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DATA CAPS AND TWO-SIDED PRICING: EVALUATING MANAGED SERVICE BUSINESS MODELS

Research in Progress

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Abstract

With the transition from a flat rate dominated pricing regime towards volume-based tariffs, bandwidth is often bundled with specific allowances or overuse-charges for data consumption. One central element in many new telecommunications tariffs is the implementation of data caps, which are a common tool to address several challenges telecommunications providers face in today's markets. In this context the recent introduction of so-called "managed services", or "all-you-can-app" offers draws the attention of regulators. The term "managed service" is coined by operators to describe online-services that have a special agreement with the network operator. These service providers agree to revenue-sharing agreements and in turn their customers are alleviated from counting the data traffic they cause against their monthly quota. In this paper we develop a framework that incorporates the different forms of volume-based Internet tariffs in the market. Furthermore, we present the case of data caps in combination with managed services offers and derive the relevant research questions. In the following section we discuss the incentives of service providers to become a managed service and outline the creation of a theoretical model to analyze the case of data caps and managed services from an economic perspective. The paper concludes with a brief summary, general implications and a description of how to complete the presented theoretical approach.

Keywords: Data caps, Business Models, Economics, Net Neutrality, Two-Sided Markets.

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1 Introduction

With the on-going transition of the Internet to a universal communications access technology, data pricing becomes the main driver of revenues for infrastructure providers in the future. While current revenue streams from dedicated services like messaging and voice are eroding, those services are being deprecated to mere free add-ons to volume and bandwidth driven Internet access pricing plans. That trend is even more pronounced in mobile markets where classic flat rate and pay-per-use pricing schemes are dropped in favor of so-called shared data plans (e.g. AT&T, Verizon). However, also in the fixed-line business big telecommunications providers foster a transition towards volume driven pricing plans to overcome the trend of all-inclusive flat rate plans.

The discussion about the current deviation from the flat rate dominated pricing regime is closely related to the debate about Net Neutrality. The reason for that relation is twofold:

Firstly, network providers try to monetize the number and type of devices that are hooked up to the network. Mobile telecommunications providers push the introduction of so-called "shared-data" plans that allow customers to consume the data allowance among all connected devices. However, for every additional device (SIM card) providers charge customers an additional (monthly) fee that depends on the type of device (e.g. notebook, tablet, mobile). In the fixed-line business such business practices are not common yet, but telecommunications providers try to restrict the usage of routers to a limited preselected set of devices, possibly allowing them more control over the connected devices in the future.

Secondly, the recent introduction of so-called "managed services", or "all-you-can-app" offers draws the attention of regulators. The term "managed service" is coined by operators to describe online-services that have a special agreement or contract with the network operator. These service providers agree to revenue-sharing agreements and in turn their customers are alleviated from counting the data traffic they cause against their monthly quota. For example, if a video-streaming provider becomes a managed service in the network of one specific network operator, all customers of this specific network operator that subscribe to the music-streaming service can use the offer as if it is provided by a data flat rate (e.g. Lunden, 2012). As can readily be seen, a business model based on selling managed service entitlements can only be sustainable if flat rate pricing is not available to Internet access customers and the available data volume per billing period is limited.

From a regulatory perspective business models like that are probably harmful to the Internet ecosystem. Managed services reopen the discussion about two-sided pricing mechanisms in the Internet, known from the Net Neutrality debate. As Krämer, Wiewiorra and Weinhardt (2013) argue, two-sided pricing mechanisms introduce a combination of additional regulatory problems that could even be intensified by the selective exemption of certain services from data caps. While the Internet currently provides a level playing field for all service providers, managed service entitlements can lead to situations where users subscribe to service providers, for the exemption of the data consumption.

This paper outlines a first approach to understand and systematically analyze current and future business models based on data caps and their impact on customer behavior, as well as on the service provider market. The remainder of this paper is structured as follows. First we develop a framework that incorporates the different forms of volume-based Internet tariffs that can currently be observed in telecommunications markets. In the subsequent section we present the case of data caps in combination with managed service offers and derive the relevant research questions. In following section we discuss the incentives of service providers to become a managed service and outline the creation of a theoretical model to analyze the case of data caps and managed services from an economic perspective. The paper concludes with a brief summary, general implications and a description of how to complete the presented theoretical approach.

2 From flat rates to data caps

2.1 Classic forms of data pricing

Network providers historically rely only on a limited amount of parameters to price discriminate between their access products. All parameters that have been used in the past are based on technical aspects of the network connection. Those parameters include:

- Time (e.g. price per minute varies between day and night or workday and weekend)
- Bandwidth (e.g. access to DSL/VDSL/Fibre or UMTS/LTE)
- Volume (e.g. price per Kilobyte/Megabyte)

Historically time-based pricing was the dominant Internet access-pricing scheme. In the early days of mobile telecommunications, data consumption (e.g. via GPRS, EDGE) was priced predominantly by data-blocks (e.g. per 10KB). With the rise of broadband access technologies like DSL, Cable, VDSL and fibre, the maximum throughput was the unique selling point for new Internet access products. Internet connections could be established without utilizing the dial-up infrastructure and the era of the always-on Internet access begun. However, the value of new high speed technologies like LTE is "caused by the technological cost benefits for the telecommunications provider rather than by a possible increase in revenue due to a higher proportion of customer preferences related to data transfer speed" (Fritz, Schlereth, and Figge, 2011, p. 277).

2.2 Data pricing in Next Generation Networks

With the transition from the flat rate dominated pricing regime towards volume-based tariffs, bandwidth is often bundled with specific allowances or overuse-charges for data consumption. One central element in many new telecommunications tariffs is the implementation of data caps, which are a common tool to address several challenges telecommunications providers face in today's markets:

- Consumers prefer un-metered Internet tariffs (Kridel, Lehman, and Weisman, 1993; Nunes, 2000; Lambrecht and Skiera, 2006a)
- Consumers do not consider network costs under flat rate tariffs, which makes these tariffs unsustainable in the long-run (Fritz, Schlereth, and Figge 2011)
- Consumers are uncertain about their data consumption (Chen, 2012)
- Consumers dislike bill-shocks (Grubb and Osborne, 2012)

There are currently three dominant volume-based tariff schemes at the market. The so-called "fair-flat" tariff is a variant of the current flat rate pricing mechanism. In contrast to data caps those tariffs establish volume-thresholds that are used to increase prices for heavy users. Customers that consume below the volume-threshold pay the standard flat rate price, whereas customers that exceed the fair-use level pay a predefined premium in that billing-period. Often providers notify users about their actual consumption and warn them if they are about to exceed the fair-use level. Some providers are even charging the additional fee only after repeated overuse (e.g. two months in a row). However, overall consumption under fair-flat tariffs is not limited.

Three-part tariffs are not limited in data consumption as well. "A three-part tariff is defined by an access price, an allowance, and a marginal price for any usage in excess of the allowance." (Lambrecht, Seim, and Skiera, 2007 p.698) Consumers with a three-part tariff pay for any usage in excess of their allowance and can end up with relatively high cost for their additional data consumption. That risk for bill-shocks makes the tariff unattractive from a customer perspective because it adds a pay-per-use element to the already uncertain and unpredictable demand for data

consumption. In contrast to three-part tariffs in voice communication, consumers can only imperfectly monitor their data consumption to determine their remaining allowance. Video-streaming for example can consume the whole allowance in a short time.

Both pricing schemes do not fully address the desire of customers for a predictable bill at the end of a billing period. Fair-flat tariffs at least define an upper bound to the overall bill and allow for unlimited data consumption at the highest price point.

Data caps on the other hand are the dominant volume-based tariff scheme in mobile Internet access, but are more and more common in fixed-line Internet access as well. Tariffs with data caps are very often sold under the flat rate label. However, in contrast to flat rate tariffs consumption under data caps is strictly limited and overuse requires direct customer action. The enforcement of data caps can either have the form of immediate disruption of the Internet service, or of artificial quality degradation of the connection. For example, many mobile network operators reduce the bandwidth of the connection to the level of 6.8KB/sec (equivalent to ISDN line speed) when the cap is reached. That form of "soft enforcement" allows operators to make the claim of unlimited Internet usage in their marketing campaigns, without loosing the important aspect of volume-based price discrimination. When the cap is reached, customers often have the option to pay an additional fee to continue to be able to use the Internet or to restore the full speed of the connection. Providers either charge customers to reset their original quota-limit, or to buy an additional predefined data-volume.

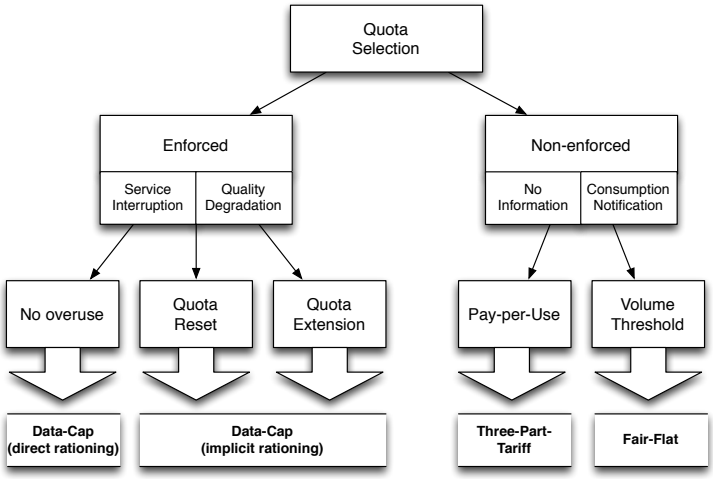

Figure 1 Data tariff framework

3 Rationing Internet access

Data caps are a form of rationing of consumer demand for data-services. Preventing any form of overuse (as shown in Figure 1) is described as direct rationing. That situation can be compared to the point-rationing systems after the Second World War. Consumers were given points that could be exchanged for scarce resources (e.g. food, cloth) (Rothschild, 1945). Prices for those goods in the virtual point currency were determined according to the level of scarcity of the goods. Consumers had to make trade-offs between their preferences, their basic needs and the scarcity of the goods according to the prices in the virtual rationing currency. Rationing theory yields some very intuitive, but insightful results that are transferrable to the theory of capped Internet tariffs. Under rationing of goods the consumption of non-rationed complements goes down, whereas the consumption of non-rationed substitutes is increased (Tobin, 1952).

That result has direct implications for Internet markets. If data caps are becoming the dominant pricing scheme for Internet access, managed service entitlements, or "all-you-can-app" offers are the only

non-rationed alternative. Consumers have to trade-off the value and data-intensity of all non-managed services (Barbagallo, 2013). Data-intensity (e.g. data volume necessary to watch one Youtube video) is comparable to the (exogenous) price in a virtual point rationing system. Rationing therefore introduces a second budget constraint into the customer's decision problem. Under direct rationing the customer is not able to make exchanges between the two currencies (money and data-volume).

Rationing is only implicit, if consumers are able to buy additional rationing points (data-volume) after they used their initial allowance. However, the exchange is only possible in one direction, as remaining data-volume cannot be used for other purposes and is not transferable. Another important aspect of rationing is the inability for savings. Rationing points can only be used in one time-period and become useless in the next period. The same holds true for data caps that represent the upper bound of data-consumption in one billing-period.

So far it is an open question if rationing by means of data caps is potentially harmful from a regulatory perspective and how such business models could reshape the service landscape in the Internet. To this end we outline the creation of a theoretical economic model to compare three scenarios against each other. The benchmark case is the current flat rate pricing regime, which will be compared to the scenario of data caps. In this specific scenario we do not consider additional revenues form selling managed service entitlements. This allows us to disentangle the effect of introducing managed services from the effect of solely introducing data caps to the market. Consequently, the third scenario considers the combination of data caps and managed services and is compared to the benchmark case (flat rate) and the data cap scenario. The model will be used to answer the following research questions:

RQ 1: How does consumption of service offers with heterogeneous characteristics (value, data intensity) change under a data cap (and managed service) regime?

RQ 2: What is the resulting effect of a data cap (and managed service) regime on content variety?

RQ 3: What is the effect of a data cap (and managed service) regime on Internet service provider's revenues?

RQ 4: Which of the three regimes is more efficient?

Research question 1 addresses the problem of how consumers change their consumption of existing services under consideration of virtual data costs. The newly introduced budget constraint for data consumption on the other hand is a strategic variable of the ISP. The second strategic variable is the magnitude of the revenue share, which is only existent under the data cap and managed service regime. Overall it is unclear, if the potential welfare loss from consumers using Internet services less is outweighed by the potential additional revenues from managed services and the potential cost reductions due to rationed data consumption.

4 Modeling data caps

4.1 From volume to value

As mentioned in Section 2.1, Internet service providers have naturally only a limited set of variables to extract value from their customers. Due to the on-going Net Neutrality debate business models that rely on the provision of Quality of Service (QoS) are still questionable. Consequently operators shift their focus to data-tariffs with caps. Caps allow operators to price discriminate between their customers according to their (average) data consumption. The cap and the absence of an immediate pay-per-use element prevent bill-shocks and make the tariff more attractive compared to e.g. three-part tariffs. The reset or extension of the quota on the other hand allows monetizing additional demand by customers.

However, customers will only buy additional data-volume if the expected utility of that data-volume will exceed the price of the volume. The expected utility of additional data-volume depends on the services that a customer prefers to use. For some Internet-based services customers already pay fees to the respective service providers. Data caps are therefore more likely to harm services that are very data-intensive (but free to use) and services that already demand a fee from customers. From a consumer perspective the service-fee and additional data-costs to use the service are adding up to the total service-costs.

That aspect is crucial in the understanding of the "all-you-can-app" business model. The successful implementation of data caps is only the first step towards a successful two-sided business model that enables Internet service providers to extract value from customers and service providers alike. If services are very data-intensive but provide much value to the customer, customers will likely pay for the overuse of their data allowance. However, if customers are not willing to pay for their overuse, service providers may have the incentive to pay for the data-consumption of their customers to facilitate the usage of their service.

That logic may hold true for profitable data intensive services that are still free to use (e.g. Youtube) and premium services that already require subscriptions from their customers (e.g. Spotify, Netflix). Figure 2 shows a simplified two-sided market and the revenue streams to the Internet service provider as described above.

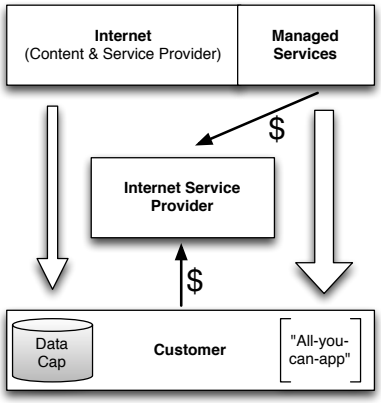

Figure 2 Managed services and two-sided pricing

To better understand the incentive for e.g. premium service providers to become a managed service, consider the following simplified example: Consumer X has a willingness-to-pay for streaming a movie of 5$. Streaming provider Y offers a movie that consumer X want's to watch for a rental price of 5$. Consumer X has already reached his monthly data cap by consuming other services and would have to pay 1$ for each additional 1GB of data. Considering the size of movies (above 1GB), consumer X will refrain from buying the movie due to the total service costs of at least 6$. Furthermore, consider streaming provider Y has variable costs of 4$ (e.g. royalties, hosting) for every movie he rents to his customers. If provider Y has the option to conclude a revenue sharing agreement with the ISP and become a managed service, renting the movie is still profitable up to the point where (1-revenueshare)*5$ = 4$. Note, that the example does not consider two effects that could possibly arise under other circumstances. Firstly, the logic of the example only applies to those cases when the customer has already reached the cap. As a managed service the service provider has to share his total revenue from all requests from the Internet service provider's customer base. That includes also those requests that would still be served under the customers cap and would therefore be made independent of the status as managed service. Secondly, keep in mind that all requests at a managed service do not count against the customer's quota. If the customer had consumed the same service under his quota in a data cap scenario without managed services, the managed service entitlement would free capacity of

his quota to consume other services. However, compared to a flat rate regime data consumption is still rationed. Smaller competitors are likely to be better of compared to a data cap regime without managed services, but could still be in a disadvantage compared to the flat rate regime.[2] That effect will be further exemplified in the following section.

4.2 Outline of the economic model

In this section we outline our approach to model data caps and consumer demand under rationing for two exemplary service providers (A and B). First, we consider the case were only a data cap and no managed service pricing is introduced. For expositional simplicity assume that both services are making money only through advertisements and consumers pay only a fixed access fee f_c to the Internet service provider.

(1) $$Max\ U(x_A, x_B) = ax_A - \alpha x_A^2 + bx_B - \beta x_B^2 - f_c$$

$$s.t. d_A x_A\ + d_B x_{AB} \leq C$$

Consumers maximize their utility given by (1) by choosing the optimal consumption level x_i of the available services. The parameters a and b represent the value of an additional unit of the respective service, while α and β are saturation parameters indicating how fast users reach their saturation point when more units of the same service are consumed. Furthermore, users have to consider the data intensity d_A and d_B of the two services in a data cap regime. Their total data consumption cannot exceed the predefined data cap C introduced by the ISP. If the daa cap is not binding, consumers will simply use each service up to its saturation point, which is given by (2).[3]

(2) $$x_A^* = \frac{a}{2\alpha}, x_B^* = \frac{b}{2\beta}$$

If the data cap is binding, solving the first-order conditions yields the following solutions for the optimal consumption levels of the services A and B given by (3).

(3) $$x_A^{**} = \frac{\frac{1}{2}(d_B^2 a - d_B d_A) + d_A \beta C}{d_B^2 \alpha + d_A^2 \beta}, x_B^{**} = \frac{\frac{1}{2}(d_A^2 b - d_B d_A) + d_B \alpha C}{d_B^2 \alpha + d_A^2 \beta}$$

It can be seen that consumption of e.g. service A in the constrained optimum is increasing in the data intensity d_B of the other service provider (i.e. how much traffic is generated by consuming one unit of the service) and the size of the cap C chosen by the ISP.

Now assume service A becomes a managed service and has to deliver a share of its revenue to the ISP. In return the data traffic caused by service A is not counted against the data cap of the consumers. Service provider A will receive demand up to the saturation point (x_A^*) by every customer. Non-managed service B is still subject to the data cap. However, the data traffic of the managed service does not count against the quota of the consumers and therefore frees capacity under the cap.

[2] There are concerns, that the introduction of managed service entitlements could increase demand for those services and consequently the costs of Internet service providers. In turn Internet service providers could ask for higher revenue shares over time to cover their costs, which in turn could drive smaller content- and service providers out of the market. However, effects similar to the "re-congestion effect" (Economides and Hermalin 2012) are just an additional assumption. A priori it is not clear if that the introduction of managed services would increase demand above the level of the flat rate. More likely, managed services are consumed up to the same saturation point as under a flat rate pricing regime. Since managed services are basically a flat rate for a specific service (paid by the service provider itself) there is no reason to assume the consumption would be higher compared to the consumption under a full Internet access flat rate.

[3] Note that the consumption under a non-binding data cap is equal to the consumption level under a flat rate and a managed service regime. The service is consumed up to the saturation point of the user.

Consequently every customer of the Internet service provider will consume less of the non-managed service B or (if the cap is not binding anymore) the saturation quantity.

(4) $$x_A^{***} = \frac{a}{2\alpha}, x_B^{***} = min\left\{\frac{b}{2\beta}, \frac{C}{d_B}\right\}$$

5 Conclusion & Outlook

Rationing through data caps is a common way to address congestion problems in networks and price customers according to their utilization of network resources. That price discrimination potential allows Internet service providers to establish new revenue streams to invest in future network infrastructure without raising prices for all customers.

However, rationing of data consumption in combination with two-sided pricing mechanisms ("all-you-can-app") can have undesirable effects on the consumption behavior of Internet users and the competition between content- and service providers. Recent studies about mobile traffic off-load (Marcus and Godlovitch, 2013) show that customers use their mobile devices for data-intensive services more frequently if they are connected to WiFi-networks. Such behavior can be driven by performance differences between fixed-line and mobile networks, but also by rationing of the monthly mobile data consumption as well.

Furthermore, the introduction of managed services could have negative effects on the competition between content- and service providers. If Internet service providers are very selective in their choice of managed service business partners, small start-ups could face new barriers to enter the market. If one player in a competitive service segment (e.g. music streaming) becomes a managed service, competitors are in a disadvantage due to the additional costs (budget constraint) of their customers compared to a flat rate pricing regime. Furthermore, it is doubtful that Internet service providers have a keen interest in accepting and promoting data-intensive service providers with low revenue streams as managed services in their networks. However, awarding managed service entitlements through revenue sharing agreements appears to be less of a concern than selling managed service entitlements through fixed-prices (cf. Krämer, Wiewiorra and Weinhardt, 2013). Furthermore, the outline of the model suggests that managed services entitlements could reduce the competitive pressure that is induced by the introduction of data caps. Data traffic that previously was counted against the quota of customers is now alleviated and can be used for the consumption of other (non managed) services. Becoming a managed service consequently has not only a positive effect on the demand of the respective service itself, but also on the remaining services in the market.

In a next step the outline presented in section 4.2 will be further developed into a complete two-sided market model. The additional budget constraint due to rationing amplifies the Internet consumption of consumers compared to a flat rate regime. Content- and service providers face a possible reduction in demand and can opt for a managed service entitlement to compensate for the demand reduction and the resulting decline in revenues. The profits of content- and service providers depend on their level of data-intensity, the cap consumers face in their Internet access product, as well as on the revenue share that the Internet service provider demands from them for the managed service entitlement. From the perspective of the Internet service provider, capping data consumption could reduce the value of Internet access for consumers and hence make price-cuts necessary. Consequently, the Internet service provider tries to find the optimal balance between the customer access fee, the data cap and the revenue share for managed services. The full model will allow us to draw further conclusion about the research questions developed in section 3. Specifically, how does content variety, consumption and Internet service provider's profits differ between the three regimes and which of them is more efficient from an economic perspective.

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