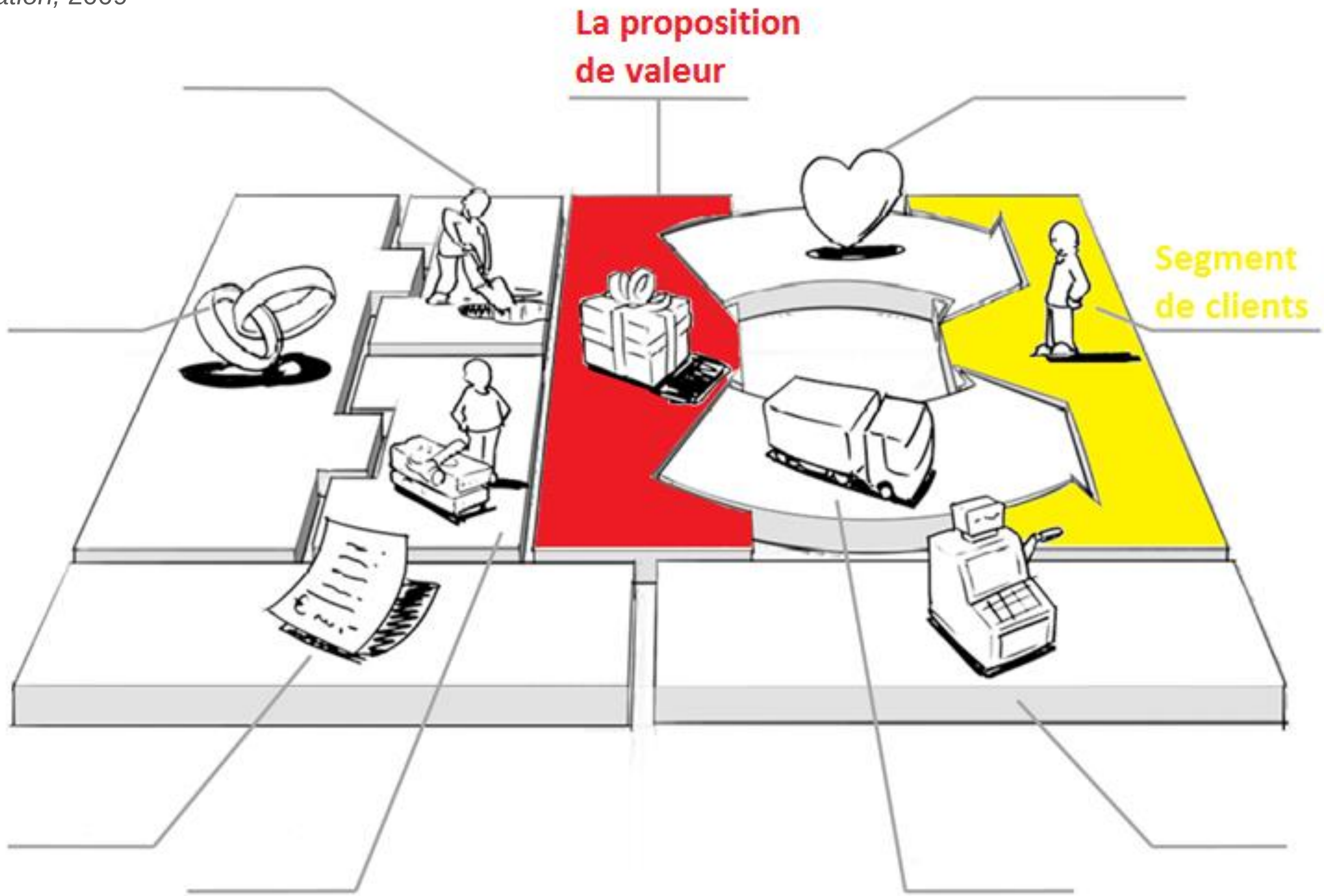
Cloud Intra and Interoperability - Lamine

Security in the Cloud - Yassine

Business Plan - Anca

## Value Proposition

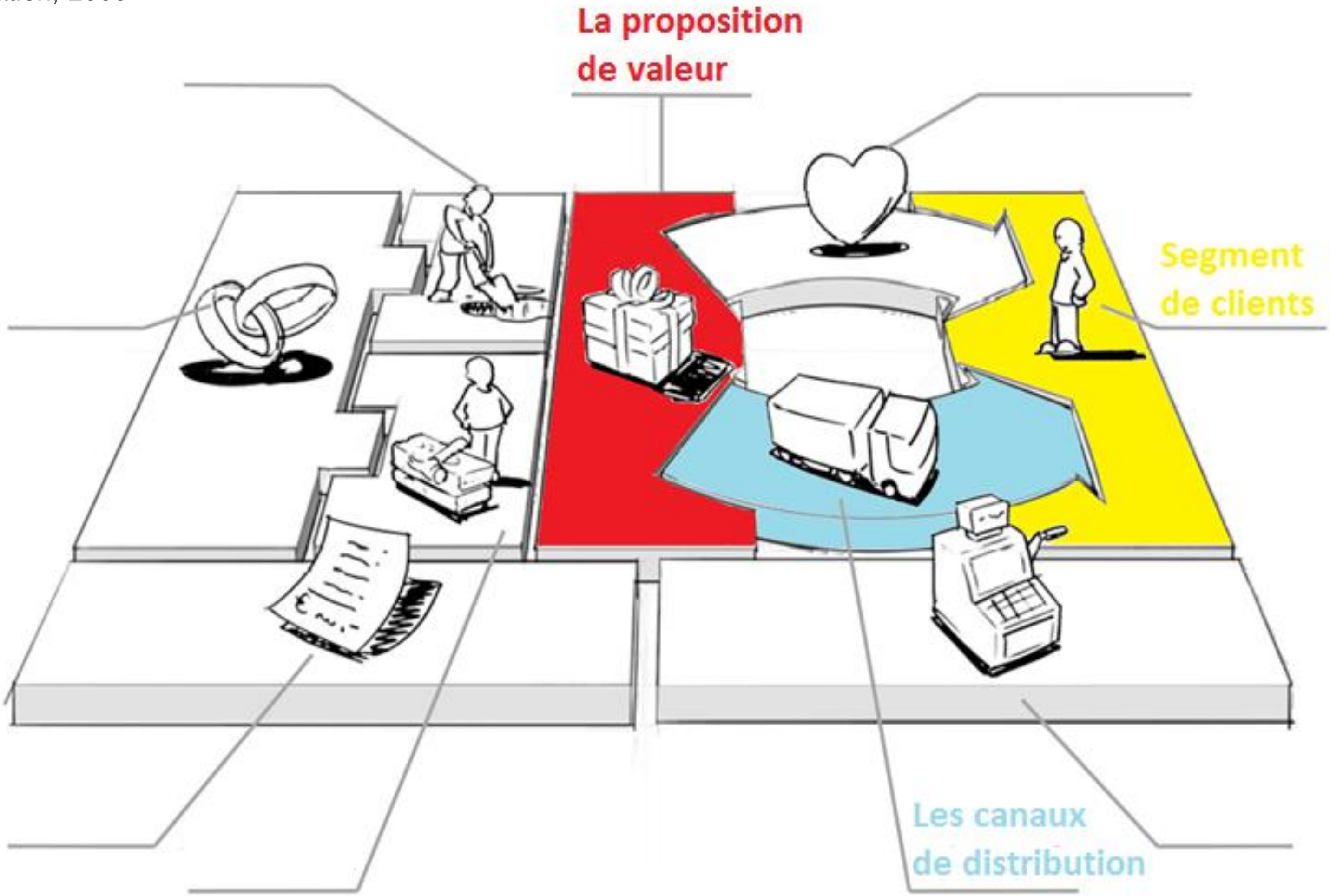
Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009




Cloud readiness and Architecture - Mouad | Cloud Intra and Interoperability - Lamine | Security in the Cloud - Yassine | Business Plan - Anca

## Channel Distribution

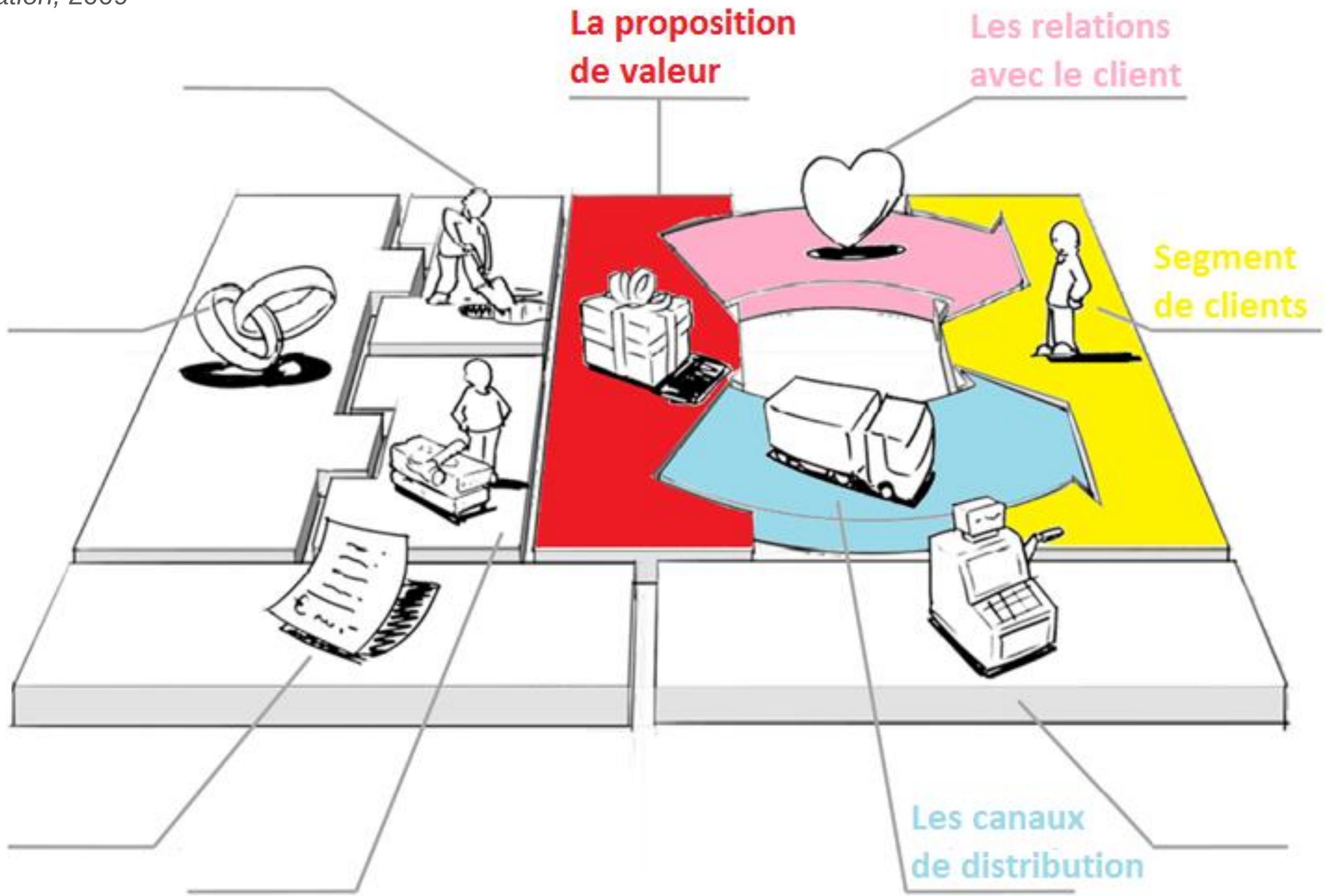
Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009




Cloud readiness and Architecture - Mouad | Cloud Intra and Interoperability - Lamine | Security in the Cloud - Yassine | Business Plan - Anca

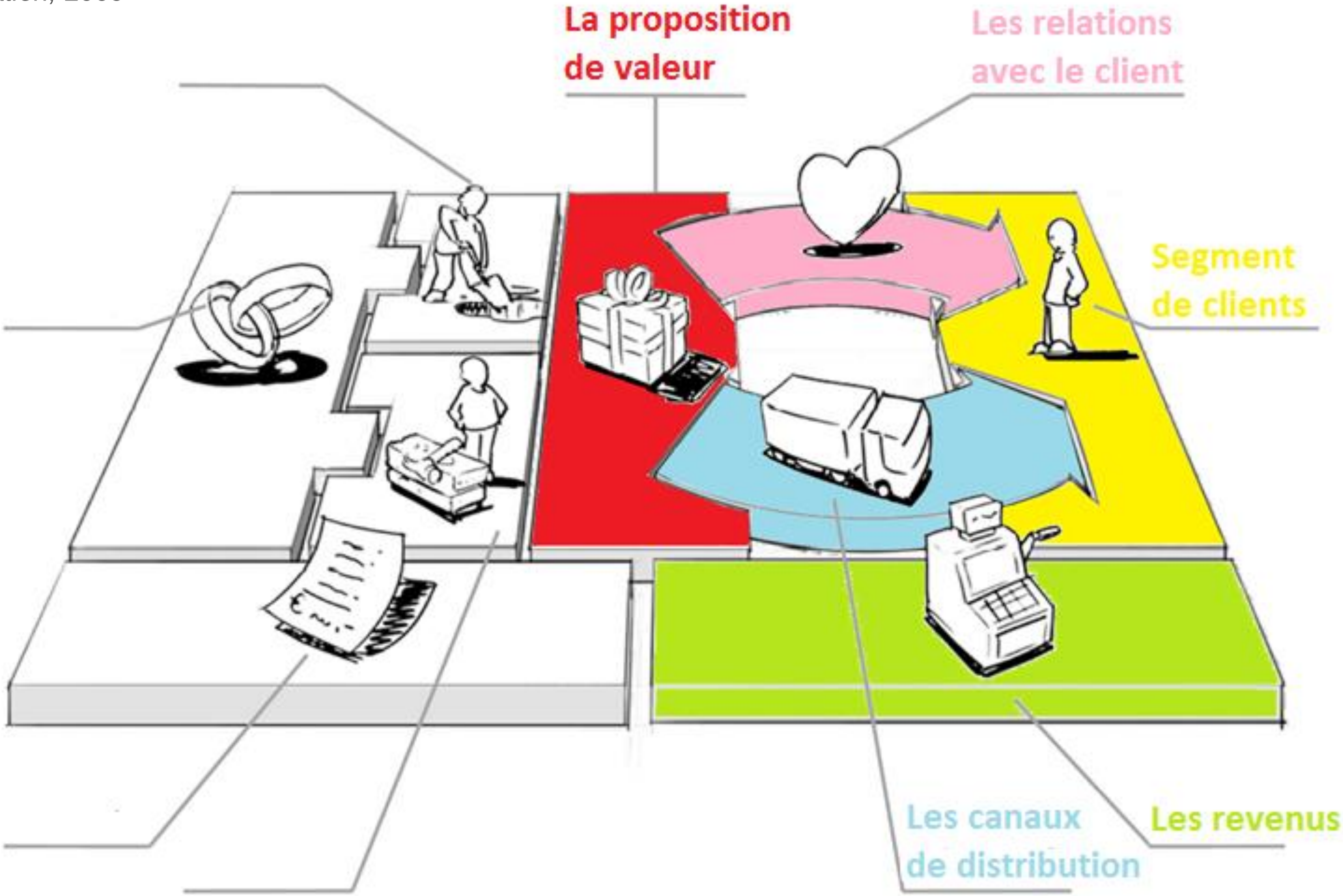
## Customer Relationships

Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009



## Revenue Streams

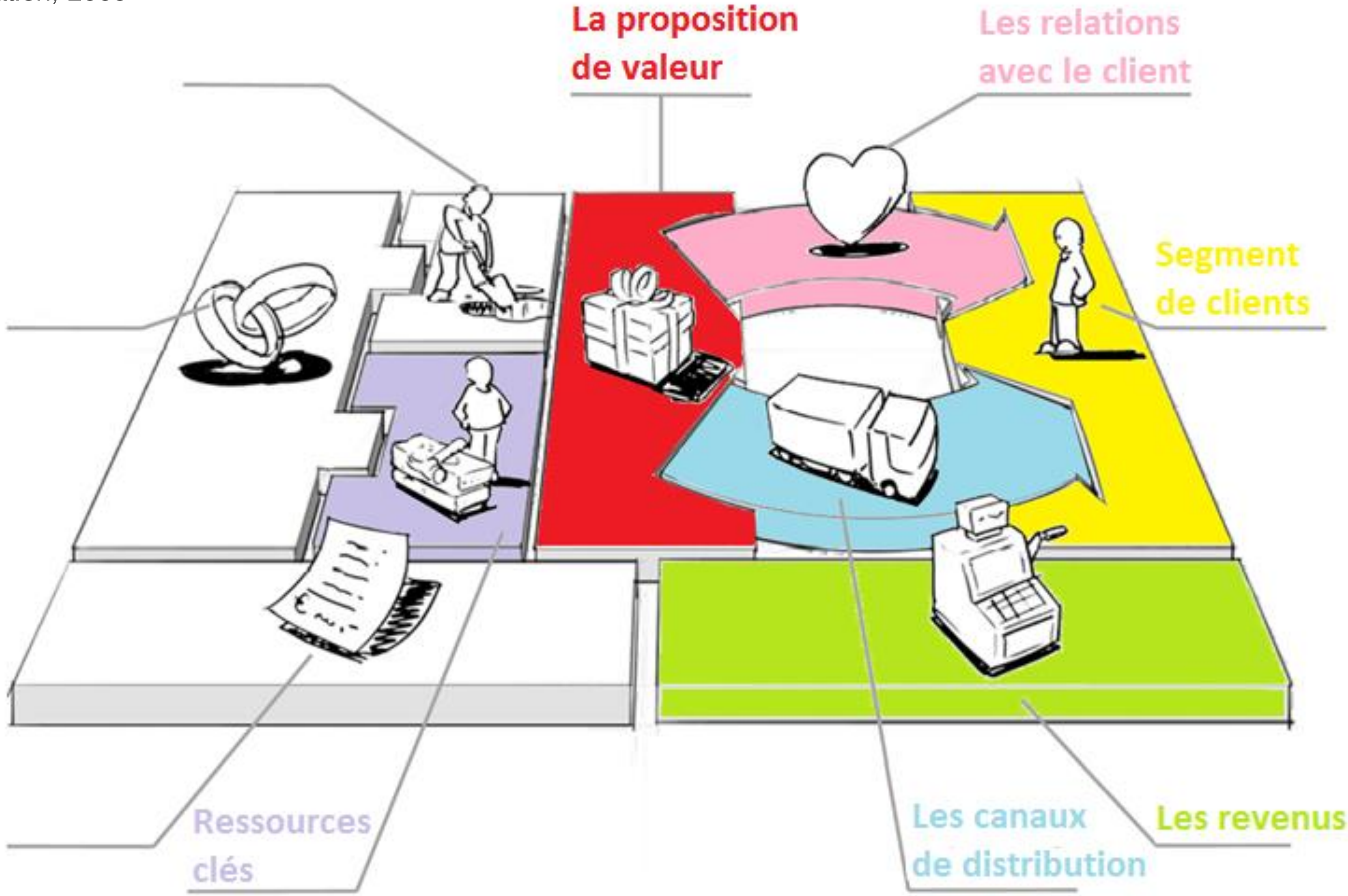
Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009




Cloud readiness and Architecture - Mouad | Cloud Intra and Interoperability - Lamine | Security in the Cloud - Yassine | Business Plan - Anca

## Key Resources

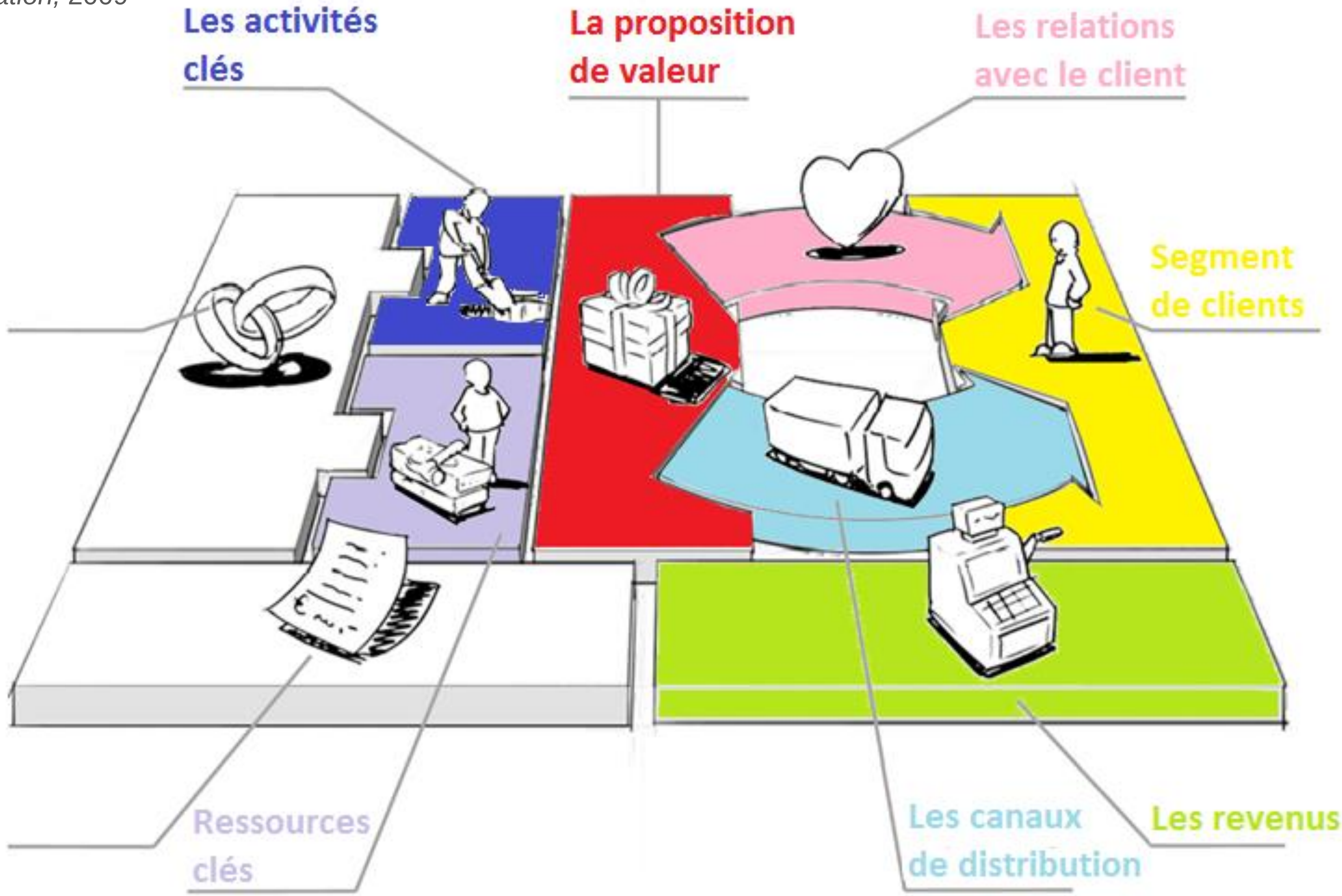
Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009




Cloud readiness and Architecture - Mouad | Cloud Intra and Interoperability - Lamine | Security in the Cloud - Yassine | Business Plan - Anca

## Key Activities

Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009




Cloud readiness and Architecture - Mouad

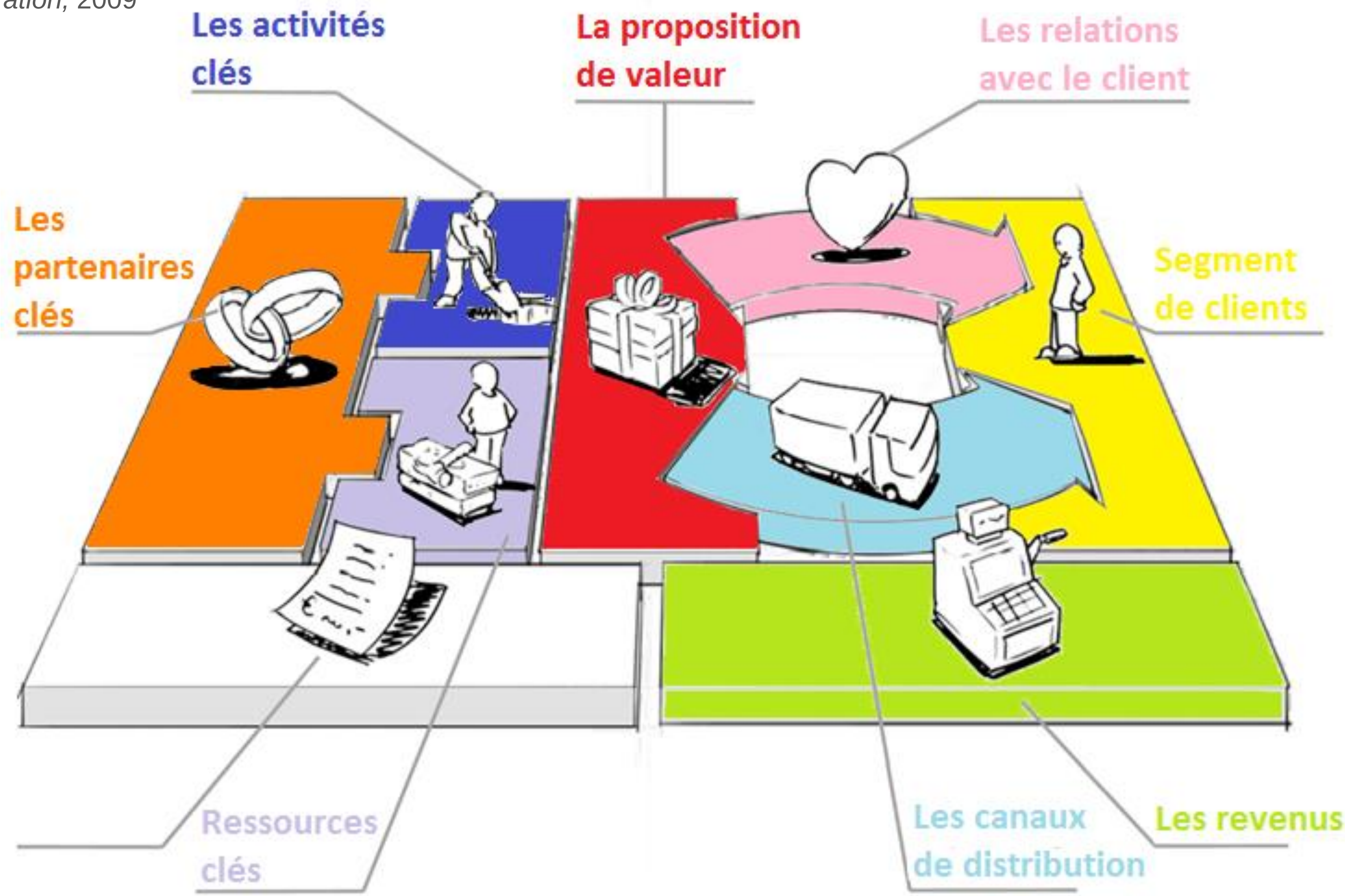
Cloud Intra and Interoperability - Lamine

Security in the Cloud - Yassine

Business Plan - Anca

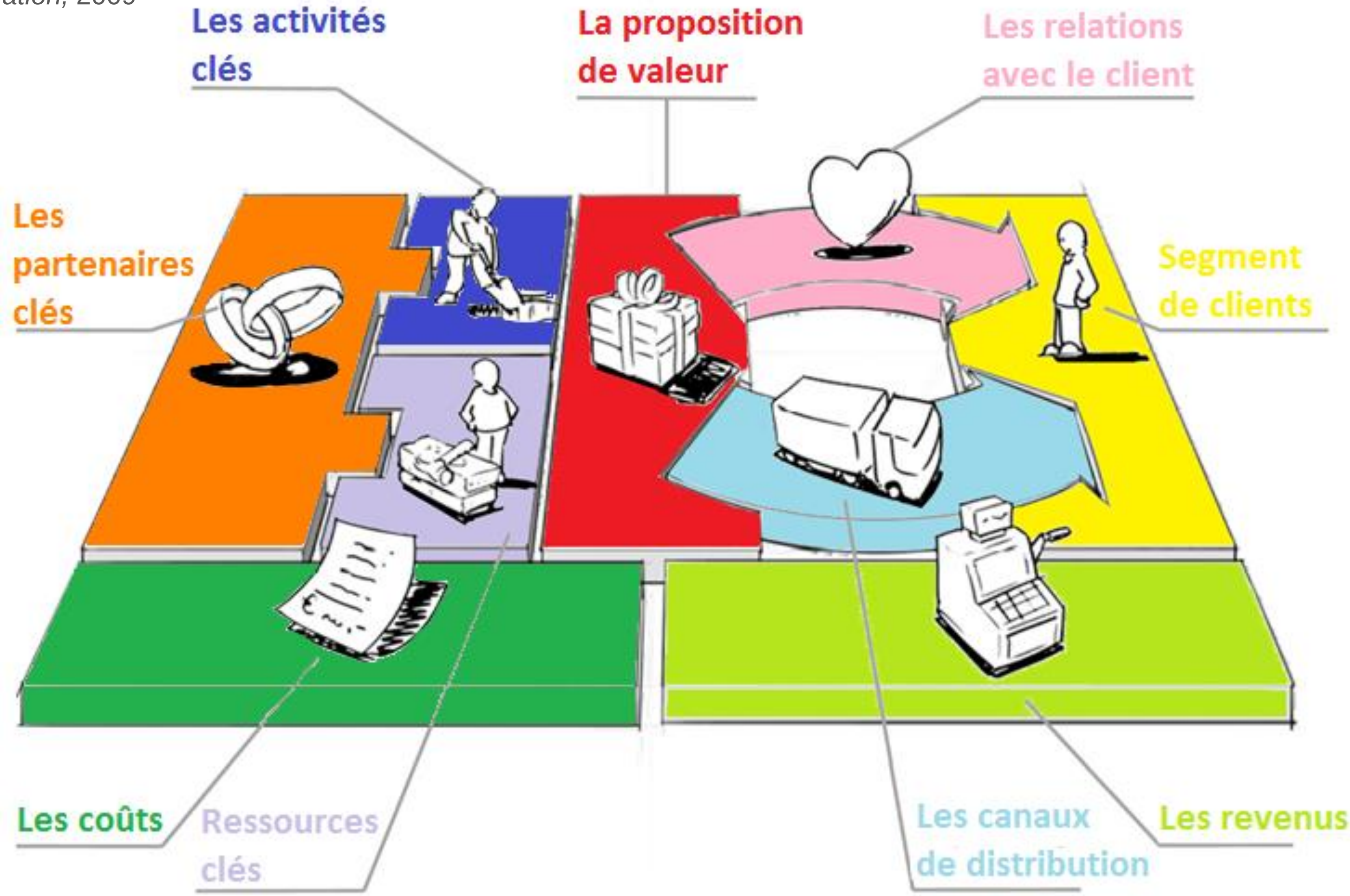
## Key Partners

Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009



## Product Costs

Source: Alexander Osterwalder, Yves Pigneur – *Business Model generation,* 2009

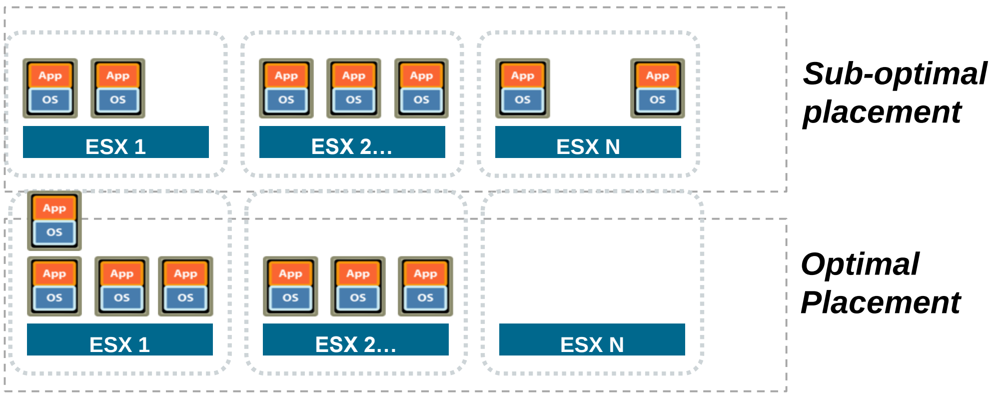


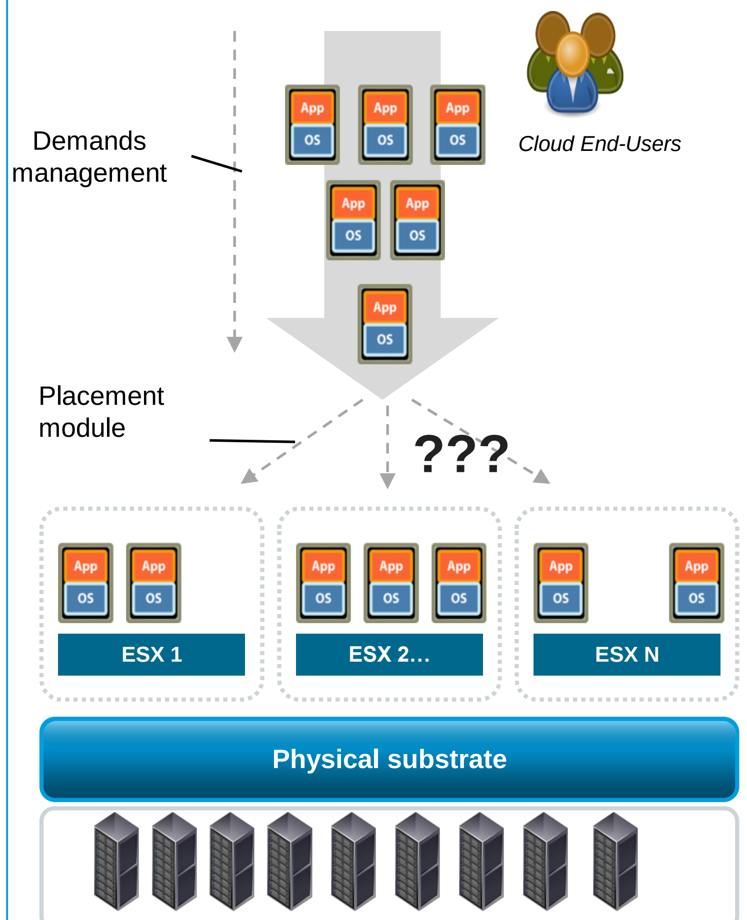
# Thank you for your attention!

# I- Smart Placement in Clouds

## VMs placement problem

**Problem definition**: given an end-user request (expressed as virtual resources often considered as VMs) of **size N**, to host on a physical substrate of ***X Servers,*** *how to optimally determine the best placement of all the VMs according to different constraints: geolocation, affinity/anti-affinity constraints, … ?*




### Benefits:

- Optimized resource consumption
- Reduced operational costs
- …etc.

### Problem challenges

- *Exponential number of constraints*

## Motivations

ENTRETIEN

# Patrick Debus-Pesquet, Numergy : "Supporter un million de VM à l'horizon 2015/2016"

Christophe Bardy

Share

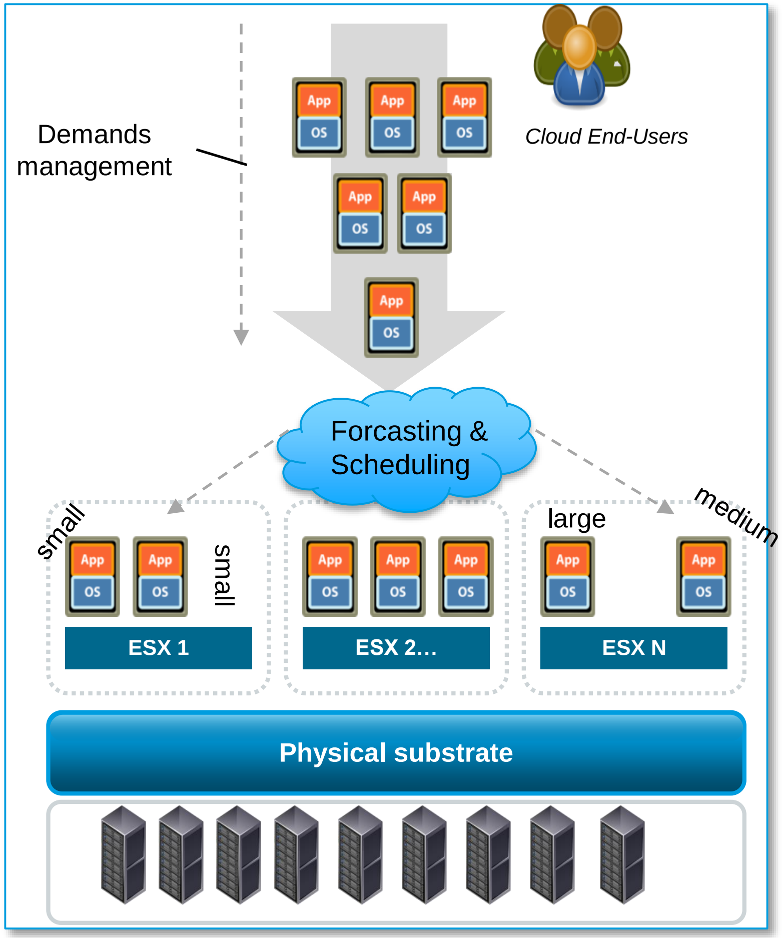
[section_title title=1 - Numergy : Une infrastructure initiale sous VMware vSphere...] ***[Note : La version initiale de l'article indiquait de façon incorrecte des SLA de 99,7, 99,8 et 99,9% pour les différentes offres de Numergy, au lieu de 99,7%, 99,9%  et 99,99%. Ces informations ont été corrigées dans cette version de l'article]*** La semaine dernière, LeMagIT a pu s'entretenir avec Patrick Debus-Pesquet, le directeur technique de Numergy, la filiale cloud de SFR, Bull et Caisse des dépôts et Consignations. Arrivé chez l'opérateur de cloud français le 10 décembre dernier. Patrick Debus Pesquet a un long historique dans l'informatique. Ce diplômé de l'IEP de Lyon a commencé sa carrière chez Shell en tant qu'analyste SNA, avant de travailler pour Aérospatiale, Renault et SITB (aujourd'hui Atos

Due to fluctuations in users’ demands, we use Auto-Regressive (AR(k)) process, to handle with future demands:

$$d_t = \sum_{i=1}^{k} \varphi_i d_{t-i} + \varepsilon_t$$

**Problem Complexity :**

NP-Hard Problem: There is an exponnential number of cases. The problem is considered as a modified instance of the Bin-Packing.



## Mathematical formulation:

**Formulation as ILP:**
The corresponding mathematical model is an Integer Linear Programming: difficulties to characterize the convex hull of the considered problem and to get optimal solutions.

$$\min Z = \sum_{i=1}^{N} \sum_{j=1}^{|I|} \gamma_{ij} y_{ij} - \sum_{i=1}^{N} \sum_{j=1}^{|I|} P_j x_{ij}$$

Subject To :

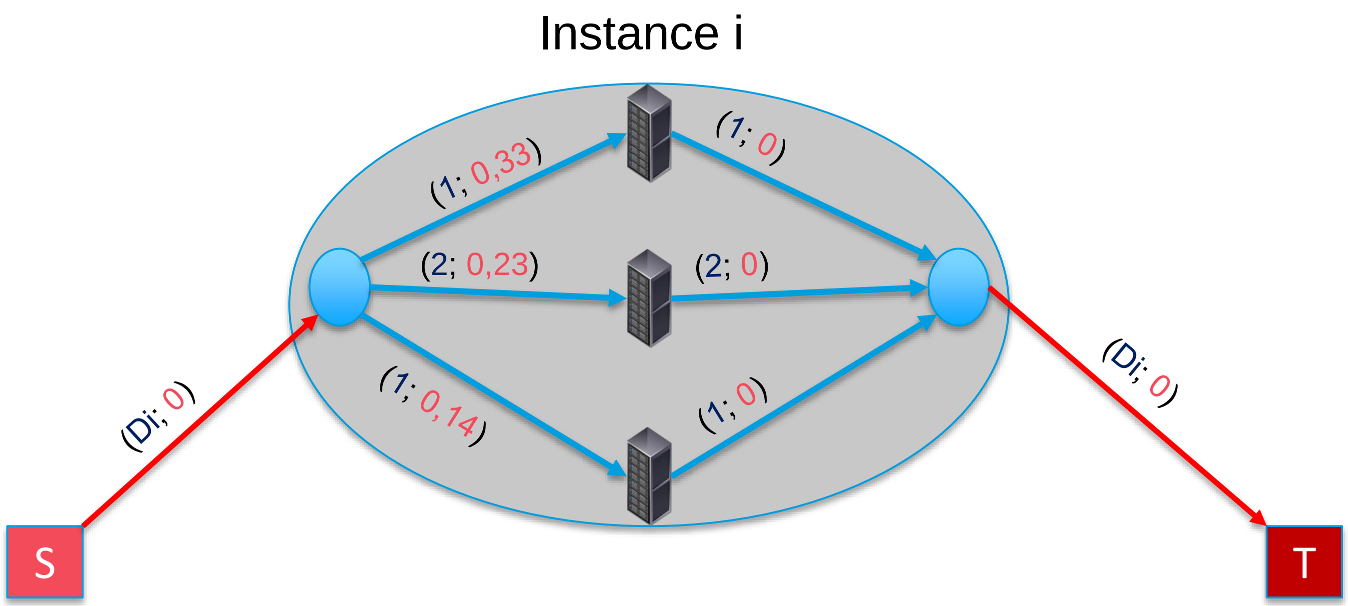
$$x_{ij} \le C_{ij} y_{ij}, \forall j \in I, i = \overline{1, N}$$

$$\sum_{i=1}^{N} x_{ij} = d_j, \forall j \in I$$

$$x_{ij} \in N, \forall i, j$$

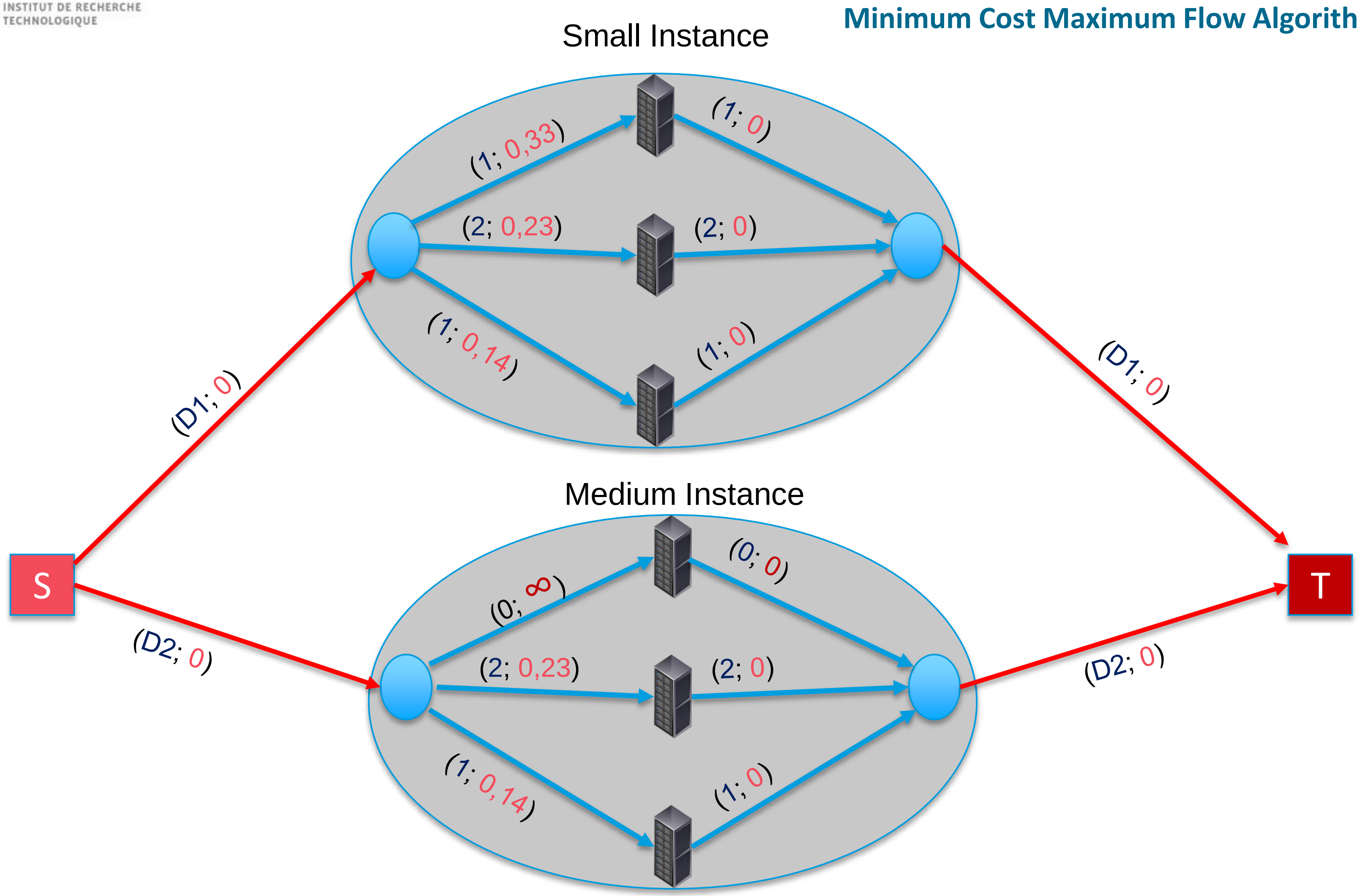
$$y_{ij} = \begin{cases} 1 \text{ if } \mathrm{VM}_j \text{ is hosted in server i} \\ 0 \text{ else.} \end{cases}$$

## Minimum Cost Maximum Flow Algorithm




Legend: (capacity; cost)

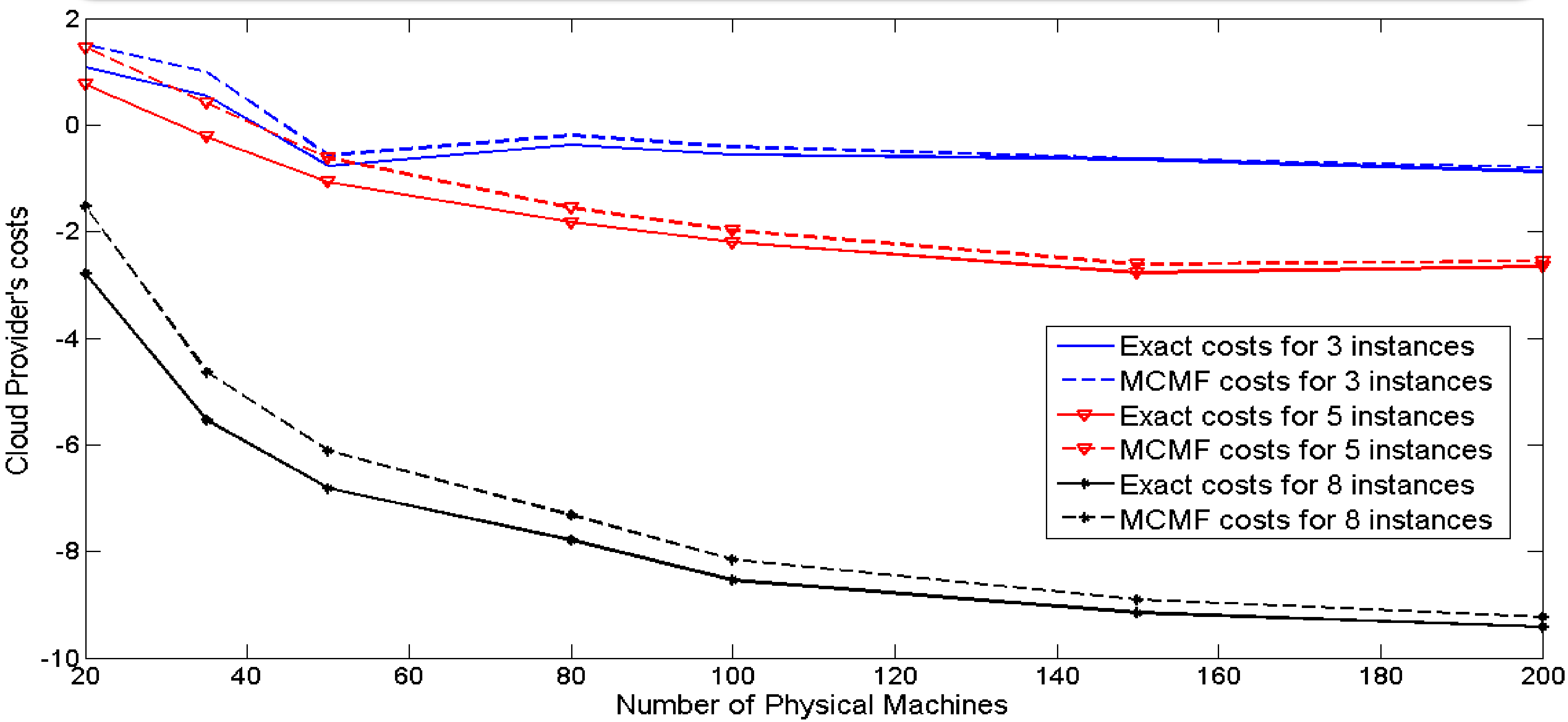
## Minimum Cost Maximum Flow Algorithm



## Simulation Tests: Case of (0;1) Random Costs

### Random Hosting Costs Scenario

We consider (0; 1) Random hosting costs between each couple of vertices (a, b), where a is a fictif node, and b is a physical machine (server).



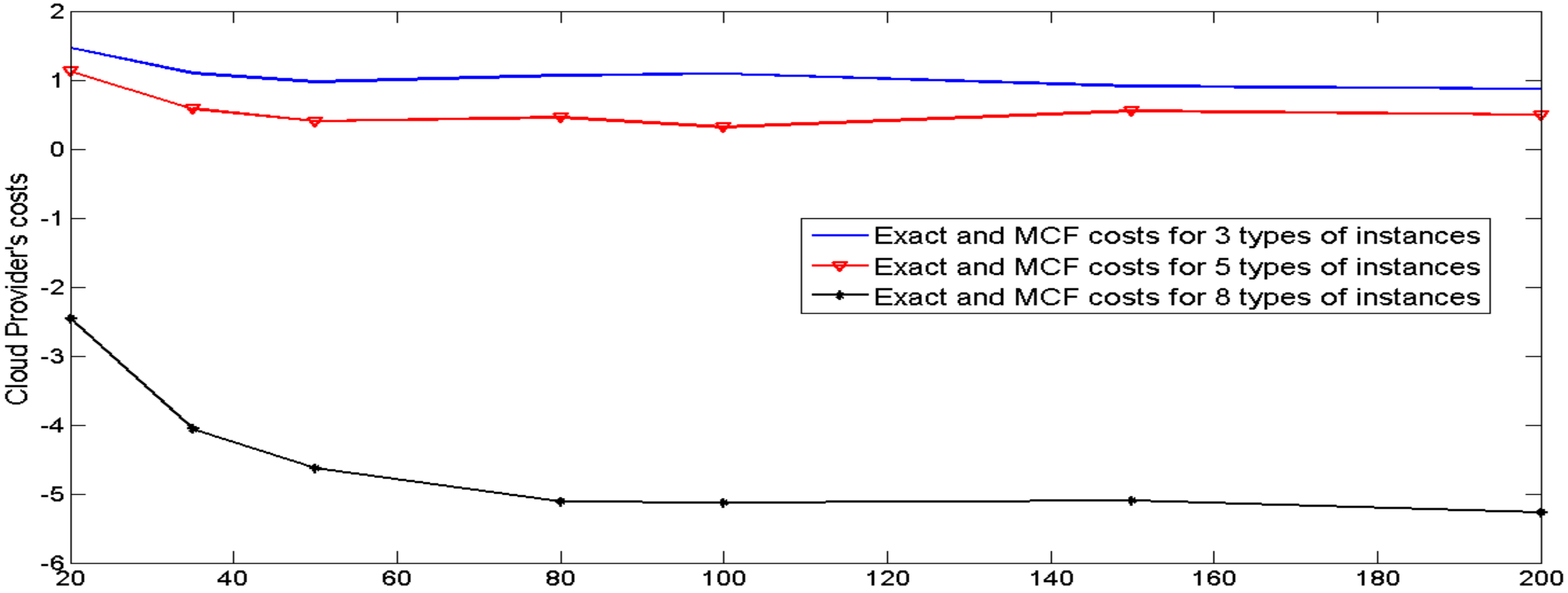
## Simulations Tests: Case of Inverse Hosting Costs:

### Inverse Hosting Costs Scenario

We consider inversed hosting costs function between each couple of vertices (a, b), where a is a fictif node, and b is a physical machine:

$$g_{ab} = \frac{1}{f(C_{ab})} \text{ if } C_{ab} \geq 0, \text{otherwise } g_{ab} = \infty$$

Where $C_{ab}$ represents the available capacity on the considered arc. $f$ est une fonction non nulle.



Publication :

- **Minimum Cost Maximum Flow Algorithm for Dynamic Resource Allocation in Cloud Computing.** *IEEE Cloud 2012, pp.876-882, Honolulu, Hawaii (USA), 2012.*