Pricing: Congestion, Content, Two-Sided Markets

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(Courcoubetis&Weber: Chapters 8, 9, and 10)

Schedule

Date	Topic
14.03.2008	Course introduction. Big picture. (HH)
19.03.2008	Consumer customers (HH)
21.03.2008	No lecture (Easter)
26.03.2008	No lecture (Easter)
28.03.2008	Enterprise customers (HH)
02.04.2008	Operators (AK)
04.04.2008	Transport pricing (AK)
09.04.2008	Mobile operator competition (HH/TB)
11.04.2008	Content pricing (HV)
16.04.2008	Investments (TS)
18.04.2008	Interconnect and roaming (HH)
23.04.2008	Charging and billing (HV)
25.04.2008	Regulation (TS)
30.04.2008	Spectrum, course wrap-up (TS)

Pricing – What is it really?

- Price is part of the marketing mix (4ps of marketing mix: product, place, promotion, price)
- Price is cost to consumers, revenue to producers

It is good to understand:

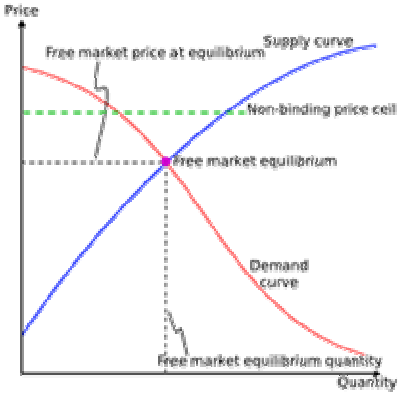
- Pricing theory
  - Economics
- Pricing practices
  - Part of business model

Pricing – Objectives

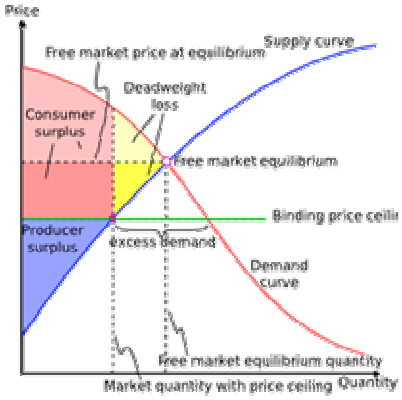
- Key element in financial performance
- Fit customer demand
- Product positioning / element of the marketing mix

Pricing from economics perspective

FREE MARKET

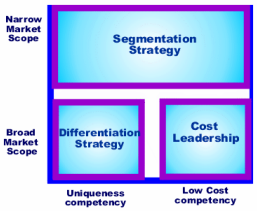


PRICE CEILING



Pricing from product strategy perspective

- Pricing is one of the most important elements from the product strategy point of view. Price is one of the key product attributes.
- Michael Porter (1980) suggested three generic strategies in positioning products or services. In both segmentation and differentiation strategies there is more freedom for price, whereas in cost leadership the idea is to push prices down.
- In operator business one can apply product positioning strategies in a variety of ways, in which pricing also plays a role. Operators have a portfolio of products, each product applying a certain positioning strategy.



Case: Finnish flat-rate packet data subscriptions – product positioning and pricing

Cost minimization (e.g. Saunalahti Dataetu) = 10€ / month
- best effort services - low prices
- no access if significant other network load
- restricted transmission rates
- no special customer support
- no special add-on content or services provided
- less business-oriented support (e.g. roaming)

Service differentiation (e.g. Elisa Business Data) > 30€/month
- high quality services - high prices
- exclusive or prioritized access
- high transmission rates, no restrictions
- add-on service packages, e.g. Vodafone Push-Email
- specialized customer support for business users
- roaming capabilities, data card options, Vodafone co-operation…

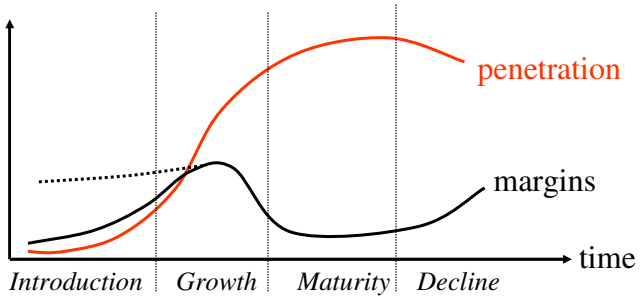
- Prices do not only derive from costs! You have to take pricing strategies into account in product positioning. Prices for example signal quality, not everybody buys the cheapest service available! High priced products are accepted by consumers, if the accompanying service is in line with the higher price.

Basic Pricing Concepts

- Who sets the price? Basic cases:
  - *Pure monopolist* sets the price to maximize his supplier surplus (i.e. profit)
  - *Regulator* sets the price to maximize social surplus (regulated monopoly)
  - *Pure competition* drives the price toward marginal cost and thus maximizes consumer surplus (all players are *price takers*)
  - *Oligopoly* allows the choice of price and quantity which triggers pricing games, and strategies!

Service life cycle phases

Impact on pricing



- Introduction: early adopters, skimming vs. aggressive growth
- Growth: increasing demand, little competition, high margins
- Maturity: differentiation pressure, tough competition, low margins
- Decline: cost cutting, harvesting niche segments, high margins

Internet access services

Congestion control

- The end-to-end bottleneck may occur at different points
  - In dedicated access:
    - Increase the dedicated per subscriber access speed (e.g. ADSL)
    - Push bandwidth sharing closer to subscribers (e.g. HomePNA)
  - In shared access/backbone/server: apply *congestion control*
- The level of congestion needs to be optimized
  - Too much congestion ⇒ *negative network externality*
  - Too little congestion ⇒ waste of network capacity
- Options for congestion control
  - Over-dimensioning (wasting of network capacity)
  - Call admission control, e.g. RSVP blocking (latest customers suffer)
  - Automatic flow control, e.g. TCP (all customers suffer)
  - Human fairness control, e.g. HomePNA (local group discipline)
  - *Congestion pricing* (maximal social surplus?)

Internet access services

Congestion pricing - theory

- Congestion price is two-part: normal + externality, $p+p_E$
  - Social surplus maximization
    (1) $max\ \sum_j u_j(x_j,y)-c(k)$, where $y=\sum_i x_i/k$, k=total fixed capacity
    $\Rightarrow p_E=-(1/k)\sum_j du_j(\underline{x}_j,y)/dy$, where $\underline{x}_j$=socially optimal demand
  - Individual maximization of surplus for consumer i
    (2) $max[u_i(x_i,y)-p_E x_i] \Rightarrow x_i=\underline{x}_i$, if number of users is large
  - Social and individual optima are the same, Nash equilibrium!
  - Congestion price converges to optimal price via tatonnement: network determines p_E using step (1) and publishes it, then each consumer i solves step (2) to find $\underline{x}_i$, and so on
  - u_j are unknown ⇒ network must vary p_E until finding equilibrium
  - y is unknown to consumers ⇒ consumers estimate it via congestion
- Congestion pricing suits for expensive bottlenecks like radio
- Congestion pricing facilitates automatic optimal capacity planning via the customer feedback loop

Internet access services

Congestion pricing - practice

- Time-of-day pricing (e.g. fixed-price tickets in Internet Café)
- Pricing per application & traffic type
  - Types pre-defined using diffserv, e.g. www, VoIP, etc
  - Automatic traffic classification and resource re-allocation
- Pricing per user's willingness-to-pay
  - Price-driven separation of service classes (e.g. Paris Metro Pricing)
  - Priority service classes based on relative quality (e.g. via diffserv)
- Note that flat-rate pricing well reflects the operator's large share of fixed cost, but cannot efficiently tackle the problem of temporary congestion!

Congestion pricing

Example: Time-of-day pricing

- Assume utility for consumer i : $u_i(x_1^i, x_2^i)$, in which the x variables imply the amount of usage for peak-hour and off-peak-hour, respectively.
- By denoting capacity limits for both peak-hour (t=1) and off-peak-hour (t=2) periods with C, we end up with a maximization problem:

$$\max_{x_1^i, x_2^i} \sum_{i=1}^{N} u_1(x_1^i, x_2^i) \quad s.t. \sum_{i=1}^{N} x_t^i \le C_t \quad t = 1,2$$

- This leads into a Lagrangian optimization problem (from the perspective of social planner), in which we can now denote the Lagrangian constants with symbols p (for comfort in the interpretation):

$$L = \sum_{i=1}^{N} u_1(x_1^i, x_2^i) - p_1\left(\sum_{i=1}^{N} x_1^i - C_1\right) - p_2\left(\sum_{i=1}^{N} x_2^i - C_2\right)$$

- It is easy to see that based on the first-order conditions of the Lagrangian formula above, we end up with the same solution (given the price vector) by solving the consumer's problem for each i,

$$\max_{x_1^i, x_2^i} u_i(x_1^i, x_2^i) - p_1 x_1^i - p_2 x_2^i \quad \forall i$$

  only if we can balance the Lagrangian constants (=prices) so that the capacity is in full use (i.e. Kuhn-Tucker conditions).

- This requires tatonnement (slight adjustments of price so that the consumption and capacity are balanced). Note that if e.g. the peak-hour utility is higher on average, in equilibrium its price must be higher, too.

Content services

Private vs. public goods

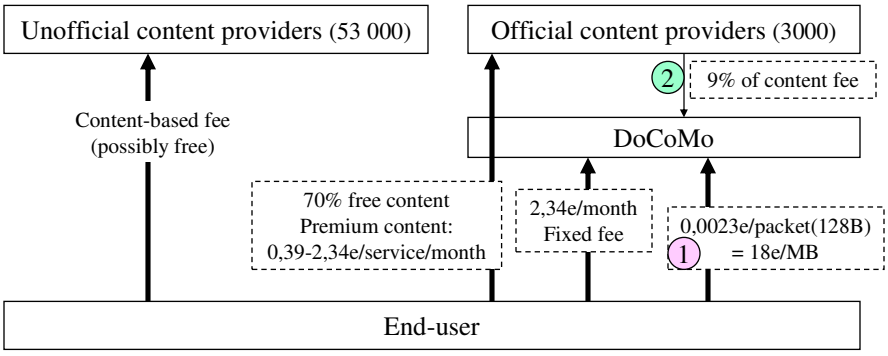
Private good (e.g. candy bar)	Public good (e.g. radio broadcast)
• You consume one, there is one less for others - *depletetable* • If consumed – no one else can - *excludable* • Marginal cost > 0 • Price = marginal cost. Achieved on ideal market when supply = demand	• *Nondepletable* – when used by one, the same amount is available to others. • *Nonexcludable* – Use by one does not exclude others from using the good. • Marginal cost ≈ 0 • Price ≈ 0 → fixed cost is not recovered → taxation, non-usage based fees

Content services

Evolution examples

- Best-effort IP service: Initially public good → Flat monthly fee → Congestion → Private good externality.
- Telephone call: In PSTN and over radio interface = private good (”candy bar”) → price/unit.
- Value-added IP service, e.g. VoIP: Initially usage fee. CPU and memory getting cheaper (Moore’s law) → Marginal cost of new customer ≈ 0 → Flat-rate.
- Digital Content: Marginal cost ≈ 0 → Copyright and IPR control enable both private and public goods. Copyright violations, e.g. peer-to-peer traffic → development of digital rights management (DRM) or bundling with other private goods!

Case: DoCoMo i-mode pricing



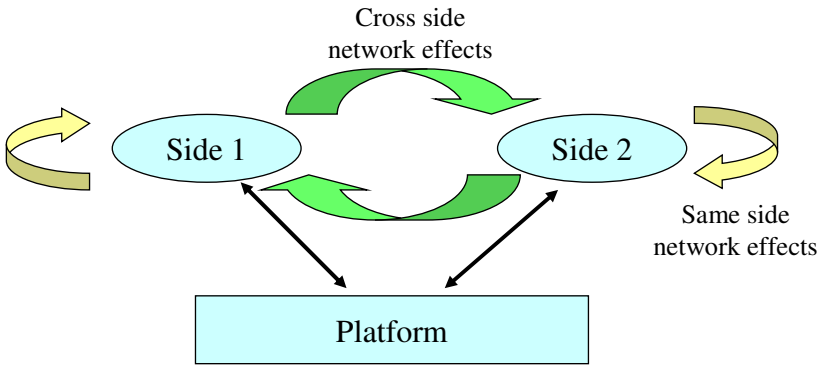
1 Accounts for 87% of the i-mode ARPU
2 Accounts for less than 1% of the I-mode ARPU

Source: Sandro Grech, 2003 (prices 2002)

Pricing of telecom equipment

- Traditionally pricing is based on hardware capacity (e.g. switching centers, routers, base stations), which hides software R&D costs → pressure to price software
- Capacity pricing is adapted per type of capacity
  - GSM MSC switching capacity (number of simultaneous calls)
  - GSM HLR storage capacity (number of subscribers)
  - GSM BTS radio transmission capacity (number of TRXs)
  - IP router capacity (bits/sec, packets/sec, number of ports, etc)
  - Server transaction capacity (SMS/sec, locations/sec, etc)
- Growing exploitation of general purpose operating systems and hardware (e.g. Unix) in network elements is likely to gradually un-bundle the pricing of software and hardware

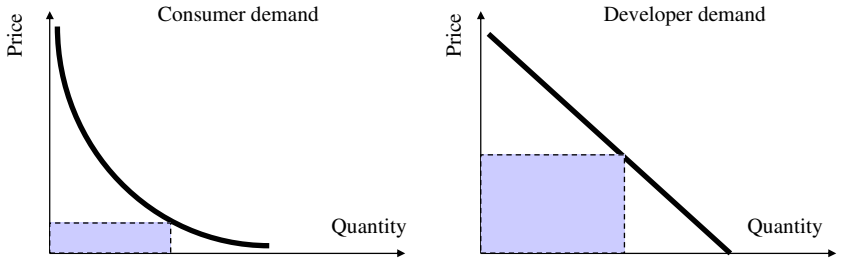
Two-Sided Markets/Platforms (2SP)



- Each side is internally homogeneous
- Sides are non-similar, asymmetric

Source: Parker & Alstyne (2000), Rochet & Tirole (2001)

2SP: Two-Sided Pricing



- Platform manager can exploit cross-effects by setting prices properly
- Platform manager's (and social) welfare can be maximized by subsidizing
  - the more price sensitive side (ref. Netscape)
  - those who add most value to platform (ref. Microsoft)

2SP: One-Sided Fallacies

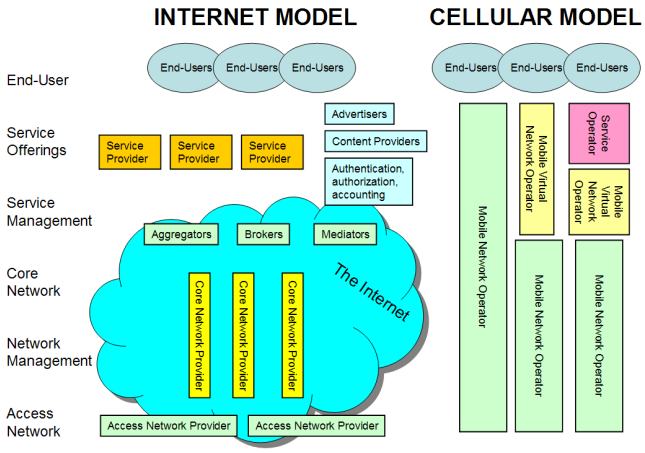
1. An efficient price structure should be set to reflect relative costs (user pays)
2. A high price-cost margin indicates market power
3. A price below marginal cost indicates predation
4. An increase in competition necessarily results in a more efficient structure of prices
5. An increase in competition necessarily results in a more balanced price structure
6. In mature markets (networks) price structures that do not reflect costs are no longer justified
7. Where one side of a two-sided market receives services priced below marginal cost, it must be receiving a cross subsidy from users on the other side
8. Regulating prices set by a platform in a two-sided market is competitively neutral

Source: Wright (2004)

2SP: Empirical Evidence

- It is relatively uncommon for industries based on 2SPs to be monopolies or near-monopolies. Some industries have several large differentiated platforms whilst others have many small platforms that are differentiated by location as well as along other dimensions
- Multi-homing on at least one side is common, indicating that horizontal product differentiation tends to be the norm
- Asymmetric pricing is relatively common – many 2SPs obtain the preponderance of their operating profits (revenues minus costs) from one side of the platform. A nontrivial portion of 2SPs appear to charge prices that are below marginal cost or below zero

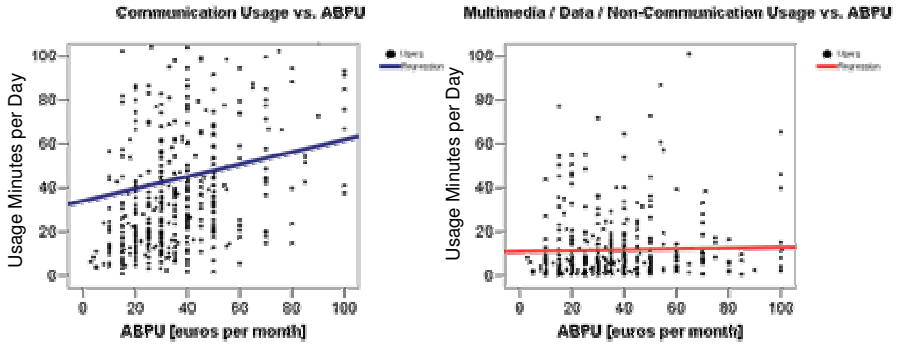
Telecom vs. Internet World



Source: MoMI 2008

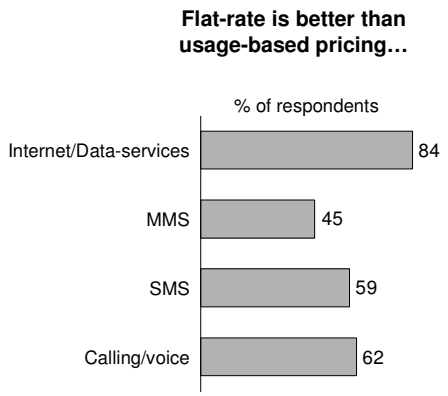
Pricing in the Internet

→ No revenue to operators from Internet and multimedia services



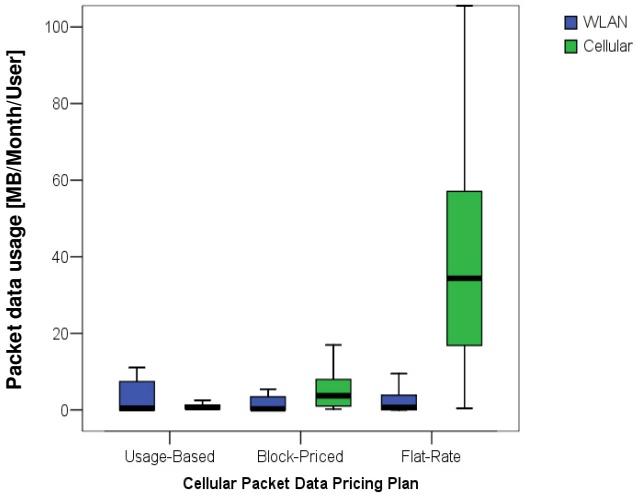
Source: MoMI 2008

Pricing in the Internet



Source: MoMI 2008

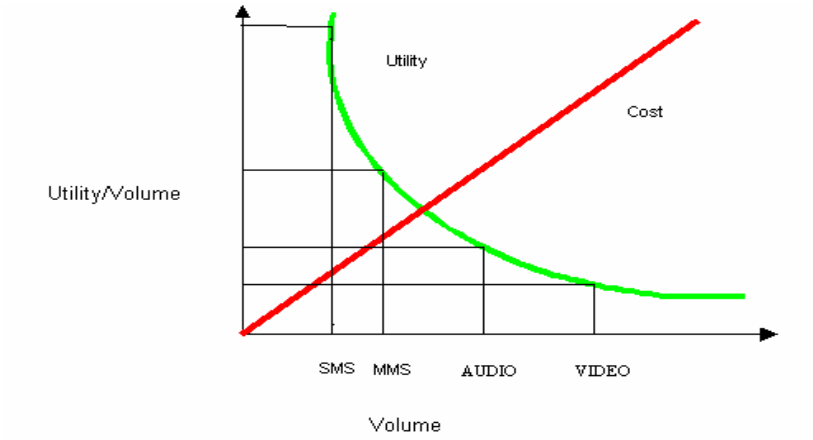
Impact of Pricing on Service Usage



Source: MoMI 2008

Service bundling

Roll-out of new services



- Cross-subsidies enable early roll-out of still non-profitable services
- Operator can also take risk of new handsets via handset subsidies