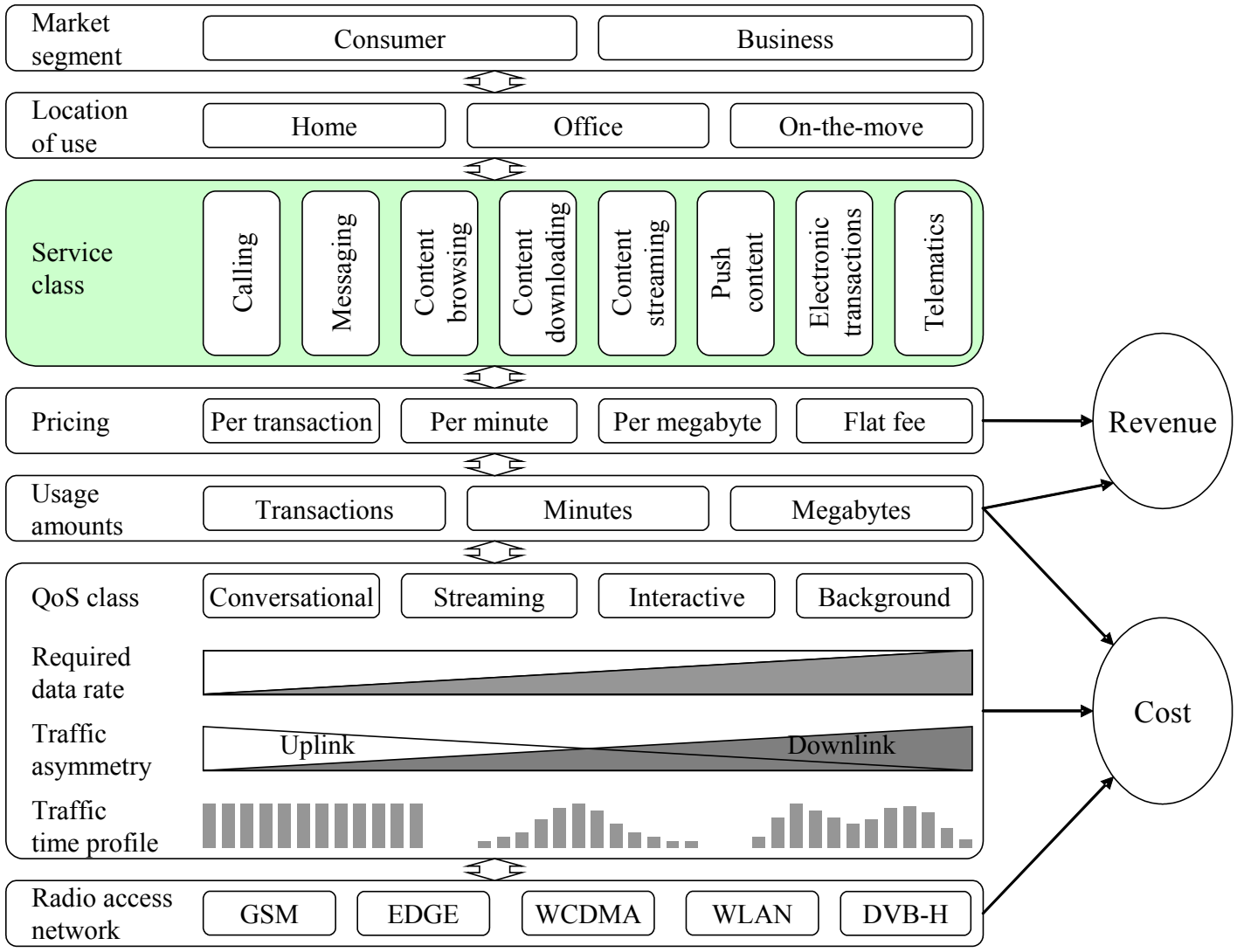
Pricing – part 1

S-38.041 Networking Business

Service Classification

Technical Pricing Parameters of Mobile Services



Source: ECOSYS, 2005

Service Classification

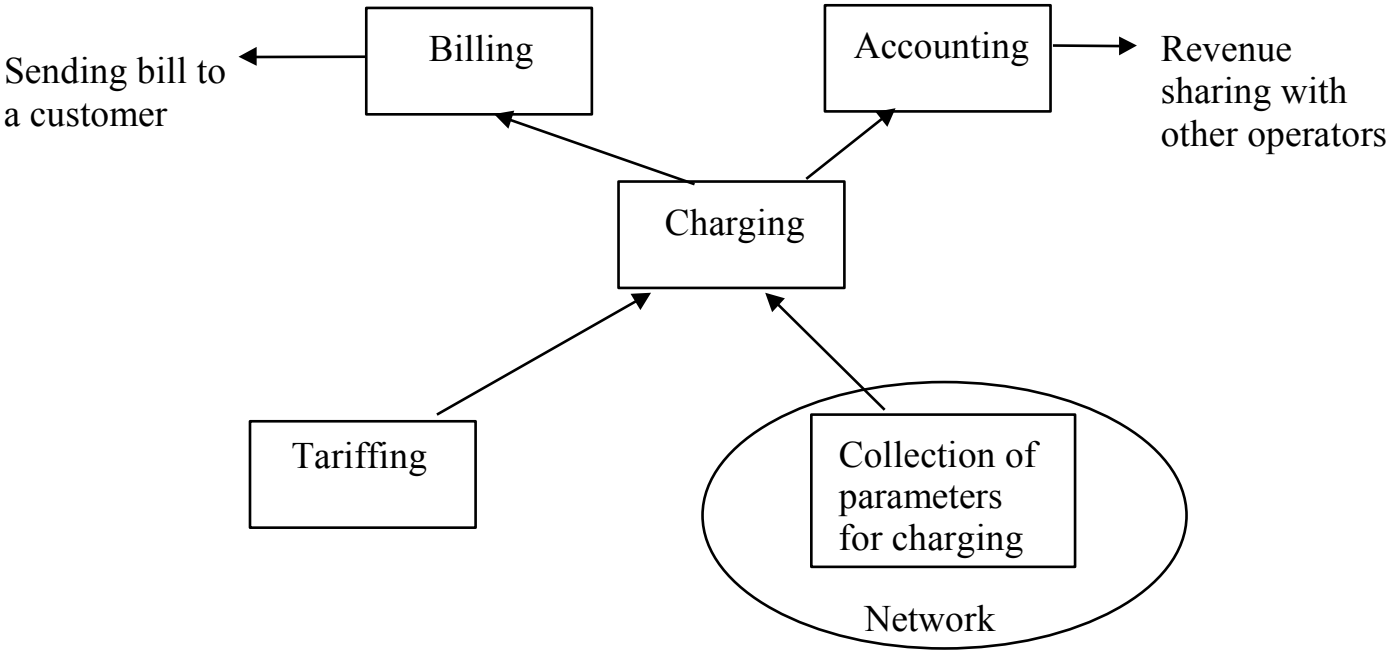
Technical Requirements of Mobile Service Classes

Service class	Calling	Messaging	Gaming	Content browsing	Content / application downloading	Content streaming	Push content	Electronic transactions	Telematics
Examples	Voice calls, video calls, VoIP, push-to-talk	Text messaging, multimedia messaging, e-mail, instant messaging	Person-to-person games, multiplayer games	Intranet, Internet, News, Info, Entertainment	Ringtones, pictures, applications, games, P2P file sharing	Video-on-demand, Audio-on-demand, broadcasting	Advertising, Pre-ordered content	Mobile payments	Vehicles, other machines, PIM and presence information updates
Person/machine interaction									
Person-to-person	x	x	x						
Person-to-machine				x	x	x	x	x	x
Machine-to-machine									x
Traffic QoS type									
Conversational	x		x						
Streaming						x			
Interactive				x				x	x
Background		x			x		x		x
Network requirements									
Radio network									
GSM	x	x							
GPRS		x	x	x	x	x	x	x	x
EDGE									
WCDMA	x	x	x	x	x	x	x	x	x
HSDPA									
WLAN		x	x	x	x	x	x	x	
DVB-H						x			
Network services									
Presence	x	x					x		
Location-based services				x			x		x
Terminal requirements									
Hardware									
Hard disk / memory card			x		x				
Bluetooth			x		x		x	x	x
Still camera		x							x
Video camera	x	x							x
Color display		x	x	x	x	x	x		x
Push-to-talk tangent									
Software									
SMS		x					x	x	x
MMS		x					x		x
WAP browser				x				x	
XHTML browser				x				x	
Java capability			x		x				
Open OS		x	x		x				
IMAP, POP		x							
Media player	x					x			x

Source: ECOSYS, 2005

Tariffing Activities

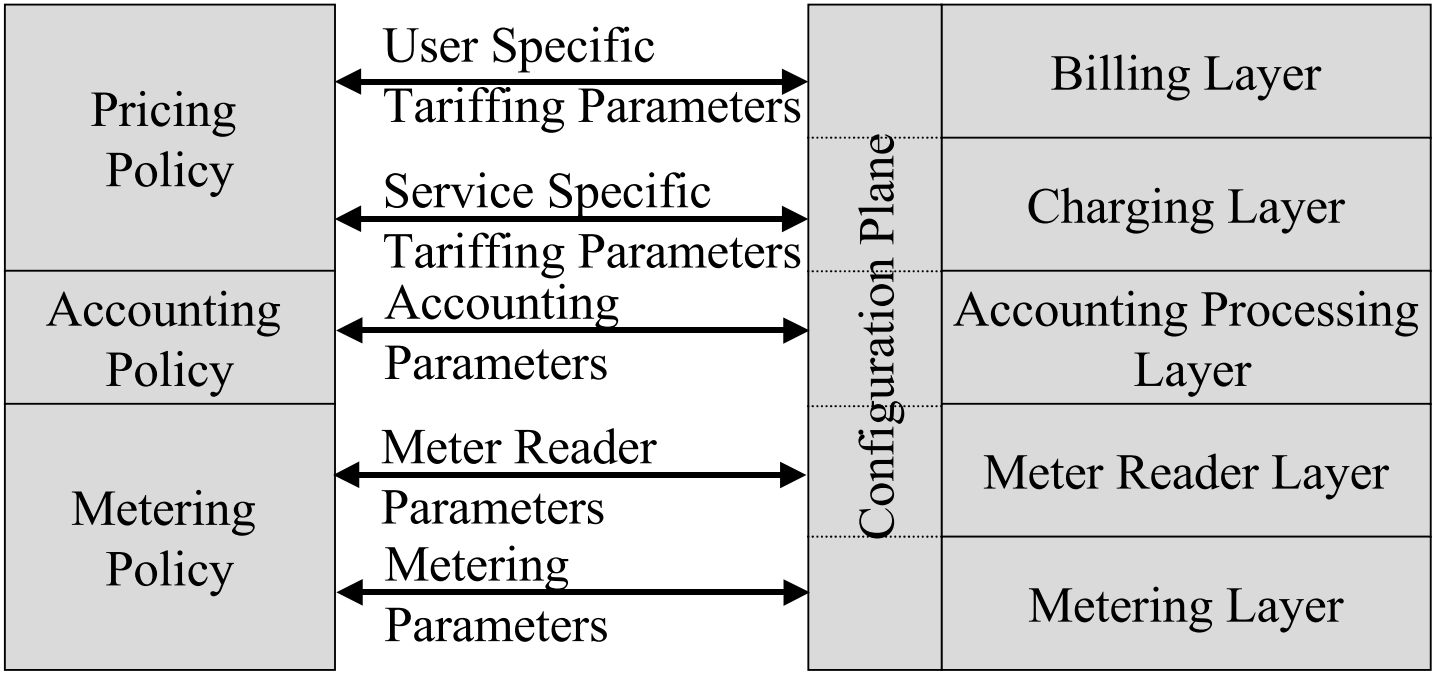
Data Flows



- *Charging* combines the resource usage data with tariffing data

Tariffing Activities

Policies vs. Functional Layers



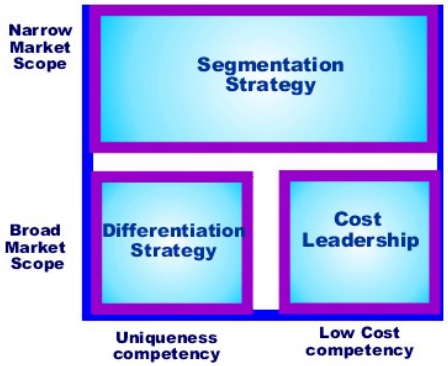
Price setting is a strategic sales activity, while charging and billing are operational engineering.

Price, tariff, and charges

- Customers pay *charges* computed from *tariffs*
- *Price* is a charge associated with one unit of usage
- Telecom tariffs are typically non-linear and two-part
- Two-part tariffs are of the form ***a+bx***
  - *a* is fixed charge (e.g. monthly GPRS access charge)
  - *x* is quantity (e.g. number of GPRS megabytes per month)
  - *b* is unit price (e.g. price per GPRS megabyte)
- Two-part tariff reflects the operator's cost structure, i.e. fixed vs. variable costs
- How to set optimal tariffs?
  - High fixed charge discourages small customers
  - High unit price discourages large customers

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

Competition

- 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!
- *Tatonnement* is the iterative process where the market equilibrium is achieved via price changes (assuming static utility and cost functions)
- Ideal tatonnement rarely happens in the real world because
  - Utility and cost functions evolving too fast in innovative markets
  - Some forms of utility functions defying convergence
  - *Untruthful declarations* (i.e. misleading can be beneficial)
  - Finite capacity constraints causing delay

Pure monopoly

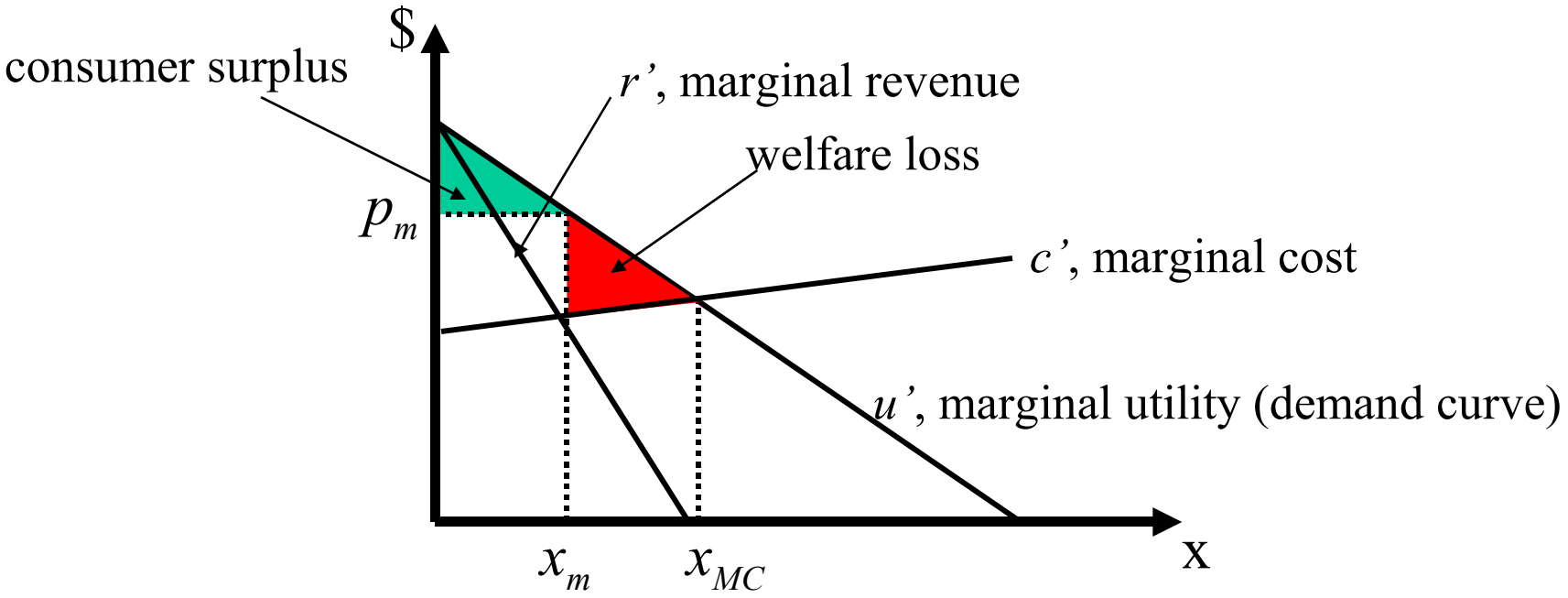
Basics

- Monopoly is a situation where a single supplier controls the quantity of production, and thus also the price
- Monopoly is likely when the market involves
  - demand-side economy of scale, i.e. positive network effects (the average utility per customer increases with larger customer base)
  - supply-side economy of scale (the average cost of production decreases with the quantity of good produced)
  - supply-side economy of scope (the average cost of production decreases with the number of different goods produced)
- *Natural monopoly* is a market consistently showing all the above-mentioned economies of scale
- Mathematically, a cost function for services x and y is said to be subadditive if $c(x+y) \leq c(x)+c(y)$, when all suppliers share the same cost function $c(\cdot)$

Pure monopoly

Profit maximization

- Monopolist's problem: maximize$_p$ [$\Sigma_j p_j x_j(p) - c(x)$]
- Profit is maximized when *marginal revenue* equals *marginal cost*
- Welfare would be maximized if price is set to marginal cost
- Regulator likes to push the price toward *marginal cost*



Pure monopoly

Price discrimination

- First degree price discrimination (i.e. personalized pricing)
  - Operator maximizes profit per customer, $p_i = u_i$
  - Also called perfect price discrimination
  - All customer surplus turns into operator surplus
- Second degree (i.e. versioning, quantity discrimination)
  - Operator posts a set of volume-based prices (i.e. volume discounts)
  - Customer self-selects to maximize surplus
  - Optimal volume pricing holds the following properties
    - The highest demand customer chooses the version of lowest price per unit
    - Monopolist takes all surplus of lowest demand customers
    - The higher demand customers receive an informational rent
- Third degree (i.e. market segmentation, group pricing)
  - Grouping based on pre-selection, e.g. student id card
  - Different price elasticities, $\varepsilon_i = (\Delta x / x_i) / (\Delta p / p_i)$, enable different prices

Pure monopoly

Required conditions for price discrimination

- Producer must have some pricing (monopolistic) power in order to charge differentiated prices. In perfect competition this mark-up pricing (price discrimination) is not possible. However, if there is free entry to new markets, there might be possibilities to expand there with price discrimination even under perfect competition (case international business with locally discriminated prices).

- Producer must have some knowledge on consumer preferences. In the first degree price discrimination we need knowledge on individual customers' willingness to pay. In the second degree price discrimination the consumer's private information is not available but we can indirectly induce different customers to reveal their preferences if we know the different types of customers who really exist. Finally, in the third degree price discrimination we need to have information on the elasticity of demand in different markets or segments.

- Consumers cannot resell/trade commodities. Otherwise e.g. people who paid a low price can resell the commodities to those who would have been willing to pay even more.

Pure monopoly

Service bundling and differentiation

- Bundling involves a service package not priced as a sum of the prices of individual services
  - Bundling sometimes enables perfect price discrimination
  - Bundling reduces dispersion in willingness to pay and thus enables greater revenue
- Operator can segment the market via service differentiation
  - Versions of service must not substitute each other (e.g. QoS)
  - Operator must prevent harmful reselling (comp. wholesale vs. retail)
  - Operator may not be able to price discriminate based on content
    - Operator not allowed to read user-created content
    - Technology-based differentiation difficult (e.g. IP vs. SMS)
    - Operator's charging can be by-passed (e.g. credit cards)

Perfect competition

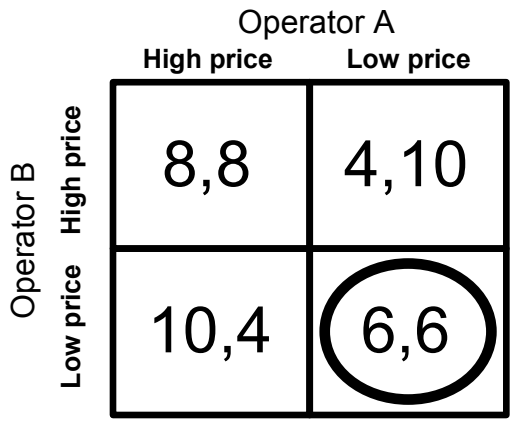
- Regulator may not be satisfied even on a welfare maximizing monopoly since innovation requires competition
- Under perfect competition
  - operators participate if, $py^* \geq F + c_v(y^*)$, where y^* is the optimal service volume and F is fixed cost
  - *market clearance*, i.e. demand = supply, maximizes social surplus
  - operators experience zero *economic profit* in the long-run (*business profit* can be positive)
- Perfect competition may not be achieved due to
  - non-identical service offerings
  - limited visibility to prices of other players
  - high switching cost paid by customers for changing operators
- An example of high switching cost is the change of a phone number, which the regulator often solves via number portability

Oligopoly

- Oligopoly is typical in telecommunications: a partly competitive and partly regulated market with a small number of operators
- Operator oligopoly can be seen as a game-theoretic set-up between operators, customers, and the regulator
- Game concepts: zero-sum game, Nash equilibrium, public goods, free rider problem, cartel, one-shot vs. repeated games
- Game models for a small number of operators
  - Cournot (quantities posted, prices adjust, all sold)
  - Bertrand (prices posted, quantities adjusted by customers)
  - Stackelberg (for duopoly, either price or quantity leadership)

Game theory

- Game theory is a stream of research focusing on games in oligopoly situations. You can analytically model what would be the best action in response to your competitor's action. Given that the other party can expect the other party to be rational, there exist equilibrium states. See e.g. Nash (1950).
- **Nash Equilibrium** definition: If there is a set of strategies with the property that no player can benefit by changing her strategy while the other players keep their strategies unchanged, then that set of strategies and the corresponding payoffs constitute the Nash Equilibrium.
- Example: Finnish mobile operator game in voice subscriptions (assumptions: very important service, guaranteed minimum consumption on the market, no demand for differentiated or high-quality services, tough price competition → low margins, people buy the cheapest plan)
- Only one Nash equilibrium: Both choose the low price strategy (low price strategy dominates the high price strategy)
- In the top left hand corner both operators have an incentive to change to the low price strategy, because then they would acquire more customers and private revenue (for some time). This is why the low price strategy dominates.
- This is the case although if both set co-operatively (contractually not legal) high prices, the total producer revenue would be higher and they would share the revenue equally!



Numbers represent imaginary (not based on empirical data) profits of the operators with different sets of pricing strategies.

Cost-based pricing

Motivation

- Marginal cost pricing maximizes consumer surplus but causes problems to operators
  - Exclusion of fixed costs
  - Prices difficult to compute
  - Prices can be close to zero or infinity
- Operator's cost recovery can be supported by weighting the social surplus function in favour of operators (Ramsay pricing)
- Two-part tariffs support the two aspects of cost recovery: fixed vs. variable costs, short vs. long-term
- Burden of fixed costs can also be reduced by cutting capacity via peak-load pricing
  - Traffic load is moved from busy hour to other time periods
  - Traffic loss vs. capacity savings?

Cost-based pricing

”Fair” prices

- Cost-based pricing assumes that costs are shared in a ”fair” way among customers
  - *sustainable prices* reflect actual costs and discourage inefficient ’hit-and-run’ competition
  - *subsidy-free prices* reduce churn of subsidizing customers
- Conditions for subsidy-free pricing are
  - charge made to any subset T of customers N is no more than the stand-alone cost of providing services to those customers

    $$\sum_{j \in T} c_j \leq c(T), \text{ for all } T \subseteq N$$

  - charge made to any subset of customers is at least the incremental cost of providing services to those customers

    $$\sum_{j \in T} c_j \geq c(N) - c(N \backslash T), \text{ for all } T \subseteq N$$

  - assuming a set of n customers $N = \{1,2...,n\}$, subadditive cost function, charges c_j, cost recovery $\sum_{j \in N} c_j = c(N)$

Cost-based pricing

Implemention issues

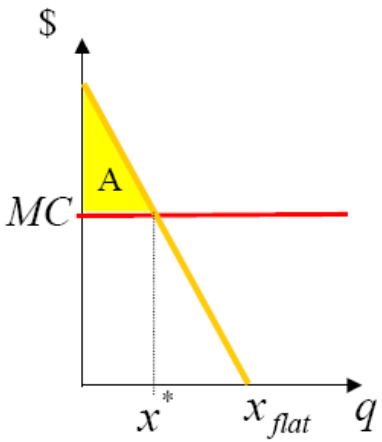
- Problem of knowing the real costs per service
  - Future is often less known than history (plus accounting delays)
  - Cost structures keep changing because of technology evolution
  - Common costs dominate
- Solutions for allocating costs to services
  - Top-down approaches (based on historic costs)
    - Fully Distributed Costs, FDC (flat, coefficients, ad hoc?)
    - Activity-Based Costing (e.g. hierarchical process)
  - Bottom-up approaches (based on current costs)
    - Efficient Component Pricing Rule, ECPR
    - Long-Run Incremental Cost, LRIC(+)
- LRIC+ is complex, but favored by regulators because of subsidy-free prices, legacy-free costs, and the right competitive signals to the market (fairness toward incumbents?)

Flat-rate pricing

- Price is set a priori, but the real cost can only be known a posteriori, e.g. broadband Internet access
- Pros
  - Simple and cheap to implement for operators
  - Predictable to customers
- Cons
  - High social cost because of waste of resources (obs. cost savings!)
  - Unfair because of subsidies (only if customers know and care!)
- How to improve flat-rate?
  - Divide flat-rates in intervals, e.g. ADSL with multiple speeds
  - Add usage-based tariff for extra usage, e.g. GPRS block pricing

Waste in flat-rate pricing

- Flat-rate pricing is used a lot nowadays. Consumers think it is flexible. From the social welfare point of view, what is the problem then?



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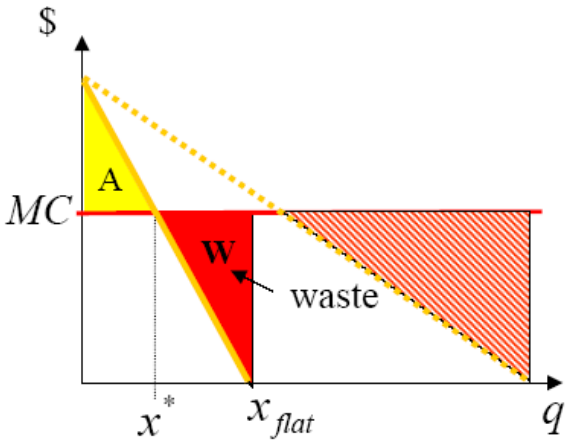


Flat price (p=0)

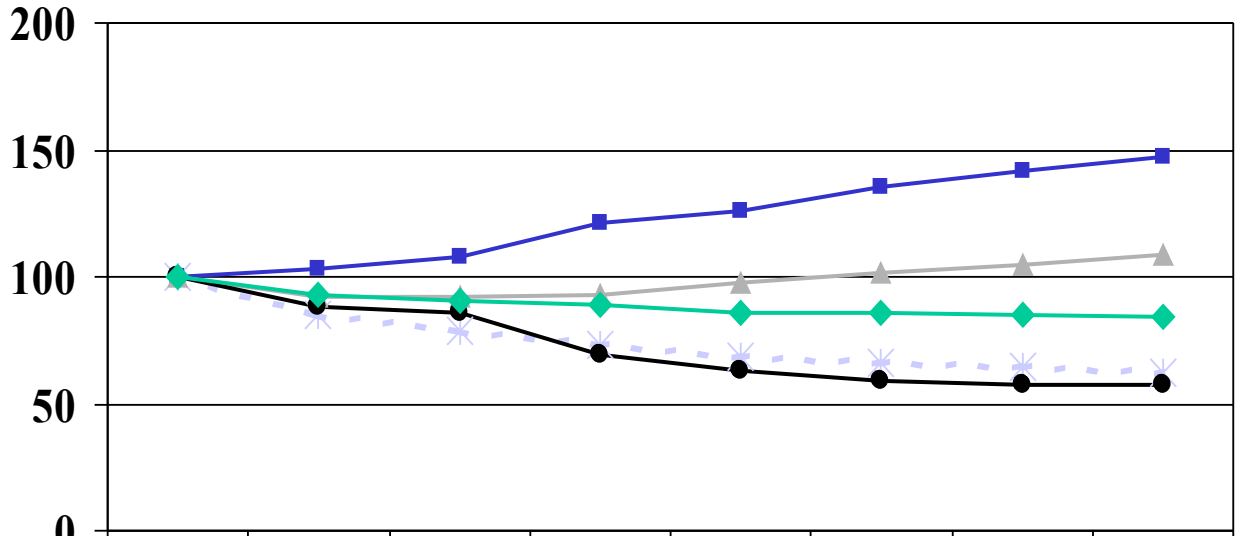
- Consumers observe the marginal price (p=0) → They consume too much → For the producer there must be some variable cost of producing the commodity → Total surplus will reduce by the amount W.
- What if we fix the flat rate based on an average consumer, so that we could cover the cost of producing the commodity? The problem here is that the people who want to consume a lower amount of service don't participate at all, and the average price goes up and up. In the end of the day only the high-consuming consumers participate → Smaller base of consumers, total revenue is lower.

  (Courcoubetis and Weber 2003)

Access vs. backbone transport

- Tough competition in backbone
  - Capacity-based wholesale pricing dominates
  - Service differentiation difficult
  - Prices close to marginal cost due to competition
  - Marginal cost of new traffic getting close to zero because the excess fiber capacity becomes sunk cost
- Monopolies and oligopolistic competition in access
  - Operators capable of bundling and differentiating
  - Evolving technology maintains dynamics in pricing
  - Regulators pushing cost-based pricing and LRIC+

Price impact of competition



	1995	1996	1997	1998	1999	2000	2001	2002
Mobile calls	100	85,3	78,8	73,4	68,4	66,1	64,2	62
Local services	100	103,5	108,2	121,1	126,1	135,5	141,8	147,6
Long-distance calls	100	92,4	92,1	92,8	97,5	101,3	105	108,8
International calls	100	87,8	86,1	69,4	62,8	59	57,7	57,7
Total	100	93	90,7	88,7	85,8	85,6	85,2	84,6

Source: Ministry of Transport and Communications/Price level of the Finnish telecommunications charges 2002, 15/2003

Willingness to pay per bit

	Volume or bit rate	Acceptable price	Value (€/Mbyte)
SMS	160 bytes	0.16 €/message	1000
Voice	16 kbit/s	0.12 €/min	1
Movie	2 Mbit/s	0.9 €/h	0.001

There are 6 orders of magnitude differences in willingness to pay for existing services! How to maintain the value of service differentiation? E.g. mobile instant messaging might leverage on the flat-rate packet data plans and substitute SMS. Similarly, VoIP might substitute circuit-switched voice at home locations etc.

Pricing in practice?

Systematic use of pricing theory?

OR

Artistic reactive innovation by trial and error?

Yes, both, continuously!