Internet Resource Allocation: Congestion and Accounting

Jeff MacKie-Mason

Dept. of Economics and Institute of Public Policy Studies
University of Michigan

`http://gopher.econ.lsa.umich.edu/EconInternet.html`
`http://www.ipps.lsa.uimch.edu/telecom-info.html`

User-centric network performance

- only as good as users think

User-centric network performance -- cont.

- what do users want?
- tasks for network design:
  - support multiple service qualities
    - varying:
      between application types
      between users
      within users
    - flexible: don't lock applications into specific qualities
- important role for user heterogeneity (between and within) in network design

Congestion and Network Design

- Internet supports multiple application types
  - but single service class
  - works best when
    - applications can adapt to service class
    - excess resources available
- Congestion:
  - reduces resource slack
  - implies resource allocation

Congestion and Network Design

- **Congestion and Network Value**
  - net value = Σ ben_i(delay)
  - When internet is congested
    - TCP applications give up their bandwidth
    - UDP applications do not
    - *regardless of user valuations*

Congestion and Network Design

- Conversely, when real-time applications suffer enough delay, they become worthless -- *regardless of user valuation*
  - shout louder?
  - set up separate network?

Using the users

- **are users are dumb terminals?**
  - make choices about call setup and network subscription
  - once connected, offer load

Using the users -- cont.

- **users are smart devices!**
  - network intelligence moving outward to improve efficiency of links
  - users are intelligent devices on the network periphery
    - network can provide **feedback**
    - users can **adapt send rates**

Using the users -- cont.

- **criteria for a feedback mechanism**
  - respond to relative valuations (heterogeneity)
    - TCP "slow start" is anonymous and inflexible
  - incentive compatible

Using the users -- cont.

- **properly designed congestion prices ("smart markets")**
  - *flexible*: value heterogeneity (within and between)
  - maximize *efficient use of existing network*
    - heterogeneity between users, within users, and between application types
  - give *efficient signals for network expansion*

Using the users -- cont.

- usage is crowded out only in favor of more valuable usage
  - not to transfer wealth, but to communicate information needed for efficient allocation

Accounting

- **How much does billing and accounting cost?**
  - large share of incremental phone call costs
    - 100% of off-peak cost
    - part of on-peak cost
    - on average, incremental billing cost about 50-80%
  - but only about 6% of total costs
- **How are packet networks different**
  - many packets per "call"
  - client-server model

Accounting Cont d

- **Approaches**
  - sampling
  - digistamps