Network Architecture and Content Provision

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Perennial Media Problem

- Mechanism vs. Policy
  - Let technology determine mechanisms, users determine policy
  - Examples: browser appearance; fixed vs. variable bandwidth
- Traditional
  - Steiner (QJE 1952): radio format competition with fixed gateway cost yields inefficient duplication; Berry and Waldfogel (1997)
  - Kids TV: Campbell (1998): Australia (pre-screening) vs. US (self-disclosure)
  - Time, place & manner restrictions for public access CATV
- Current
  - CDA: common carriage, PICS
  - must carry rules: satellite vs. cable vs. land broadcast
  - privacy: cookies, P3P

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What's on tonight?

- *Internet*: multiple applications, diverse and rapidly growing content
- *Cable TV*: one application, limited content
- Less drastic: WWW vs. America OnLine or Microsoft Network

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Is convergence really happening?

- Qwest: 16,000 route miles of fiber
  - by 1999, more bandwidth than sum(AT&T, MCI/Worldcom, Sprint)
  - voice, video conferencing, high-speed Internet
- Ameritech
  - local telephony (12 MM customers)
  - long distance/cellular (5MM)
  - cable TV (65 communities)
  - Internet
- Web and TV
  - Windows98 includes TV processing

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Internet has fundamentally different service architecture

- Network provides only bit transport
  - End hosts freely construct applications
  - No modification needed for new applications
- Network provider is *application and content blind*
- Significance:
  - Prices cannot depend on content *inside* packets
  - Content must be self-selected

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Architectures for Awareness

- *application-blind*: Internet
- *application-aware*: telephony, online services (AOL, MSN, et al.)
- *content-aware*: cable TV, online services, printed newspapers

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Architecture and Content Provision

- Questions we address:
  - which existing content will be offered?
  - what effect on content creation?
- Key features:
  - price differentiation
  - service and user cost differences

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Modeling Assumptions

- network service provider: unregulated monopolist
- competitive content provision, zero marginal cost
- consumers
  - α buys at most one unit, values good *i* at v_i^{α}

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Content Provision:
"Within" Heterogeneity

- *within variation*: same value for each user, different for each good: $v_i^{\alpha} = v_i,\ v_i \neq v_j$
- aware provides all goods: $p_i = v_i$ for each i
- blind provides high-value goods
  - $\max_p\ R = p \sum_i f_i\, \delta(v_i \geq p)$
  - goods with $v_i < p$ not offered

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Implications

- network always prefers *aware* -- can mimic blind
- consumer surplus and welfare depend on type of consumer heterogeneity
  - *within* vs. *between* (different values for each users, $v_i^{\alpha} \neq v_i^{\beta}$)
- if only "within":
  - consumer's surplus higher (nonzero) in blind
  - welfare higher in aware (cf. first-degree discrimination)

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Content Provision:
"Between" Heterogeneity

- if "between" variation, welfare effects ambiguous
  - consumers may prefer blind or aware
  - welfare may be higher under blind or aware
  - why? more goods offered, some consumers get some of the surplus

Possible preferences over network architecture

	Net Revenue	Consumer Surplus	Social Welfare
Ex. 1	aware	aware	aware
Ex. 2	aware	blind	blind
Ex. 3	aware	blind	aware

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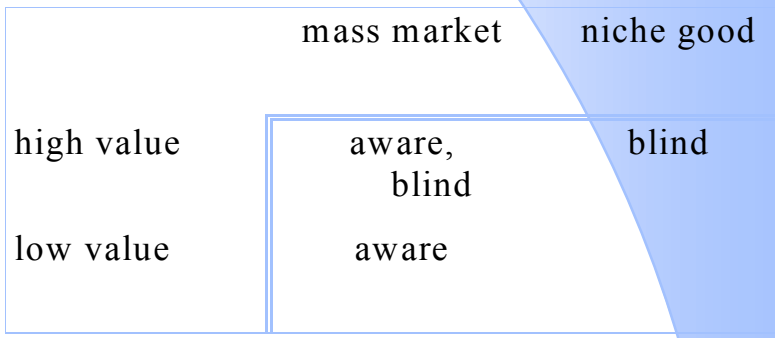
Price differentiation with gateway/liability costs

- Network as gateway: C_i per new good
  - channel costs
  - liability risk
- Basic result: *blind orders goods by* ***maximal WTP****, aware orders by* ***maximal profit***
  - *blind*: offer if $R_i(p^{max}) > 0$
  - *aware*: offer if $R_i(p_i^{max}) > C_i$

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Example: Mass market vs. niche goods

- assume goods either: high or low value ($v_i = v^h$ or $v_i = v^l$)
  mass market or niche ($f_i = f^m$ or $f_i = f^n$)
- assume $p^{max} = v^h$ (blind price = high value)
  $f^m v^h > f^m v^l > C > f^n v^h > f^n v^l$
- then aware offers mass market, blind offers high value:



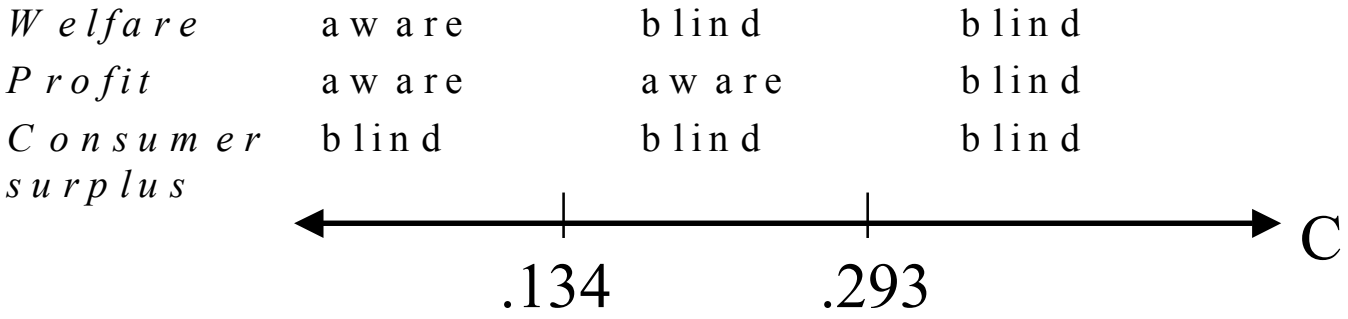
- *political economy:* now blind may have higher *revenue* and welfare

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Special cases

- same value, different market size ($v_i = v$, but f_i vary)
  - blind offers all goods, avoids gateway costs
  - aware doesn't serve some niche goods
  - $\Rightarrow$blind dominates (net provider gets all surplus with $p=v$)

- different values, same market size ($f_i = 1$, but $v_i \sim U[0,1]$)
  - possible inefficiencies and political economy conflicts



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Price differentiation and content creation

- *aware* can extract all profit; *blind* leaves more for creator
- *aware* can mimic blind pricing, but only *blind* can commit to not expropriate returns to creation
- *aware* net acts as gatekeeper: discourages experimentation

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Experimentation example

- *blind*: create if $E_{\alpha}[R_i(p^{max}) > I_i]$ for any creator
- *aware*: create if $E_{net}[R_i(p_i^{max}) > C_i + I_i]$ for net
- Let: Pr[high value | aware or blind] = ε
  Pr[believe high | creator or net] = δ, i.i.d.
- Then: Pr[create | blind] = $1 - (1-\delta)^K$, for K creators
  Pr[create | aware] = δ
- Welfare effects?

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Observations

- Comparison
  - Aware net better based on content offering?
  - Blind better for content creation?
- Strategic shift by online services
  - repositioning as Internet gateways
  - shift from content differentiation to value-added service differentiation?

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Another role for architecture: editorial

- **Clutter**: value decreases in number of goods *available*, $F_C^j(|G|)$ borne by user
- **Attention**: value decreases in number of goods *purchased*, $F_a^j(|G_\alpha|)$ borne by user
- Clutter has two features:
  - *externality*:
    - too much content offered
    - aware net can internalize and solve this problem
  - *net profit vs. WTP ordering*
- These results go away if the problem is attention, not clutter
  - no externality
  - both order content offerings by WTP

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Clutter example

- label goods by $x \in [0,1]$
- α values each good at $v^{\alpha} \sim U[0,1]$
- clutter: $F_{\chi}(z) = \lambda z^2$
- For x goods: $U_{\alpha} = \int_{1-x}^{1} (v^{\alpha} - p)ds - F_c(x)$
- From $U_{\alpha} = 0$, users with $v^{\alpha} > p + \lambda x$ connect
- total demand per good is $1 - p - \lambda x$
- total profit is $(1-p-\lambda x)px$

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Clutter example cont.

- *aware*: $p = 1/3$, $x = 1/(3\lambda)$
- *blind*:
  - goods offered if $\max_\alpha v^\alpha > p$, or if $1 > ((1-\lambda x)/2 < 1)$
  - so, goods ordered by max WTP
  - and severe congestion externality: *all users crowded out*

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Summary

- **Content Provision**
  - If variation in v_i^{α} mostly in i ($v_i^{\alpha} \approx v_i^{\beta}$, but $v_i^{\alpha} \neq v_j^{\alpha}$) then
    - aware has higher profit and welfare
    - blind has higher consumer surplus
  - If potential welfare dominated by niche goods and/or gateway/liability costs, then
    - blind has higher profit, welfare, consumer surplus
- **Content Creation**
  - If clutter important, aware can internalize
  - For creation, blind can:
    - credibly commit to marginal incentive
    - encourage more experimentation

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