Charging *ATM* Services: Introduction

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Why Charge for Telecommunication Services ?

- In order for the Network (or Service) Provider to:
  - Recover costs
  - Make profits and save capital for future expansion
  - Control the system:
    – examples: charging of applications for admission to U.S. universities
    charging for street-parking in Athens
  - Obtain information from users:
    – examples: special long-distance call packages in U.S.A.
    => their adoption is indicative of user's *future* behavior

Terminology

- Price:
  - money paid per unit
    – example: Drachmas/sec, EUROs/Mbyte, $/call

- Charge:
  - total payment for the service, determined on the basis of prices
    – example: amount of money paid in a restaurant, determined on the basis of the prices of portions

- Tariff:
  - parameterised class of formulae for determining charges
    – example: Athens taxis have 2 tariffs

Terminology (continued)

- Accounting:
  - the gathering of all information necessary to
    – compute the charge of a service
    – attribute the charge to the customer liable to pay

- Billing:
  - the procedures associated with issuing and delivering the bill of a customer of telecommunication services

- B-ISDN and ATM will be treated as synonyms, although:
  - B-ISDN (Broadband - Integrated Digital Services Network) is a class of *networks*, while
  - ATM (Asynchronous Transfer Mode) is the *technology* adopted to offer B-ISDN services

Types of Charge

- There a four types of charge:
  - Fixed charge
  - Usage charge
  - Congestion charge
  - Quality charge

- A charge of a telecommunication service constitutes a combination of the above components, which may overlap

Fixed Charge

- Is independent of *usage*

- Examples:
  - monthly subscription to a telephone service
  - membership fee to a private club

- Some services charged exclusively on fixed charges:
  - examples: all-you-can-eat restaurants
    - monthly flat rate charging of Internet access

Usage Charge

- Depends on the amount of *resources used*

- Examples:
  - telephony is charged on time and distance
  - a fish portion in a restaurant is charged proportionally to the weight of fish

- Theoretically, in a competitive enviroment:
  - usage charge = cost of additional resources required to offer the additional instance of service

- *Difficulty*: Define and measure parameters that reflect resource usage => to be used as *charging* parameters
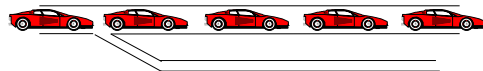
Congestion Charge

- Depends on congestion *during* service

- Applies to cases where:
  - there is *infinite* capacity => everyone can be served, but
  - congestion results in service quality *degradation*

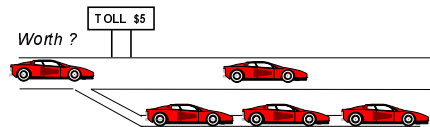- Example: Charging access to highways, bridges etc.

Congestion Charge (continued)

- *Free* access => traffic in highway is *heavy*

- *Paid* Access => traffic in highway is *lighter*

TOLL $5

Worth ?

Congestion Charge (continued)

- Congestion charge influences users' *demand*, according to their *utilities* => Should not be:
  - very *high* => leads to *under*-demand
  - very *low* => leads to *over*-demand

- Theoretically:
  - congestion charge = social cost of serving the additional user, due to the congestion caused
  - may be *irrelevant* to actual costs

- Hard to *define* and measure *on-line* => Can be *approximated*:
  - a priori congestion charge => example: highway toll
 - time-of-use charge => example: *time-of-day* pricing of telephony

Quality Charge

- Differentiates instances of a service with different quality

- Often included in usage charge

- Examples:
  - overnight and first-class delivery by Post
  - luxurious restaurants
  - collective items

Charge as Control Mechanism

- Charges can be used as an *internal control* mechanism of the system provider-users to reach the social optimum

- Example:
  - Network Provider sells bandwidth at the equilibrium price *p* per kbps, determined by *demand = supply*
  - *given* this price, each user *i* selects amount x_i of kbps purchased
  - provider pays for capacity with the revenue collected
  - equilibrium price *p* also leads to social optimum
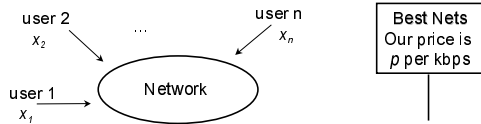
Capacity Expansion

- A network provider should expand capacity when:
  - congestion arises
  - social welfare can be further increased, *despite* the cost for additional capacity

- Economic theory suggests that expansion can be funded by re-investing the revenue from *congestion* charges
  - example: highways with tolls
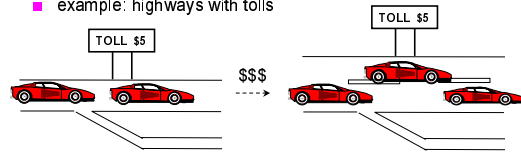
Incentives

- A charging scheme influences users' *demand* and behavior, according to the *incentives* it offers to the user, regarding how to maximise his *own utility* (benefit from service *vs* charge)

- Each individual user's behavior influences the *global* well-being (social welfare) of the society (users and network)

- A charging scheme is *incentive compatible* if individual user utility optimisation *also* results in social welfare optimisation

Examples of *Wrong* Incentives

- Free use of Internet:
  - *congestion* everywhere

- Sole monthly flat charge for Internet access (U.S.A.):
  - *blocking:* connections with modems were left permanently open

- Free night use of mobile telephones (U.K.):
  - *blocking:* telephones were left open for long hours

- All-you-can-eat restaurants:
  - food quality *drops:* higher costs encountered because customers tend to take larger portions

Examples of *Right* Incentives

- Usage-based charging of Internet:
  - considered as the *only* way to avoid congestion

- Time-of-day charging in telephony:
  - shifting of non-business calls off peak period
  - satisfaction of both business and non-business users

- Special tariffs offered by Mobile Operators: for business users, for users calling mostly within city etc.

- The above charging schemes are *incentive compatible* and result in more efficient operation of the network

Incentive Compatibility (revisited)

- In *competitive* environments: a provider should aim for incentive compatible charging

- Otherwise, users would migrate to a competitor who
  - charges according to an incentive compatible scheme
  - leads to a *more* satisfied (as a whole) user society

Factors Determining Charges of Telec. Services

- Cost to Provider

- Market Issues and Marketing Decisions

- Regulatory Constraints

- Technological Issues

Costs

- A network provider faces costs for:
  - equipment and software
  - operation, management, and maintainance
    - include accounting and billing costs, which may (but should *not*) be *high*:
    - were 6.5% of AT&T revenue in 1984
  - labor

- The level of costs in telecommunication environments is highly uncertain

Costs per Call - Relation to Charges

- For each call, costs are incurred for:
  - set-up of call
  - transmission of information
  - switching of information

- It is hard to accurately estimate the cost of individual calls, due to the complexity of the system

- Under perfect competition charges should reflect costs
  - hard to achieve accurately, even with elaborate cost models

Market and Marketing

- Charging schemes and charges depend on:
  - users' demand
  - competition
  - complementary and/or substitute services offered:
    - by the *same* provider
    - by *other* providers
    - distinction *not* always clear
    - example: ATM *or* Internet ?
      or both ?

WWW	*content* provider
Internet	*service* provider
ATM	*network* provider

  value chain
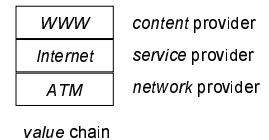
  - strategy on resale

Other Factors Determining Charges

- Regulatory constraints

- Technological issues determine
  - service supply
    - types
    - quantity
    - quality
    - service mix offered
  - costs
  - resource usage parameters
  - feasiblity and cost of accounting

User Requirements on Charging Schemes

- According to market surveys (for *ATM* services), users *prefer* charging schemes that :
  - are simple - example: flat rate charging
  - are fair => pay *less* when using the service *less*
  - are predictable - *counter*example: charges depending on network state
  - reflect some measurable notion of *usage*
    - same *usage* at same time=> same *charge*
  - lead to simple and *auditable* bills

- Users do *not* like congestion-based charging, particularly if charges vary without *warning*

Advantages of Usage-based Charging

- Appealing to *users*

- Can offer the right *incentives*, and lead to an *efficiently* operating network
  - the incentives should be *explained* to users
    - example: flat rate vs usage-based charging of local telephones (USA)

- Can also charge for congestion in a sensible way
  - example: time-of-day pricing of telephony

- Usage charges can reflect *costs* better than flat-rate

- Economic theory suggests that usage-based charging be employed under *perfect competition*
  - otherwise, users can switch provider !

Difficulties with Usage-based Charging

- *Definition* of resource usage *not* always clear
  - examples:
    - *telephony*: call duration and distance
    - *leased lines*: bandwidth and distance
    - *ATM*: ?
    - *postage service*: letters charged on *weight* big objects also charged on *volume*

- *Measurement* of (theoretical) resource usage can be:
  - technologically hard (or even infeasible)
  - costly
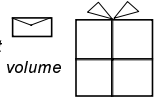
Why is ATM *Hard* to Charge ?

- A large variety of combinations of *parameterised* bearer services should be charged under a *unified* framework

- It is hard to define and measure *resource usage* due to:
  - its dependence on QoS
  - statistical multiplexing
  - burstiness of traffic

- It is hard to quantify and apportion *costs*, due to:
  - sophisticated technology
  - statistical multiplexing

Why is ATM *Hard* to Charge ?

- Users can select from different ATM bearer services
  - Market should be *segmented* appropriately

- ATM is a *new* service:
  - ➡ it is hard to predict *user* response to charges

- ▼ Complex and/or costly charging of ATM may *impede* its market penetration and growth

Concluding Remarks

- What is needed for charging ATM successfully ?
  - Understand *all* sides
  - Respect *complexity*, *technology*, and *us rs*
  - Comply with *s   d rds*
  - Compromise between   *ur*   and *s*

- What should we avoid ?
  - Do charging ad-hoc
  - A prohibitive accounting cost
  - Ignore incentives
  - Consider that charging is only a marketing issue
  - Think of charging as being independent of the technology
  - Add the charging component in the last minute