Assignment 2 – Virtual Phone

Problem Statement:

Virtual Phone ltd, a new startup, will start a new mobile service in **Finland,** starting **2013** and expanding to **Europe 2014** and **global markets 2015**. Their service is backend system for HTML5 enabled mobiles that are fully virtualized [1]. This means that most of the mobile content and applications reside in the cloud. Virtual Phone ltd considers purchasing a computing platform from you, **A2 ltd.** We can ignore data storage and transmission costs. Your task is to write a summary of your **tender** that defines the **computation system** and **costs**. You have to optimize your system based on **load** and **cost**, and evaluate **CO_2** consumption.

Input:

The customer has given the following requirements:

- Number of customers: end of 2013: 1 M +/- 10%, 2014: 10 M +/-30%, 2015: 100 M +/-50%
- Provide your offer with ECU[1] equivalent computation units
- 1 ECU provides equivalent CPU capacity of a 1.0-1.2 GHz 2007 Opteron or 2007 Xeon processor
- 1 ECU can serve up to 10 end users during max load
    - 50% of computation power goes to real-time computation (PaaS), Linux or Windows
    - 50% of computation goes to batch jobs (IaaS), Linux
- Customer growth is even and exponential
- Load distribution similar every day, and load evenly distributed between max and min load
- Keep always 10% safe margin for your real-time capacity
- PUE (impact of transmission or number of users omitted)
    - Public cloud: PaaS = 1.2, IaaS = 1.1
    - Private cloud (web hotel) = 1.7
    - Private cloud (own cluster) = 2.5
- Data should be stored close to customer to minimize Round Trip Time (RTT)
- Period of evaluation: 3 years, interest rate: 10%

Cost comparison:

The tender should be built using four different options:

1. Public cloud (PaaS using either Google Apps Engine[2] or Microsoft Azure[3]; IaaS Amazon EC2[4])
2. Hosted private cloud (for example, Nebula[5] basic Linux virtual server (2GB/100GB) with backup services, ~equal to 8 ECUs, costs 254 euro/month with 6 month agreement)
3. Own private cloud – see next page for specification
4. Hybrid using previous alternatives (1-2, 1-3, 2-3)

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[1] http://aws.amazon.com/ec2/instance-types/
[2] https://cloud.google.com/pricing/
[3] http://www.windowsazure.com/en-us/pricing/calculator/
[4] http://aws.amazon.com/ec2/pricing/
[5] http://www.nebula.fi/palvelut/pilvipalvelut/kapasiteettipalvelut/

You may also use other cloud or hosting providers, but at least the previous ones provide the price data. If they have several options, just pick up an average choice that fulfills the task requirements. PaaS and hosting service options perhaps do not provide ECU compliance, but you may make your own assumptions based on the data available. Please consider on-demand and also reserved instances, which might require 6 month, 1 year and 3 year contract. Auction prices are out of scope. Only computation costs should be taken into account, e.g. data, transmission and additional service costs can be omitted. Geographical location of servers must be noted to guarantee low RTT. Convert dollar to euro with a divider 1.2.

Own infrastructure is based on a rack that has a fixed cost of 20 000 euro and max capacity of 64 blades. Each blade costs 3000 euro and includes 16 cores. Each core has a similar capacity to 2 ECU. Blades can be added every 6th month. Amortization period is 36 months with interest rate 10%. According to Greenberg [2], server costs create 45% of all ICT costs. The rest, 55%, include infrastructure, power and network costs. In addition you need add admin staff costs to monthly fee with a factor of 8 (1 euro for servers = 8 euro admin salaries).

Compare different price options per year, and select your architecture [3]. We assume that all prices stay the same for the 3 year period. Present costs per month and year with an excel sheet showing your component portions, e.g. x % public PaaS, y % public IaaS, z % hosted or/and v % own private cloud. We assume that both PaaS & IaaS functions can also be run in hosted or own cloud without any additional costs.

Carbon footprint comparison:

Calculate carbon footprint values relative to computation for your chosen architecture.

Learning Goals:

The main objective is to understand the cost differences between public, private and hybrid clouds. Additionally impact of carbon footprint should be compared.

Submission Instructions:

Send your ~4 page report in PDF, formatted with IEEE template[6] (Latex or Word) to course email: t-110.5121@tkk.fi by 19.12.2012 23:59. Report can have the following structure:

- **Title, author details with email and student number**
- **Abstract and keywords**
- **Introduction:** Explain assignment requirements, restrictions and alternatives.
- **Background:** Explain the cloud alternatives, their major differences and costs associated.
- **Architecture**: Describe your chosen architecture. Give reasons why did you chose this one, what are the critical issues in other options.
- **Cost analysis:** Calculate all costs relating to computing (also admin with your own cluster) during 36 months (2013-2015) with the current price data and show the cost curves per month for 3 years.
- **Carbon footprint analysis:** Evaluate relative carbon footprint values in each scenario. Do you think that a virtualized phone is greener than a standalone mobile (1 ECU) if we assume that a virtualized phone needs 10% less computation? Mobile PUE is 7. Computation vs. communication tradeoff?

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[6] http://www.ieee.org/conferences_events/conferences/publishing/templates.html

- **Discussion:** What are the restrictions, pros and cons and risks of your proposal? Does the company have a solid business case? How much they should charge customers monthly to cover computing costs only? Elaborate future development ideas.
- **Conclusions**: Summary of your work.
- **References**

References:

1. A. Taivalsaari and K. Systä, "Cloudberry: An HTML5 Cloud Phone Platform for Mobile Devices," IEEE Software, July/August 2012, pp. 40-45.
2. A. Greenberg, J. Hamilton, D.A. Maltz and P. Patel, "The Cost of a Cloud: Research Problems in Data Center Networks," ACM SIGCOMM Computer Communication Review, vol. 39, no. 1, Jan 2009, pp. 68-73.
3. M. Hajjat, X. Sun, Y-W. E. Sung, D. Maltz, S. Rao, K. Sripanidkulchai, and M.Tawarmalani, "Cloudward Bound: Planning for Beneficial Migration of Enterprise Applications to the Cloud," ACM SIGCOMM'10, August 30-September 3, 2010, New Delhi, pp. 243-254.