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Determining bucket structures in pricing plans for private user cloud computing storage services: A Monte Carlo simulation study

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Abstract

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Bucket pricing plans are non-linear pricing plans, under which users pay a lump sum for a certain amount of units (bucket), which are provided for a fixed period of time. If a customer fully exploits the purchased bucket, she can either opt for the next higher bucket or refrain from further use of the service. Cloud computing storage services (CCSS) are often provided under such bucket pricing plans. Providers of CCSS are faced with a bucket structure optimization problem with regard to the number of buckets offered and their lower and upper storage volume boundaries. This paper develops a multi-period model of tariff choice decisions of private customers of CCSS and their impacts on the profits of CCSS suppliers as a function of varying bucket structures. We apply the model in Monte Carlo simulations to determine profit maximizing tariff structures while varying different market characteristics such as median demand saturation, demand heterogeneity, price per unit, and bucket ceiling allocation. The analysis suggests that demand heterogeneity and price per unit are the most influential variables for CCSS tariff structure optimization. Price plans with more than two buckets tend to generate higher profits than simple schemes with two buckets only if demand heterogeneity is low and the price per storage unit is high and/or median saturation level of customers is low.

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1. Introduction

Cloud computing (CC) services are a means „for enabling ubiquitous, 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“ (Mell & Grance, 2011, p. 2). Triggered by the almost ubiquitous availability and increasing average bandwidth of (mobile) Internet protocol (IP-) based telecommunciation networks, CC offerings are among the services in information and communication technology (ICT) with excellent growth prospects over the next years in both organizational (Haag & Eckhardt, 2014) and private user context. In Germany alone, CC service revenues are projected to double between the years of 2014 and 2016 from appoximately 10.3 bn Euro to 20.1 bn Euro (BITKOM, 2013 and 2014a).

According to BITKOM (2014b), one of the most prevalent trends regarding CC use of (German) private customers is the increasing substitution of local hardware storage (e.g., hard drives or USB thumb drives) by CC storage services (CCSS). Instead of storing files on their local devices, users sign up to services such as Dropbox or Microsoft OneDrive, which enable them to upload and store data on the servers of the respective provider and, thus, access or synchronize their personal files across multiple Internet-enabled devices (Gerpott & May, 2014). CCSS providers commonly charge their services in several unit bundles for fixed prices. This type of non-linear pricing scheme is known as a bucket pricing plan (Iyengar, 2010; Schlereth & Skiera, 2012). For example, in Germany, Dropbox' basic plan consists of two bucket offers, one with a 2 gigabyte (GB) ceiling, which is free of charge, and a second bucket with an upper storage limit of 1 terabyte (TB) at 9.99 Euro per month. At the same time, Microsoft offers its OneDrive CCSS with four different buckets. The first complimentary bucket ceiling includes an allowance of 15 GB. The second and third upper bucket ceilings comprise 100 and 200 GB at 1.99 and 3.99 Euro per month, respectively. The fourth upper bucket ceiling includes 1 TB of storage space at 7.00 Euro per month.

Without claiming that these isolated examples are representative for the market for CCSS, the considerable differences in average price per unit, in the number of buckets, and in bucket ceiling allocations raise the question of how providers can design an optimal bucket pricing structure in terms of the number of buckets from which a consumer can choose and their upper and lower ceilings. Hence the main issue, which is addressed in the remainder of this article, is to develop a model to derive a profit-maximal bucket pricing plan subject to individual tariff choice decisions of residential CCSS consumers. The next section provides an overview of related work in order to clarify the scholarly context. The third section explains the mathematical background of the optimization problem. In the fourth section, a Monte Carlo simulation is conducted to explore the profit development in different demand situations against the background of varying offers. The simulation results are discussed in section six, which also highlights avenues for future research.