



CSPE: Cloud Storage Provisioning Decided by Rate of Return and Workload Characteristics

Jianzong Wang*, Rui Hua, Changsheng Xie, Jiguang Wan, Yanjun Chen, Peng Wang and Weijiao Gong
 School of Computer Science and Technology, Huazhong University of Science and Technology
 Information Storage and Digital Media Lab, Wuhan National Laboratory for Optoelectronics

Motivation

The work introduce a Cloud Storage Provisioning Engine (CSPE) to help users rationally evaluate the benefit of purchasing new disk drives and leasing from remote servers offered by Infrastructure as a service (IaaS) providers.

The contributions of CSPE are as follows:

- CSPE evaluates the future storage demand by tracing previous data increment tendency, which is completely customer-made for growth-oriented enterprises.
- CSPE uses the widely-used Internal Rate of Return (IRR) in economics to solve "purchase or not" problem with regard to storage provisioning .
- In regular services stage, we optimize our engine from workload utilization perspective to further complete workload provisioning for the purpose of cost saving.

CSPE Decision Model

TABLE I
NOTATIONS OF MODEL

Notations	Description
C_t	Initial disk drive investment
C_0	Initial disk drive investment
r	Discount rate
t	Time period (years)
n	The life cycle of this project (years)

- The internal rate of return makes the net present value (NPV) of all cash flows (both positive and negative) from a particular investment equal to zero. The simplified standard NPV equation is shown in Eq(1):

$$NPV = \sum_{t \in n} \frac{C_t}{(1+t)^t} \quad (1)$$

- We can infer that IRR of purchasing new disk drives is given in Eq (2)

$$NPV_p = \sum_{t \in n} \frac{C_t}{(1+IRR_p)^t} \quad (2)$$

- Similarly the IRR of leasing over the clouds in the right of Eq (3):

$$NPV_l = \sum_{t \in n} \frac{C_t}{(1+IRR_l)^t} \quad (3)$$

- Using secant method Eq (4), we get IRR_p and IRR_l respectively, then we could calculate ΔIRR Eq (4) using the equations of next page:

$$r_{n+1} = (1+r_n) \left(\frac{1+r_{n-1}}{1+r_n} \right)^p - 1 \quad (4)$$

$$\Delta IRR = IRR_p - IRR_l$$

Where

$$P = \frac{\log(NPV_{n, in} / |C_0|)}{\log(NPV_{n, in} / NPV_{n-1, in})}$$

System Framework of CSPE

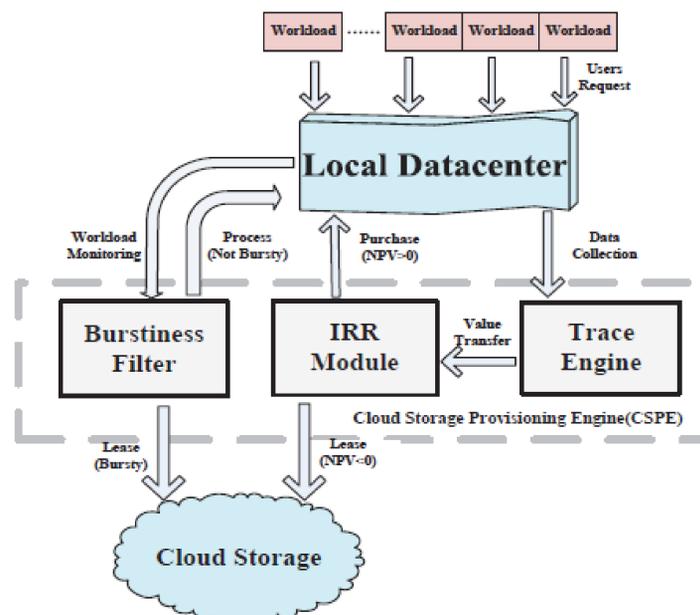


Fig. 1. Framework of CSPE

Trace Engine

- Analyze previous records in the local datacenter
- Predict data extension tendency and estimate future demand in storage

IRR Module

- Draw graphic images of calculated IRR values a storage life expectancy from 0 to N years.
- Based on the IRR results, the enterprises can make a quick purchase or lease decision in a more straight way.

Burstiness Filter

- Monitor users' request (i.e. workloads),
- Detect bursty workloads ,then migrate them to the clouds.

CSPE Working Flow

We drive our CSPE working by following steps.

- Firstly, we employ **Trace Engine** to predict next future years' demand by analyzing previous records of increasing storage in local datacenter, and transport the predicted results to the **IRR Module**.
- Then, we bring in **Internal Rate of Return (IRR)** Models to measure and compare the profitability of investments in order to help decide whether companies should purchase new disk drives or lease remote cloud computing service. However, merely a solution to "to purchase or not" problem is not enough for practical applications.
- Lastly, we come up with a module called **Burstiness Filter** to identify those bursty workloads and then migrate them to the cloud storage service providers for the benefits of cost savings and risks. Because a bursty (i.e. high peak average utilization ratio) workload actually causes a less dense workload placement possible on the server and hence much lower average server utilization, which renders in deployment of more resources and higher cost.

CSPE Model Characterization and Preliminary Evaluation

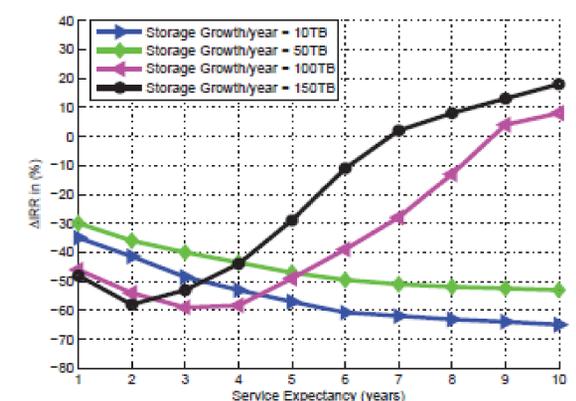


Fig. 2. Preliminary Testing of ΔIRR Tendency

- The evaluation shows the approximate ΔIRR trend in recent 10 years.
- IRR of leasing over the clouds exceeds that of purchasing new disk drives and human capital for operation and monitoring.
- For the large size enterprises with a datacenter of thousands servers, the investment of purchasing new devices becomes more profitable after 8 years, especially for those far-sighted enterprises with servers of long expectancy.

This work is supported by National Project on Key Basic Research Project of P. R. China (973 Program) under the grant No. 2011CB302303, Natural 863 Plan under the Grant No. 2009AA01A402, Natural Science Foundation of P. R. China under the Grant No.60933002, and the Innovation Plan of WNLO

*Corresponding Author: jzwang@smail.hust.edu.cn, Please be free to mail me if need further discussion