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Service Differentiation

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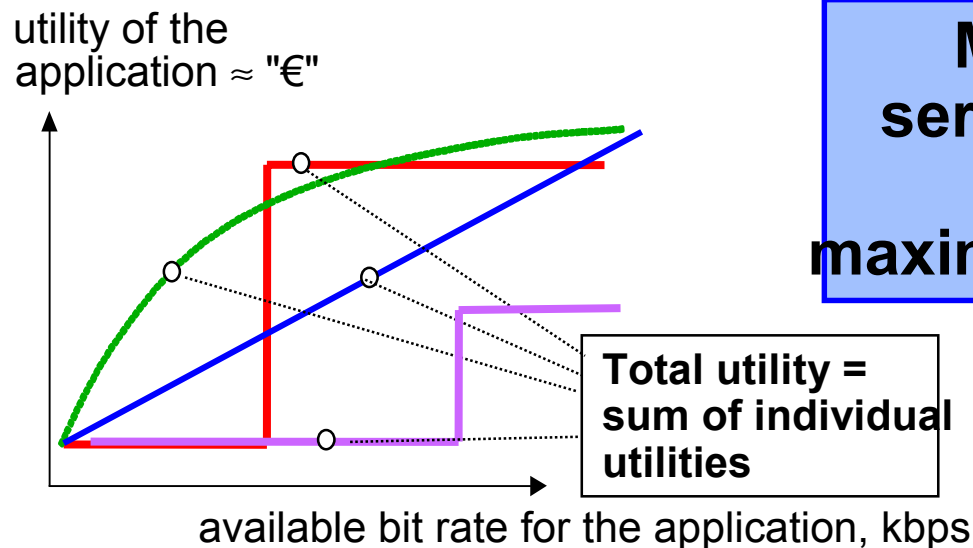
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Contents

- Normal opinions about Quality of Service
    - Guarantees
    - Treatment of packets

- Critical review

- Consequences
    - How to design feasible services differentiation

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Normal Opinions about QoS

- A service with formal QoS with hard guarantees
  is better than
  a service with loose QoS with soft (or no)
  guarantees

- Packets with tighter QoS requirements
  should be treated better than
  packets with looser QoS requirements

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Hard or Soft Guarantees

- Background
  - there are different application types with totally different utility functions (voice, video, web, messaging)
    - utility is a measure of the usefulness of the service and/or user satisfaction

utility of the
application ≈ "€"

available bit rate for the application, kbps

**Total utility =
sum of individual
utilities**

**Main objective of
service differentiation
=
maximisation of total utility**

- Which one, hard or soft, is better from utility perpective?

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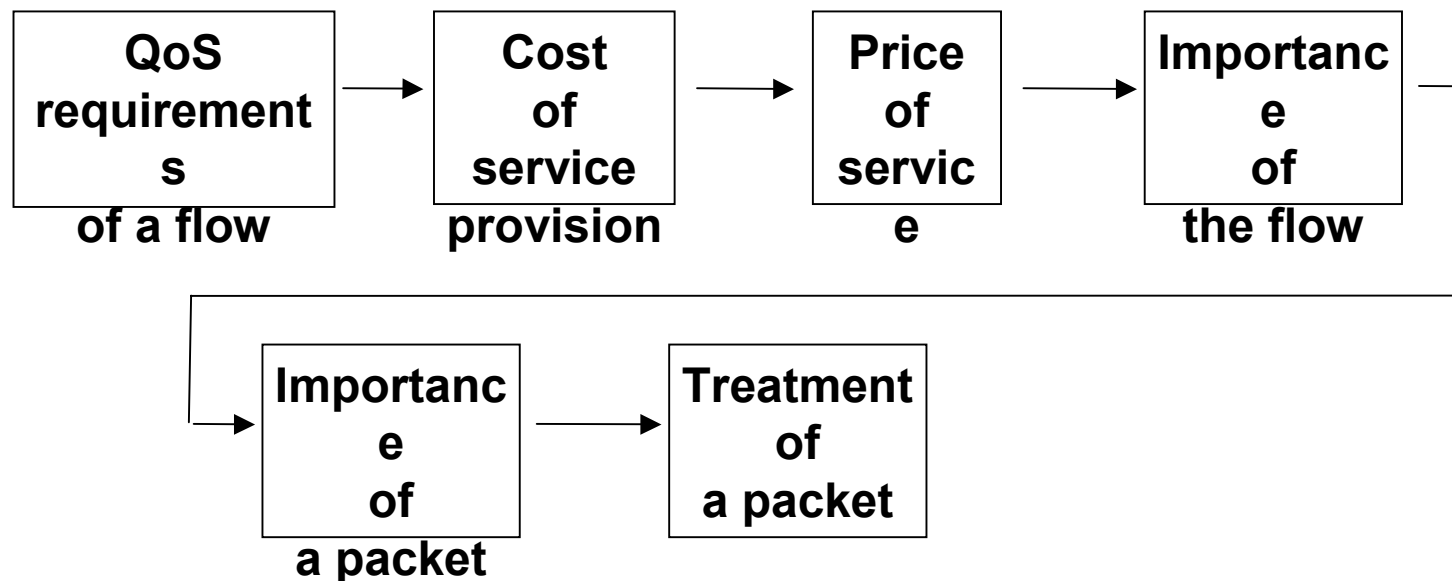# Reservation (hard) vs. Sharing (soft)
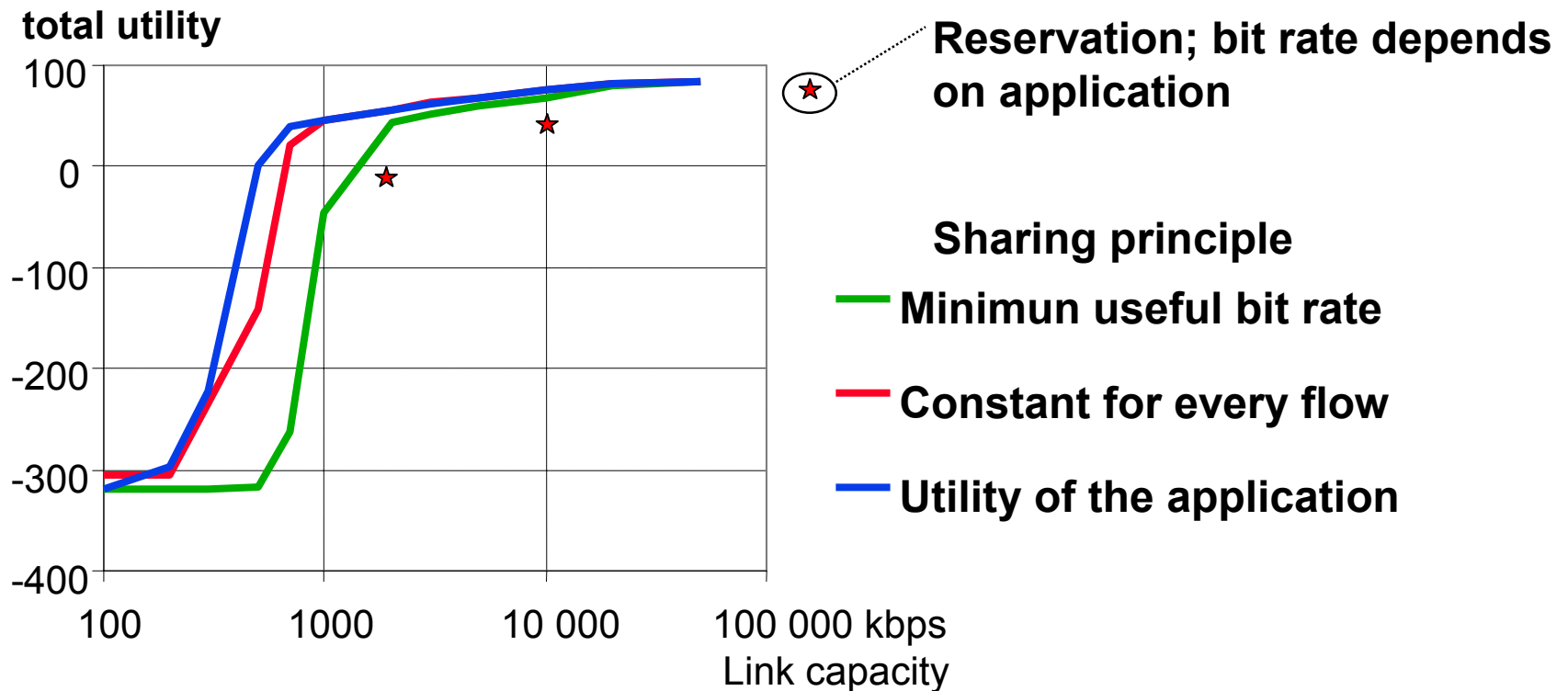
- **Statement**
  - with adaptive applications, for given total capacity the overall utility will be higher when resources are shared rather than reserved
    ⇒ with typical Internet applications soft guarantees generate higher utility than hard guarantees

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QoS Requirement vs. Treatment of Packet

- Conventional way of thinking
  - QoS requirement should dictate the treatment of the packet inside the network: higher QoS requirement => better treatment
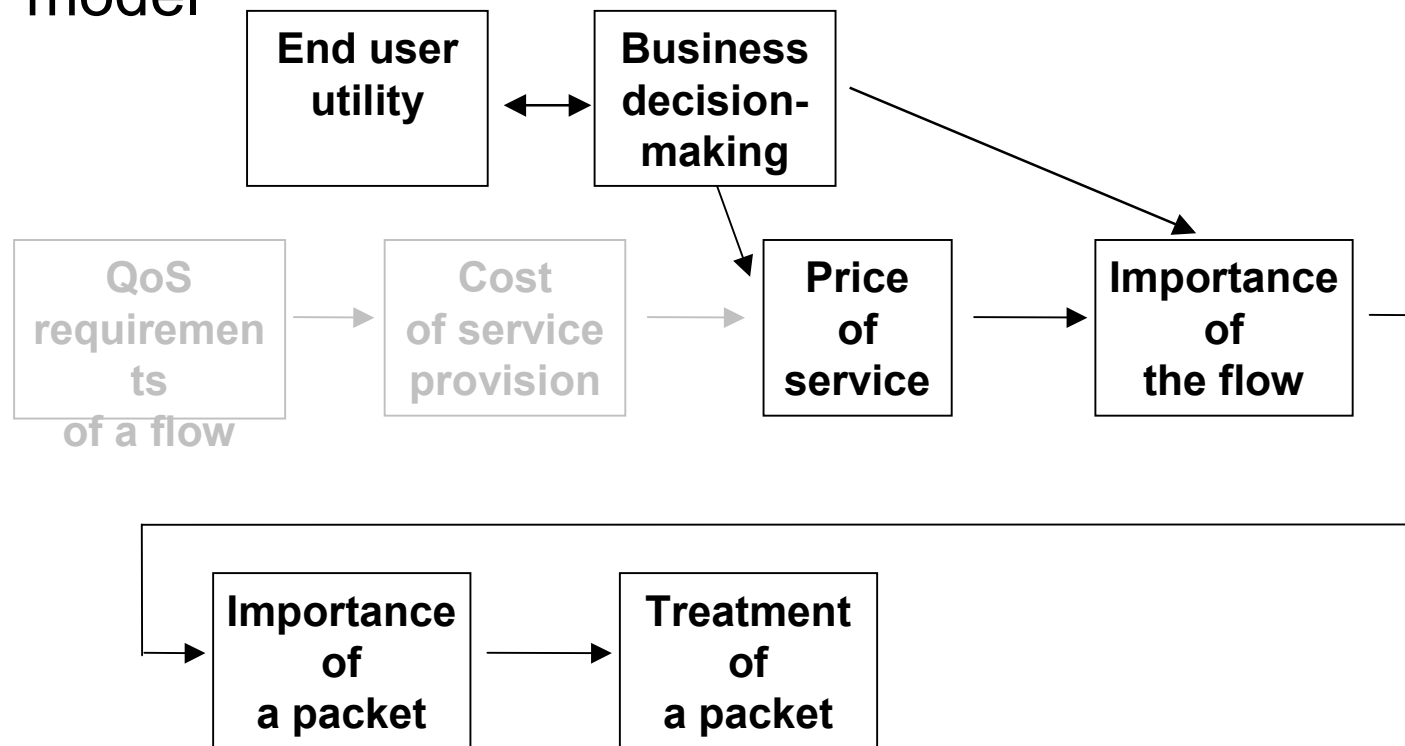
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┌──────────────┐   ┌──────────┐   ┌──────────┐   ┌──────────────┐
│     QoS      │──▶│   Cost   │──▶│  Price   │──▶│ Importanc    │
│ requirement  │   │    of    │   │    of    │   │      e       │
│      s       │   │ service  │   │  servic  │   │     of       │
└──────────────┘   └──────────┘   └──────────┘   └──────────────┘
  of a flow         provision          e            the flow

       ┌──────────────┐   ┌──────────────┐
       │ Importanc    │──▶│  Treatment   │
       │      e       │   │      of      │
       │     of       │   │   a packet   │
       └──────────────┘   └──────────────┘
         a packet
```

- However, this model produces poor total utility because it does not take into account the utility of the flow at all

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Example of Utility Differences

- Short Message Service
  - price paid by customers = 1 € per kbyte

- If a 2 Mbps, 2 h video were transmitted by the same price per bit
  the result would be 1 800 000 €
  - that is, million times more than customers likely are ready to pay

- This is much more important issue from service provision viewpoint than the fact that the QoS requirements of video distribution are more stringent that those of SMS
  - short messages can tolerate packet losses and delay, but still they are much more valuable for customers and network operators than video packets

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Business vs. Treatment of Packets

- Better model

End user utility	↔	**Business decision-making**

QoS requirements of a flow	→	Cost of service provision	→	**Price of service**	→	**Importance of the flow**

Importance of a packet	→	**Treatment of a packet**

- End user utility and/or business model of the operator shall dictate the treatment of the packet inside the network:
  higher utility per packet => better treatment

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Realization of Service Differentiation "DiffServ Style"

- Access node marks packet into two scales
  - Urgency
    - based on the delay requirement of the application
    - 2 or 3 levels
  - Importance
    - relative utility per packet (from end user and/or operator viewpoint)
    - $\geq$ 6 levels in order to achieve sufficient dynamics

- Core nodes
  - utilize the urgency and importance marking to share the resources in optimal way
  - one buffer per urgency level
  - packets are discarded according to importance marking
    - but only when necessary

- Maximization of total utility

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Conclusions

- Feasible Service Differentiation
  - Soft is often better than hard guarantee, particularly with adaptive applications
  - Packet treatment shall depend on the end-user utility rather than QoS of application

- A simple realisation is available
  - based on DiffServ packet marking
    - rather than resource reservation
  - supports the service provider business by maximising the total utility

  - More about the topic
    - Kalevi Kilkki: "*Differentiated Services for the Internet*", Macmillan Publishing Company, June 1999

MACMILLAN TECHNOLOGY SERIES

DIFFERENTIATED SERVICES FOR THE INTERNET

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