The Stability of Best Effort and Managed Services, and the Role of Application Spawning in the Internet *

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Themes

-Is there a business case for Best Effort service?

-What are the implications to the preservation of Best Effort service from allowing Managed (Premium) Services in the Internet?

-How does application spawning by Best Effort usage affect the Access Provider's business decision in provisioning bandwidth for the services?

-How does the "damaged goods" strategy play in the business decision?

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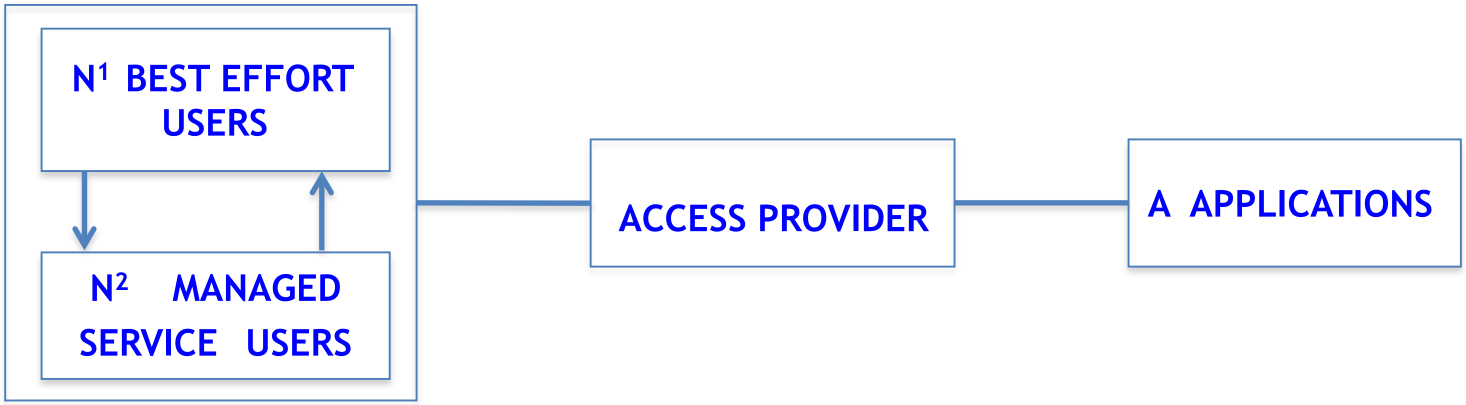
* Based on recent work +

"The Stability of Best Effort and Managed Services in the Internet, and the Role of Application Creation", Proc. Smart Data Pricing Workshop, IEEE INFOCOM, 2014,
and earlier paper in Proc. 24th International Teletraffic Congress, 2012

Mapping to Two-Sided Market Model



Key Model Features:

•Users parameterized by θ, intolerance to delay = WtP to avoid delay

•Two classes of users: Best Effort & Managed Services
BE is "free" but incurs delay and negative utility; MS users pay fee to avoid delay
Utility-maximizing users with smaller θ subscribe to BE, larger θ to MS

•Negative externality – delay to BE users increases with #(BE users)

• Profit maximizing Access Provider decides on how much BandWidth (BW) to provision for BE and MS at fixed rental cost per unit BW, and also decides MS transaction fee

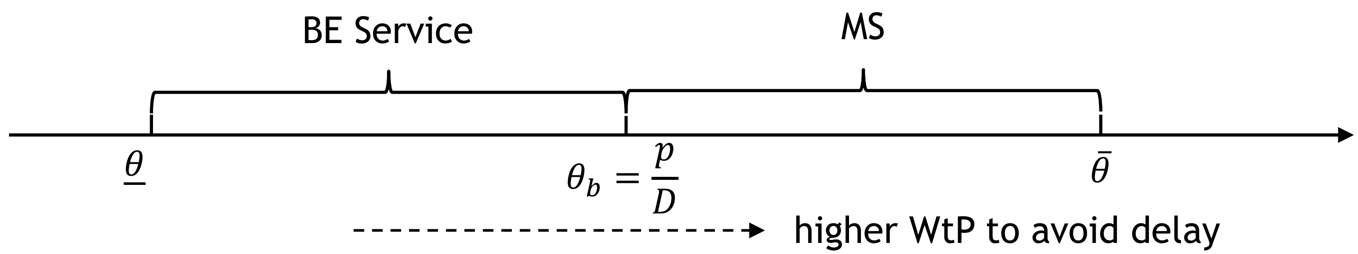
•Access Provider levies transaction fee to MS users, plus fixed fee to all subscribers

•Users' utility is proportional to number of Applications, A

•Spawning of new applications is proportional to BE usage

Model Parameters

- Given delay, D, of BE service, and transaction fee, p, for MS:
  users with delay cost lower than fee use BE service, others use MS



- **User's net utility:**
  $$u(\lambda) = \omega(1 - \exp(-\gamma\lambda)) - \theta D\lambda \quad \text{: BE users}$$
  $$= \omega(1 - \exp(-\gamma\lambda)) - p\lambda \quad \text{: MS users}$$
  where λ is transaction rate

- **Access Provider:**
  s, fee collected from all subscribers to broadband service
  r, rental fee paid out for unit BW acquired for deployment
  b^{MS} , BW provisioned for each MS transaction
  } **fixed**

  B^{BE}, B^{MS} are BW provisioned for BE, MS resp.
  p, transaction fee for MS
  } **decision variables**

Analysis

- **Users' decisions based on self-utility maximization**
  - subscribe to broadband service?
  - which service to use, BE or MS?
  - how much usage of selected service?

- **Access Provider's decisions based on profit-maximization**
  - transaction fee, p, for MS?
  - how much BW to rent for deployment for BE and MS?

- **Application spawning**
  - new applications are spawned from BE usage

    $\frac{dA}{dt} = -\mu A + \eta(\text{BE usage})$, where A = #(Applications)
  - benefit (utility) to all broadband access subscribers is proportional to A

Results

hold A, #(Applications), fixed

Solve for Users and Access Providers behavior and decisions, compute profit

Compute A's drift from dynamics of "application spawning"

Re-solve

Obtain characteristics of A's "attractor", i.e., steady state,

and corresponding BE and MS bandwidth deployed at attractor as operating point

Main result For fixed A, the result of the self-optimizations by Users and Access Provider gives function K(A) such that

K(A) > 0 → only BE service is offered by Access Provider

K(A) < 0 → only MS service is offered by Access Provider