

ANALYSIS OF CLOUD SERVICES SPOT MARKETS

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Motivation of the work

Cloud computing is a global phenomenon in the actual world and has become the computing platform of choice for an increasingly diverse set of users from corporations through SME's and startups as well as for the public sector. According to 2017 forecasts [1], worldwide spending on public cloud computing will increase from \$67B in 2015 to \$162B in 2020 attaining a 19% CAGR.

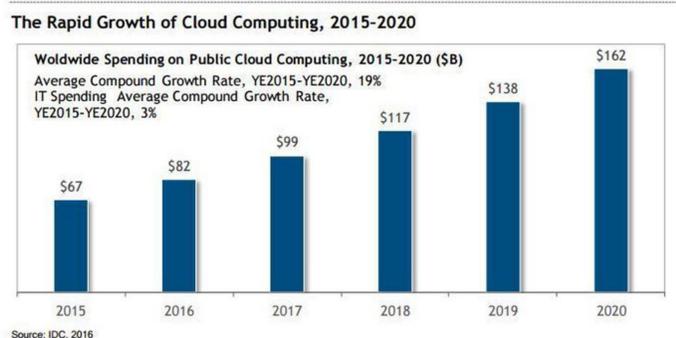


Figure 1: Forecasting of the growth of global spending in cloud computing in the next years

The market of IaaS services is dominated by Amazon Web Services with more than 30% of the market share followed by Microsoft, IBM and Google [2].

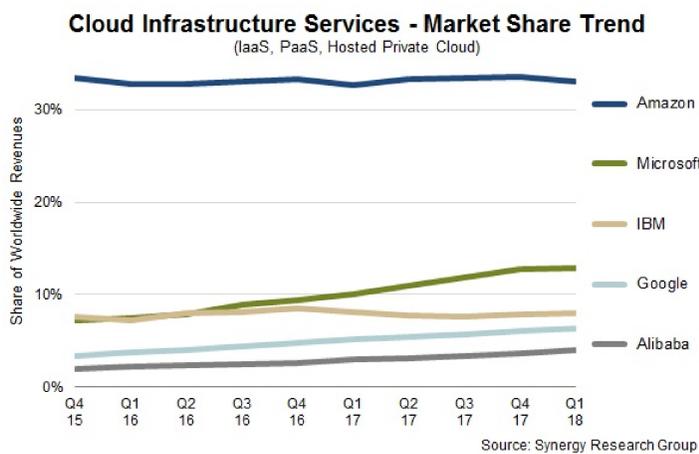


Figure 2: Cloud Infrastructure Services - Market Share Trend

Even though service costs per PM are decreasing steadily [3], they are a great barrier for a broader adoption of the IaaS services.

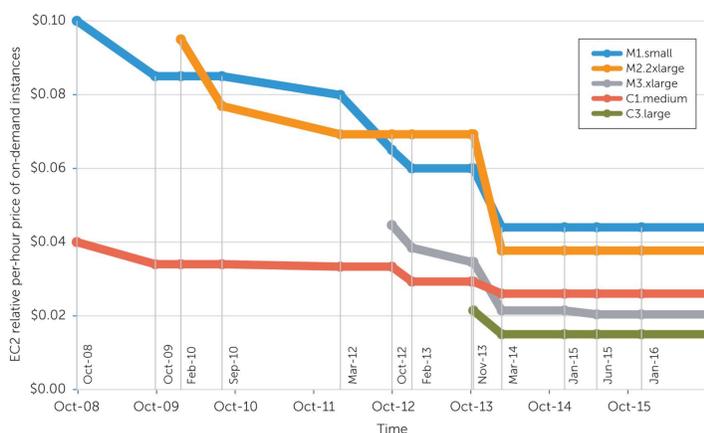


Figure 3: AWS IaaS price reduction over time

Even though different IaaS providers have different price strategies, AWS is the leader and it offers three main pricing options that provide different trade-offs between the level of commitment the user is willing to make and the cost of the service:

1. **On-demand** instances let users dynamically purchase compute capacity at any time without any prior commitment, but at a premium price.
2. **Reserved** instances demand a one or three year commitment with a significant discount compared to on-demand instances.
3. **Spot** instances are based on the sparse capacity of AWS and, like on-demand instances, they come with time granularity and do not require any type of commitment. Spot instances are auction-based price system [4]. Users who have registered a bid in excess of the spot price gain access to the desired resource until they finalize their job or lose the instance as soon as their bid falls below the next announced price. Amazon provides historical spot price information for the past 90 days to enable users to devise bidding strategies that realize different trade-offs between cost and the ability to secure the desired resources. AWS also offers some tools to help their customers to make their bids. The use of Spot instances allows AWS users savings in the 90% range compared with the On-Demand prices of the same instances.

In the literature there are different studies that analyze the AWS Spot market since they appeared in 2011. These studies analyze this market from a statistical perspective, price simulation and prediction, price strategy definition, etc. Some remarkable papers that have to be analyzed will be:

1. *Statistical modeling of spot instance prices in public cloud environments* [5]
2. *Deconstructing amazon ec2 spot instance pricing* [6]
3. *Optimal bidding in spot instance market* [7]
4. *Towards optimal bidding strategy for Amazon EC2 cloud spot instance* [8]
5. *How to bid the cloud* [9]
6. *On optimization of simulation execution on Amazon EC2 spot market* [10]
7. *How not to bid the cloud* [11]

Thesis Objectives

This thesis will be focused on the development of technologies and solutions to analyze the behavior of the AWS Spot market from the users perspective. On the basis of historical data of the prices of AWS Spot Prices, the assumption that the markets are governed transparently by supply and demand prices or, alternatively, that the markets are artificial and prices are set by suppliers, shall be analysed. In the course of the development of the thesis, various hypotheses will be formulated to explain the behaviour of market prices, which will be validated through the study of historical data, the development of price forecasting systems for the different services and the empirical verification of the results.

Research Plan

The research plan for the development of this thesis is:

1. 2017-2018: Recovering of the Spot prices from the AWS API for different regions. Definition of an architecture that allow to efficiently storage and analyze this information that would be used to analyze the prices with a long term perspective.
2. 2018-2019: Analysis of the literature related to the cloud services auction markets, specially, the AWS Spot market.
3. 2018-2019: Generation and formulation of new hypotheses that try to explain how AWS Spot market works.
4. 2019-2020: Simulation and evaluation of the hypotheses.
5. 2019-2020: Exploration of new methods to predict the prices of the Spot instances and definition of new strategies to achieve better savings using AWS Spot Instances as the main IaaS infrastructure in different projects.

Next Year Planning

Over the next year, the architecture to store the AWS Spot prices will be developed and the initial study of the state of the art of the analysis of the AWS Spot market will be done.

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