Pricing Data Smartly

Q3.1 What are other alternatives to tackling capacity constraints in cellular data networks?

In the text, we looked at flat-rate, usage-based, and capping. Another possibility would be to slow down certain classes of traffic. For example, at one time, Comcast throttled BitTorrent users, who often had massive amounts of file sharing and movie downloads. But this may raise concerns as to whether the ISP is keeping the network fair and neutral. In fact, Comcast went through litigations with the FCC when it was performing such throttling.

Yet another option would be to offload some of the traffic to open WiFi networks operating in unlicensed frequency bands. As we pointed out in Chapter 2, though, WiFi has many problems of its own that would become bottlenecks in this situation.

Q3.2 What are the criteria that we can use to compare alternative solutions to the exploding demand for mobile data?

The top ones include the following:

- *Economic viability*: As profit-seeking companies, ISPs need to first recover cost, and then maximize profit. Their profit margins are declining, as many other types of transportation businesses have seen in the past. Mobile and wireless networks are bright spots that they need to seize.
- *Fairness*: It is unfair if one consumer has to subsidize another's lifestyle. Under flat-rate pricing, light users will have to pay extra due to the presence of heavy users.
- *Consumer choice*: Consumers should be able to choose among alternative plans, *i.e.*, pay more money to get premium services or receive standard services with a cost savings.

Along these dimensions, usage pricing makes more sense than fixed pricing (although it can be further enhanced with more intelligence, like the methods in smart data pricing).

Q3.3 What are other ways of quantifying someone's utility?

Besides observing consumer behavior, we could run human subject experiments. For example, when you're on the phone, your utility will change depending on the perceived delay of the call, as well as the rate that is being allocated to your call. So researchers may run tests on various people with differing levels of delay and rate, and record their perceived "satisfaction." As another example, with a video, your satisfaction will vary depending on whether you are watching in high or standard definition, how the sound quality is, and other factors as well. If enough experiments are run, utility can be fitted accordingly.

Q3.4 What other advantages does usage-based pricing have over flat-rate pricing?

In the book, we looked at how usage-based pricing enforces the demand curve, while flat-rate pricing can lead to the tragedy of the commons. Another disadvantage of flat-rate is that it creates waste: In Illustration 9, we represent the difference in pricing signals between flat-rate and usage-based graphically. On the left is usage-based: the provider incurs a certain cost per GB consumed, and charges accordingly. To maximize payoff, the user will consume the corresponding number of GB on the demand curve.

On the right, we have a flat-rate pricing scenario. The provider incurs the same cost per GB, but does not charge users accordingly: it has to determine what the best monthly price to offer is. The user, being charged whatever this flat rate is, is incentivized to increase the number of GB consumed to the top of the demand curve.

To look at the implications here, we define the **user surplus** as the difference between utility achieved by the customer, and the cost incurred by the provider. Clearly, larger surplus is better.

- For usage-based, the consumer's utility is $\mathtt{A} + \mathtt{B}$, and the cost incurred by the provider is $\mathtt{B}$. Hence, the user surplus is $(\mathtt{A} + \mathtt{B}) - \mathtt{B} = \mathtt{A}$.
- For flat-rate, the total utility is the entire area of the triangle: $\mathtt{A} + \mathtt{B} + \mathtt{C}$. On the other hand, the price incurred by the provider is the area of the rectangle formed by \$/GB and GB: $\mathtt{B} + \mathtt{C} + \mathtt{D}$.

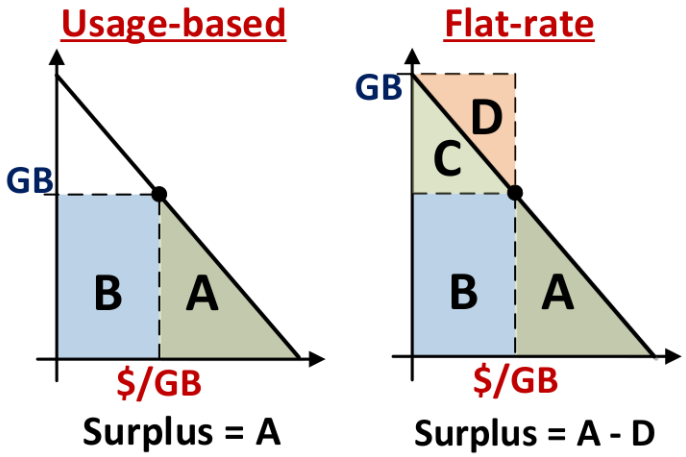

Illustration 9: Comparison between the user surplus under usage-based (left) and flat-rate (right) pricing schemes. On the left, the surplus is A, whereas on the right, it is $A - D$. The area D creates negative surplus, and is nothing but waste: it is the extra cost incurred that is not counteracted by any change of utility.

> Therefore, the surplus is $(A + B + C) - (B + C + D) = A - D$. This surplus is less than that of usage-based pricing by the area D.

The area D in Figure 9 is nothing but "waste:" it's added cost is not counteracted by any gain in utility. Hence, it detracts from the user surplus. Just as with the tragedy of the commons, this highlights that usage-based pricing is more efficient because it sends the right signals to the consumers: don't take more than your demand calls for. No network service is actually free, so "free" is not a particularly efficient pricing signal.

Another disadvantage is that flat-rate favors heavy users. Let's consider three different types of users: a light user, who has relatively small need for data, an average user, who has typical needs, and a heavy user, who consumes a lot. You can see the demand characteristics of each of these three types of users in Illustration 10: the light user is the lowest one, and the heavy user is the highest one, because for a given price, the former will demand the least data, while the latter will demand the most.

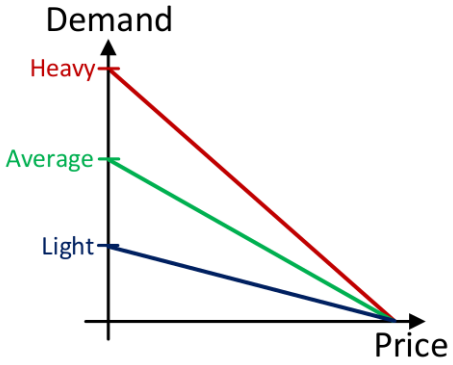

Illustration 10: Demand curves of three different types of users: light, who have the lowest demand for any given price; average, who are in-between; and heavy, who have the highest.

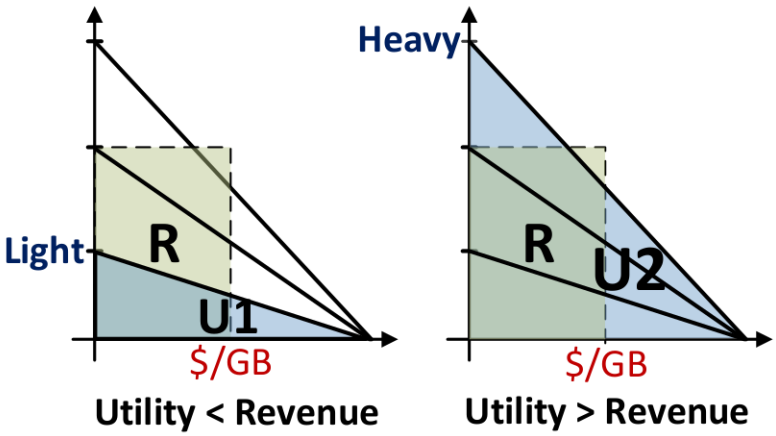

Illustration 11: Under a flat-rate scheme, users are charged based on the consumption amount of an average user. The provider must set this price high enough to recover its capacity costs. As a result, light users can have a very negative surplus (left), while heavy users can have a very high surplus (right). Light users subsidize the lifestyles of heavy users under flat-rate pricing.

Clearly, we have large diversity in the consumption characteristics of each consumer. Usage-based pricing has no problem dealing with this, because by charging per GB of data used, light users will be charged the least, and heavy users the most. This is straightforward, intuitive, and fair. For flat-rate pricing, it's a different story: how does the provider determine what price to charge? Well, it needs to make sure its revenue is high enough. If it knows the total number of customers it has, it can estimate the total capacity cost it will incur based on how much everyone will consume in total. Now, everyone needs to be charged the same price. The only way to do this while recovering expenses is to average the total cost over all of the users.

As a result, everyone will get charged based on the consumption of the average user, as shown in Illustration 11. Based on the amount (in GB) consumed on average, the provider sets its own cost incurred (in \$/GB) to guarantee that the resulting revenue obtained from each user will suffice when added up. The amount it charges each user is hence given by the area `R`. We make two observations:

1. *Light user*: On the left side, we highlight the case at hand for light users. Under a flat-rate scheme, the user's utility is given by the area of the entire triangle, `U1`. Now, compare this with the amount that it will be charged, given by the rectangular area `R`. Clearly, the utility is less than the revenue, and hence, we have a negative surplus for light users.
2. *Heavy user*: On the right side, we instead show the case for heavy users. The utility is given by the triangular area `U2`. And the amount charged is the same as it was for light users. Clearly, the utility is greater than the revenue, and hence, we have a positive surplus for heavy users.

So, heavy users can obtain very high payoffs, while light users may have very negative payoffs. By charging a flat-rate price, light users are effectively subsidizing the lifestyles of heavy users, who incur no additional charges for their voluminous consumption.