Internet services pricing under usage-based cost allocation: Congestion dependence

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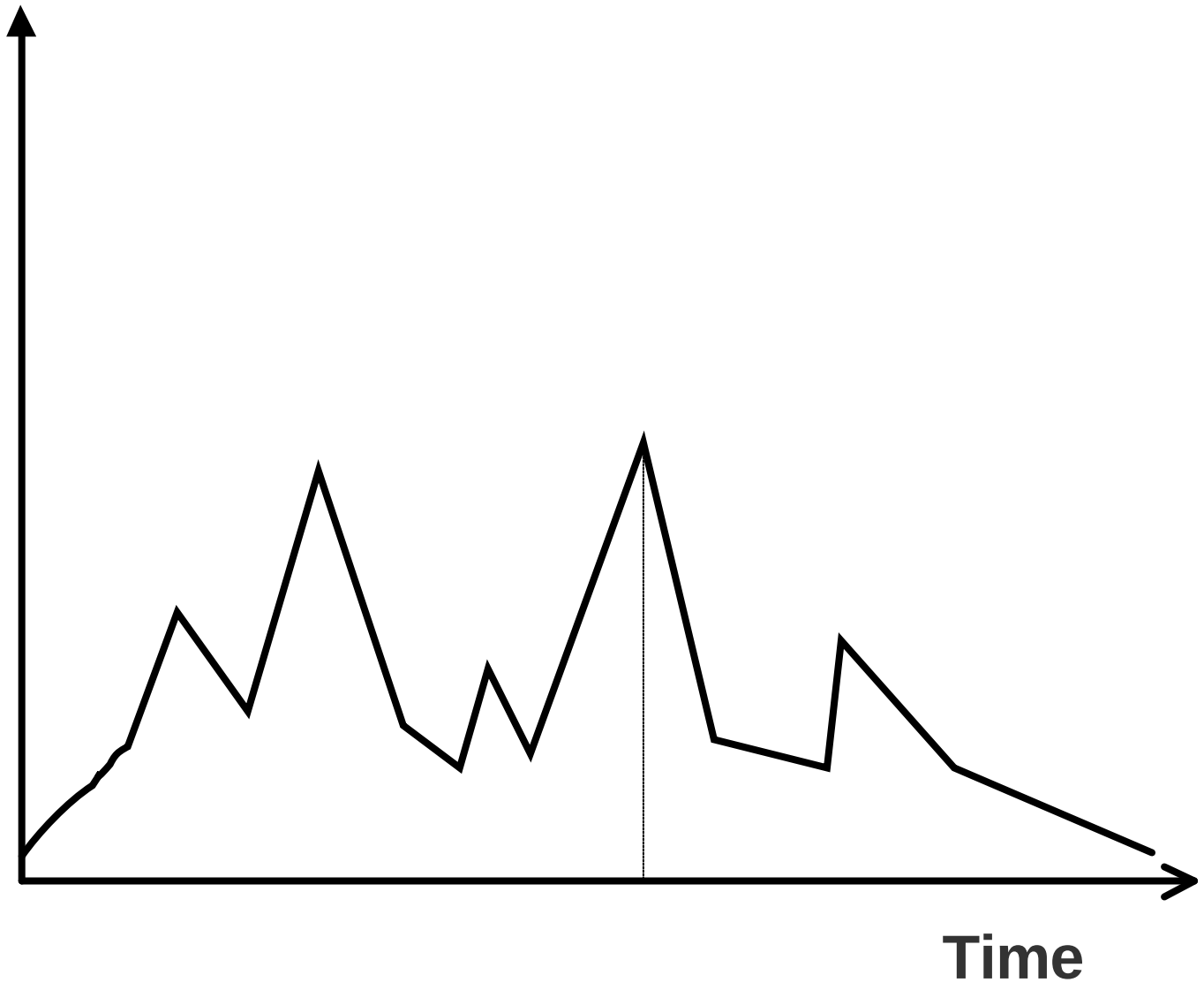
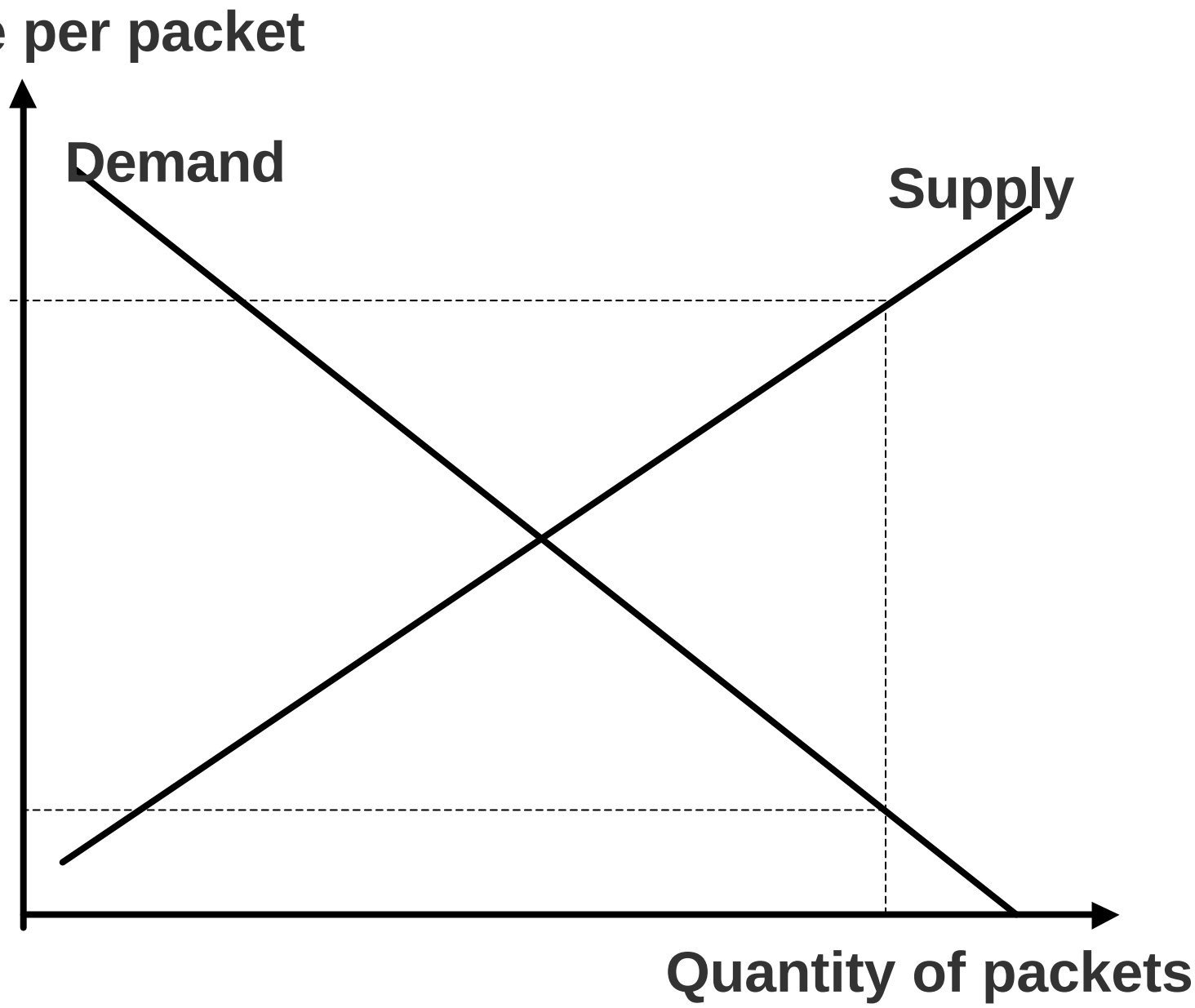
Issues addressed in this presentation

- QoS and congestion management
- Real-time services
- Matching price structures with cost causation
- Technical mechanisms to improve QoS
- Future fragmentation in standards, and industry structure ?
- Network externalities


No. Packets
Time


Price per packet
Demand
Supply
Quantity of packets

QoS and congestion management

- QoS on the internet is essentially statistical:
  - Latency, jitter, bandwidth, packet loss, availability.
- All packets treated the same, but ‘real-time’ service packets require different QoS.
  - Real time service not yet viable on the public internet.
  - As well as for technology reasons, one of the main causes of this is that economically efficient pricing structures are not used.

Existing congestion management

- Over-provisioning has been the principle means ISPs have used in meeting peaks in demand.
- ISPs accept traffic on a ‘best-effort’ basis, although increasingly QoS statistics are contracted.
- Congestion management / resource optimisation is treated as a technical issue

Congestion management

- TCP
  - Little account of order and timing
  - queuing results in overflow indicating congestion to sending TCPs and a slow down in packet sending.
- ATM – traffic shapping

- Presently backbone congestion is hidden within:
  - Overall round trip times and system start-up latency, and
  - Delays between the backbone and end-user.
- Broadband access will help bring backbone congestion into focus.

Congestion management

- Prices provide the efficient means for managing congestion.
- Presently, dial-up users are charged:
  - by their access provider
    - per minute (EU); Zero - DLS, USA, NZ; 25 cents (Aust)
  - per month by their ISP
- Price signals are passed from the parameter up through the loose hierarchy
  - No congestion pricing with ISP interconnection

Congestion management

- Increasingly flat-rate pricing is the end-user ISP model - extra packets are not priced.
- To be economically efficient the structure of prices should match the structure of costs.
- There are 3 types of cost involved that should ideally be mirrored in the prices charged to users.

1. fixed costs (these don’t vary with usage).
2. initial cost of connecting a customer to the internet
3. congestion cost

Congestion management

- Assuming a technology solution would have been found, one of the costs implied by the existing price structure concerns the absence of the market for real-time services.

- For economic efficiency the price structure should have all 3 components:

  1. A subscription charge
     - These costs can not be said to be incremental to any single customer.
     - No person should be charged a subscription more than their willingness to pay.
  2. A one-off charge, and
  3. A congestion charge.

Congestion management

- Web-sites are the main senders of traffic - not end-users.
- Fixed costs (1) should be shared between W-S and end-users, given network effects.
- Does not alter the need for congestion pricing, but does complicate it.

Congestion management

- The congestion charge
  - should not apply when the network is uncongested
  - should equal the margin cost of delay if existing capacity is optimal.
  - If a price higher than this can be charged, and the network still becomes congested, it indicates a profitable opportunity to increase capacity.
- On the PSTN congestion pricing is charged during a time-of-day.
- Not practical for the internet due to congestion periods being unpredictable. Alternative is some form of spot market.

Congestion management

- real-time *Vickrey auction* has been proposed
  - All users admitted to the internet during this period would pay the bid price of the marginal user.
  - This would be zero at uncongested periods
  - Where there is insufficient capacity, it will provide a price that will signal that an increase in capacity is profitable (required).
- Not practical as packets can not be accounted for presently.

Future congestion management

- MM-V provide an intellectual basis behind research for a practical solution.
- IntServ is designed to allow control of end-to-end QoS per data flow.
- Enables QoS statistics to be raised to several levels, thus making it possible for real-time applications to run on the internet.
- Option that appears more suitable for real-time service requires estimates of the demands required by users so that resources are available.

Future congestion management

- Problems:
  - RSVP has poor scalability
  - IntServ requires a basic feedback mechanism to prevent network resources being cornered - not addressed by designers.
  - Complexity of the IntServ RSVP model is means it is not considered the way forward for the public internet.
- DiffServ requires users wanting higher QoS to define their service profile, with tagged packets needing to fit this profile

Future congestion management

- Traffic controls :
  - Occur at admission
  - traffic is scheduled according to customer profile
  - traffic is sorted for different treatment
  - network resources need to be allocated
- Sorting, profiling, metering, happen at the boundaries between networks, where packets tags are addressed in aggregate - scalable ✓
- Needs IPv6 to operate
- No guarantees - requires QoS contracting and verification between ISPs.

QoS and standards co-ordination

- Strategic interests of 1 (or more) leading IBPs may be to differentiate itself by offering new services on-net only.
- If this was likely to occur, vertical and some horizontal integration may well occur.
- In a growing market where indirect network effects are strong, the incentive to co-operate with standards may counter incentive of IBPs to differentiate themselves.

Conclusions

- The internet is edging toward becoming an integrated services network
  - e-mail; File Transfer Protocol (FTP); WWW; VoIP; Video.
- Lack of efficient pricing structure running through the internet is delaying the development of ‘real-time’ services.
- Ongoing technology developments are occurring, but economic issues need to be addressed.

Conclusions

- Arguably the main problem will be in securing similar QoS for traffic going off-net.
  - Accounting systems that provide ISPs with transparency will need to be developed.
- Strategic interests of 1 or more IBPs may result in (vertical) agreements, vertical mergers, and real-time services only being provided on-net .
- Email, WWW, FTP would still be universally provided. But new products might be on-net only.