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
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.