Charging for ATM-based IP Multicast Services

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Overview

- State of the Art in Charging and Accounting
  - Charging Aspects: customer, economic, technical
  - Charging schemes
  - Price discrimination for different service classes
- Reliability and Error Control
  - Error control for layered video services
  - Charging and error control
- Layered video for IP multicast over ATM
  - Separate vs. tagged video streams
  - Cost and utility functions
- Conclusions

Charging Aspects

- Customer aspects
  - cost-awareness (-> user interface for cost/quality)
  - cost related to goodput
- Economic aspects
  - Differentiate between different service types and QoS levels
- Technical aspects
  - Minimize overhead for charging
  - Cell-based charging for ATM services computationally demanding

Charging Schemes

- Usage-based charging
  - \+ Measurements allow QoS-sensitive fair charging
  - \- Measurements may impose significant overhead
- Smart Market Model [MacKie-Mason and Varian ‘94]

  Monetary value attached to each packet

  cost related to goodput
- Priority-based Schemes [Cocchi, Estrin, Shenker, Zhang ‘93]

  Different priorities determine BW and delay properties
- Expected Capacity Allocation [Clark ‘95]

  In/out tagged packets according to traffic contract

Price Discrimination for Different ATM Service Classes

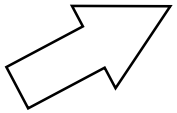
ATM pricing proposal by Walker, Kelly, and Solomon:

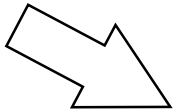
Example name	Traffic contract differentiated ATM streams for Premium IP	Traffic Description/ Traffic Contract Parameters	Possible use	Indicative order of magnitude for core ATM network charge
Gold	rt-VBR	PCR, SCR, MBS CLR, Delay/Variance requirements	interactive video & voice	$0.2 per Mbit for reserved bandwidth
Silver	nrt-VBR	PCR, SCR, MBS, CLR, Delay/Variance requirements	voice & video messaging & retrieval,	$0.05 per Mbit for delivered volume
Bronze	UBR	PCR	video distribution, low cost voice, IP traffic	$0.002 per Mbit for used volume.

Walker, F.P. Kelly, J. Solomon,
”Tariffing in the New IP/ATM Environment”,
Telecommunications Policy, Volume 21 (1997), pp. 283-295, May 1997

Reliability versus Cost

ATM &
IP Integrated
Services
vs.
IP Differentiated
Services





- **Reservation** for connections/flows
  => high QoS, high cost network service
  => Charging per connection/flow:
  complex and costly

- ***No*** reservation (potentially multiple service classes)
  => best effort (low QoS), *low-cost* network service
  => needs powerful transport-layer error control
  => charging may be simpler (e.g., aggregate volume in service class),
  but: how to ensure fairness (unnecessary redundancy / retransmissions, local retransmissions)

Key Concepts for Audio/Video Services

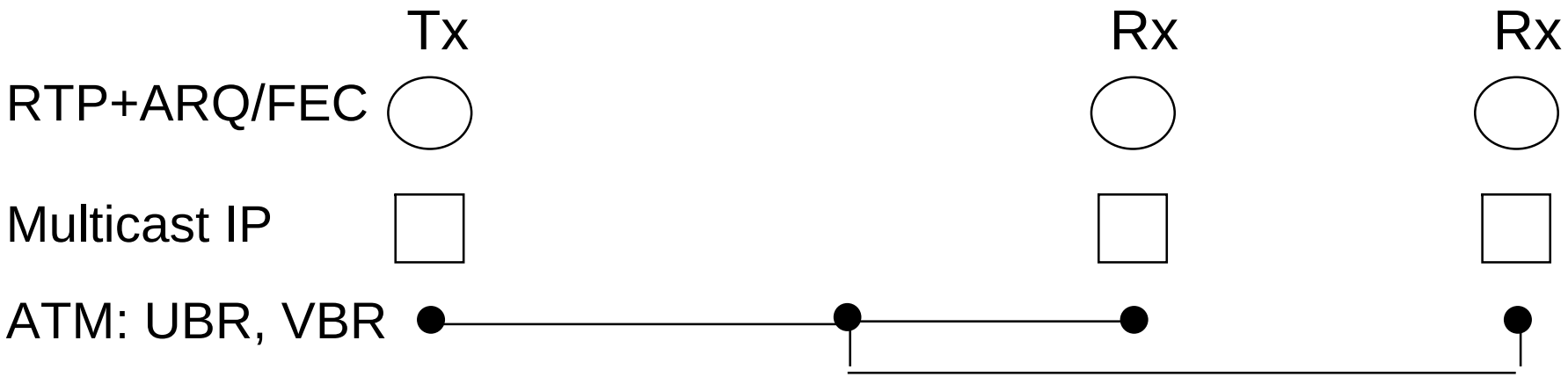
- Guaranteed QoS A/V services with reservation
  - Heterogeneous Network: IP/RSVP (IntServ)
  - End-to-End ATM connectivity: Native ATM service

  => expensive
- Low-cost shared bandwidth A/V services
  - Best-effort IP service + RTP with error control enhancing reliability, e.g. use 10 s delay budget to get 20% loss probability down to 2%
  - Increased Quality with high-priority retransmissions

Challenge: Charging for ATM-based Multicast IP

Scenario:

- Video Service, coding scheme supports layering (MPEG, Wavelet)
- Multicast (heterogeneous RTT, loss rate, processing capability)
- IP over ATM
- low-cost low-QoS NW services
- Transport layer with RTP+ARQ/FEC for QoS enhancement
- Multiple ATM service classes with different cost: UBR, VBR
- Multiple service providers in a single layer



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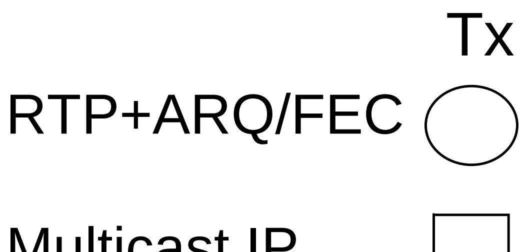

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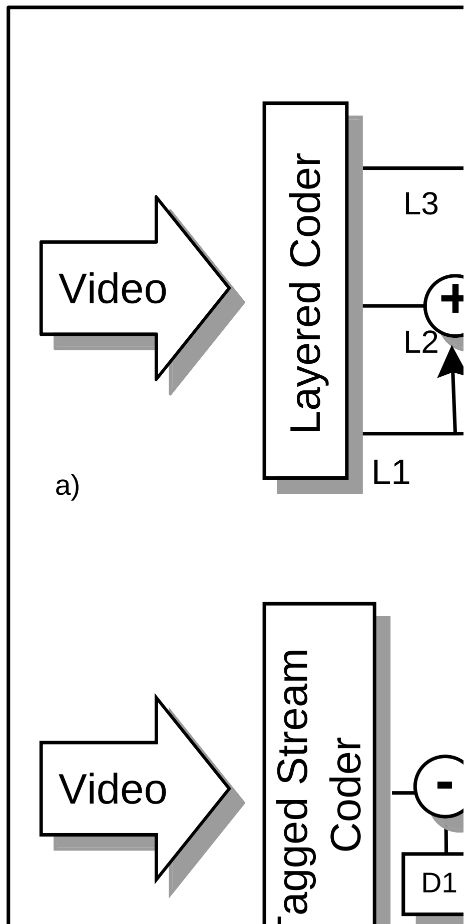
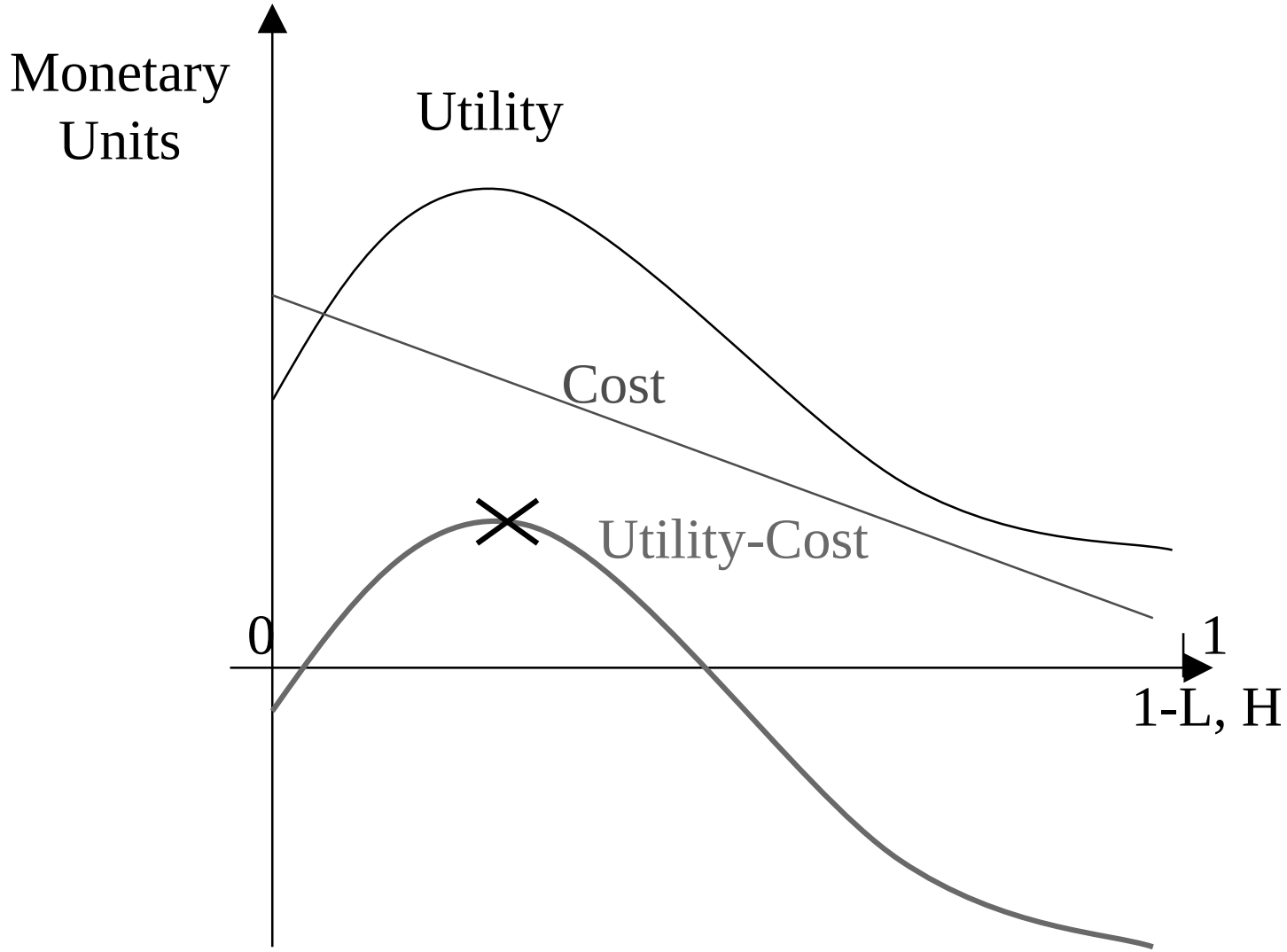
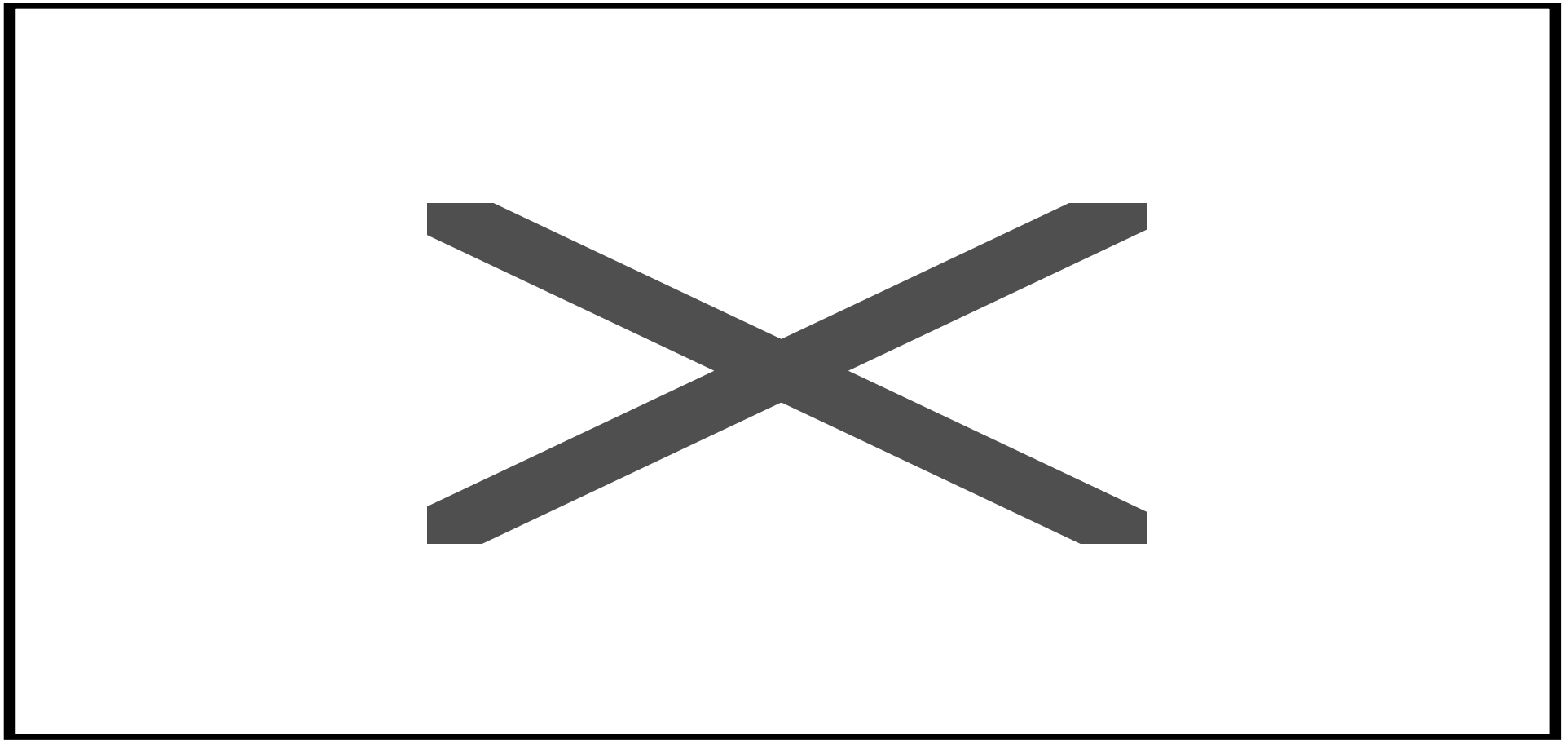
Layered V



Cost and Utility Functions for Layered Video



Multicast Scenario with Multiple Service Providers



- Different charging and accounting domains with local pricing decisions

Conclusions

- Price discrimination for different ATM and IP service classes
  - low-cost ATM UBR service with low reliability
  - high-cost high-QoS ATM VBR service
- Advanced applications (c.f. layered media coders)
  - improved performance/cost ratio
  - mechanisms QoS enhancement

    ARQ and FEC to reduce loss within delay budget

  => exploiting price differences