S-38.041 Networking Business

Course introduction

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S-38.041 – Contacts

- Personnel
  - Lectures Heikki Hämmäinen (tel. 4516144)
  - Assistant Mathias Tallberg (tel. 4512462)
- Communications
  - Course web site http://www.netlab.hut.fi/opetus/s38041/k04/index.shtml
  - News group opinnot.sahko.s-38.tietoverkkotekniikka
  - Email: see course web site

S-38.041 - Completion

- Examination
  - An acceptable performance required in the examination
  - Exam includes 5 questions a 6 points
  - Exercise participation corresponds to 6 points in the exam
- Excercise
  - One day session of mobile operator business game
  - Voluntary participation
  - Organized at the end of April
  - Register to Mathias Tallberg by email

Lecture schedule

28.01	Course introduction. Big picture.
04.02	Consumer customers.
11.02	Enterprise customers.
18.02	No lecture.
25.02	Operators.
03.03	Transport pricing.
10.03	Content pricing.
17.03	Charging and billing.
24.03	Investments.
31.03	Interconnect and oaming.
07.04	Regulation.
14.04	No lecture.
21.04	Mobile operator competition.
28.04	Differences between markets.

21.04-05.05
Game sessions

05.05
Examination

Course materials

- Lecture slides (to be available on web before each lecture)
- Core readings
  - *Pricing Communication Networks* (chapters 5-14), C Courcoubetis, R Weber, Wiley, 2003 (commercial)
  - *Telecommunication Regulation Handbook*, H Intven, M Tetrault, infoDev, 2000 (free)
  - *Seamless mobile IP service provision economics*, ed.F.Loizillon, TONIC, EU, 2002 (free)
  - Maybe some additional articles
- Other recommended readings
  - *Network Services Investment Guide*, Gaynor M, 2003
  - *The Telecom Managers Survival Guide*, Medcroft S, 2003
  - *The i-mode Wireless Ecosystem*, T.Natsuno, Wiley, 2003

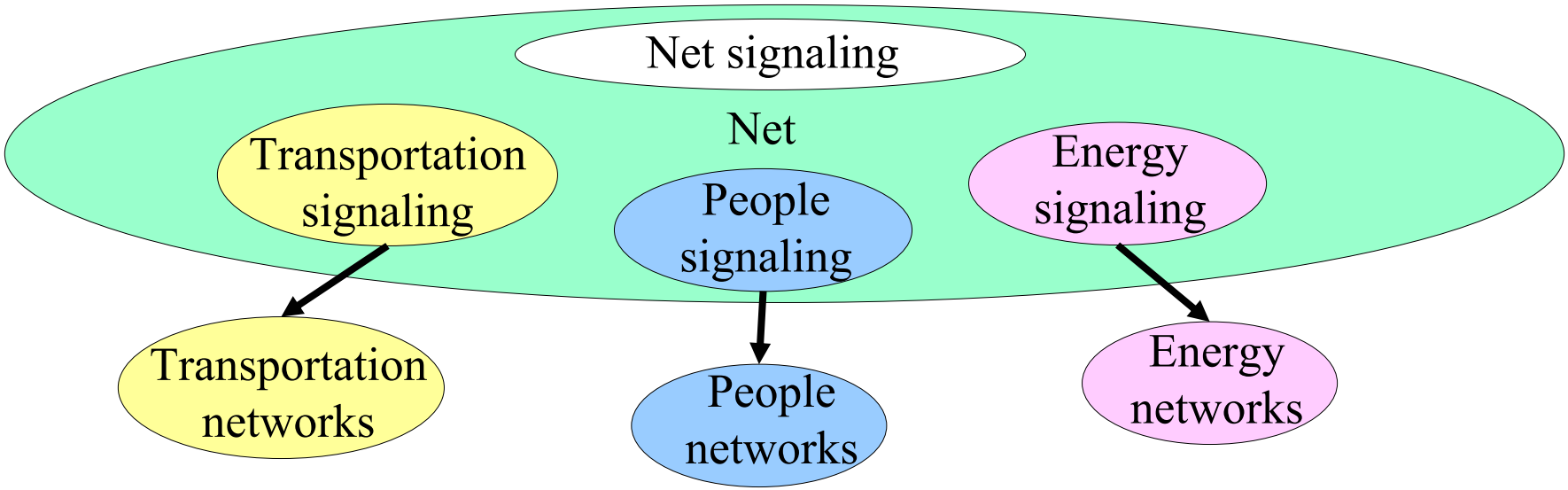
Introduction – Big Picture

Common problems of networked industries

Problem	Description	Examples
Bottleneck	Traffic stacks because capacity is limited or temporarily blocked	Airport, telephone switch, damaged railroad bridge
Access	Physical availability, economical affordability	Electricity, water, phone lines
Small vs large customers	Unit cost depends on the volume of contract	Prices of electricity, water, communications, etc
Short vs long haul	Unit cost depends on distance. International miles cheaper than local miles.	Prices of postal mail, telephone, etc

About ”signaling”

Core of information society



- Signaling controls the resources of a network
- Net enables signaling for physical networks
- Signaling of physical networks depends on signaling of Net

Visions of media convergence

Big Pipe
- Single channel
- Unified value nets
- E.g. Internet

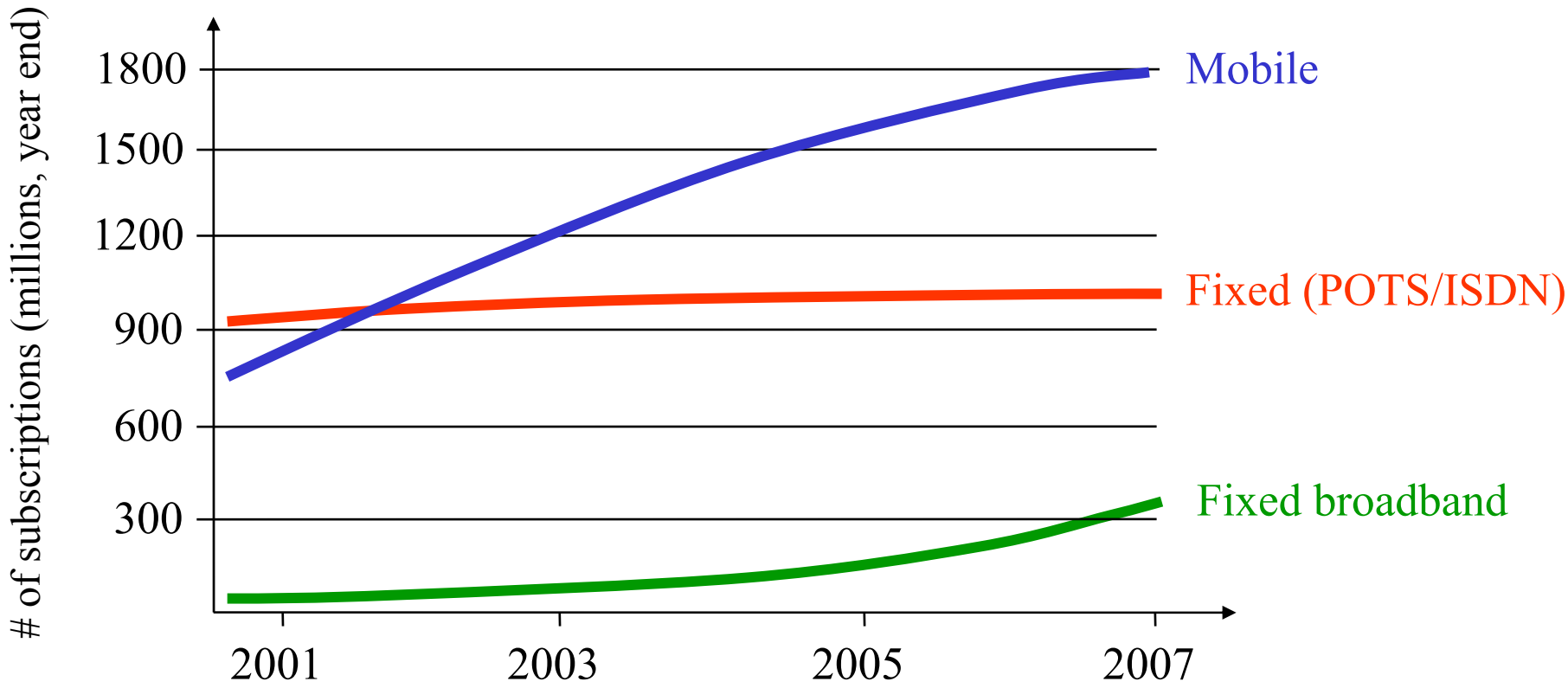
Big Box
- Single terminal
- Several channels
- Smart or dumb
- E.g. Linux/Java

Big Company
- Global company
- Single ecosystem
- E.g. Vodafone, MS

- Big Pipe may happen as Internet evolution
- Big Box may result from the operating system battle
- Big Company may get control of Big Pipe and/or Big Box
  - Ecosystems grow and die slowly
  - Governments may interfere
- Different views: Believers vs Agnostics vs Atheists

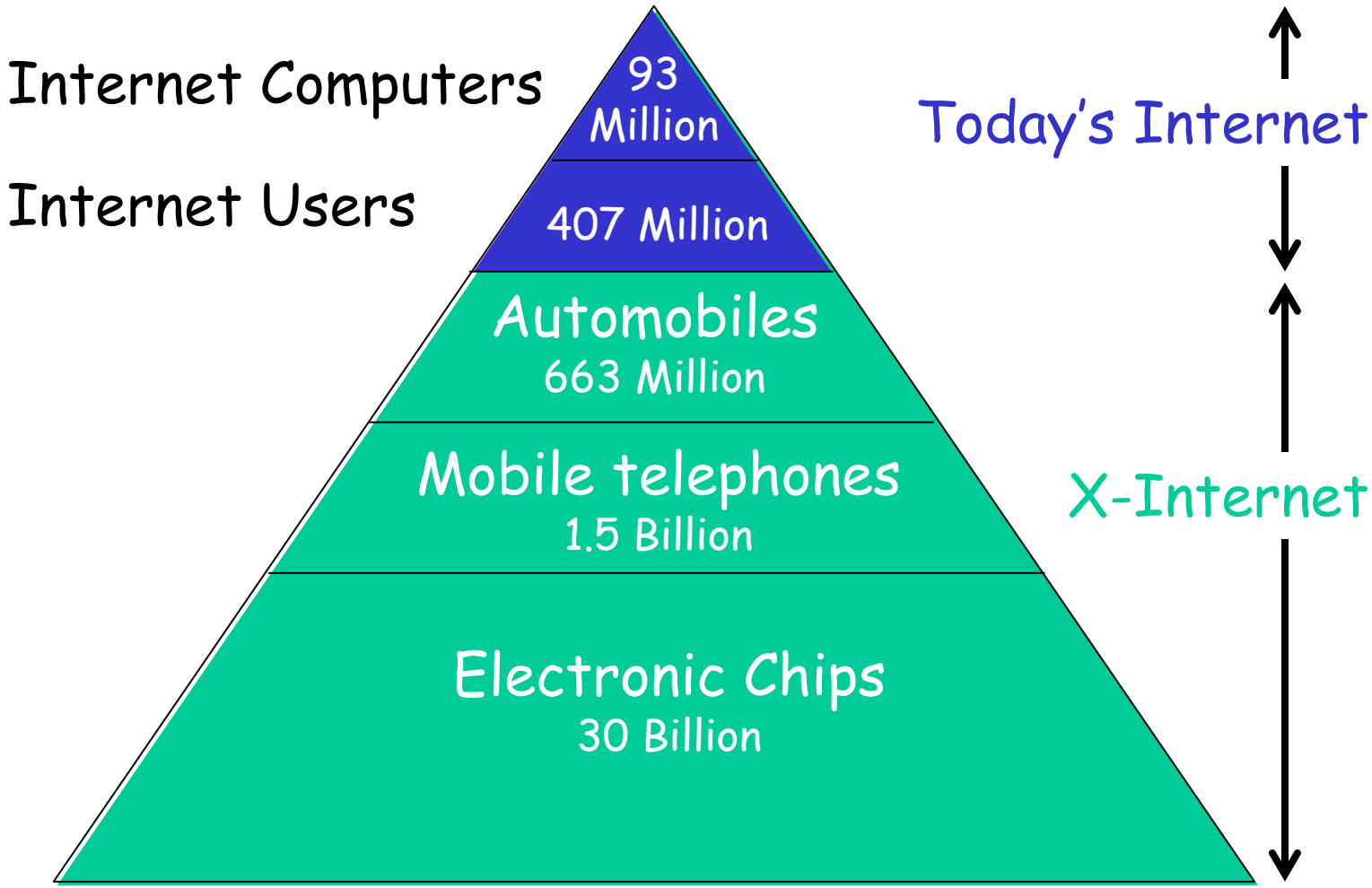
Source: P Longstaff, 2003

Worldwide subscriptions forecast



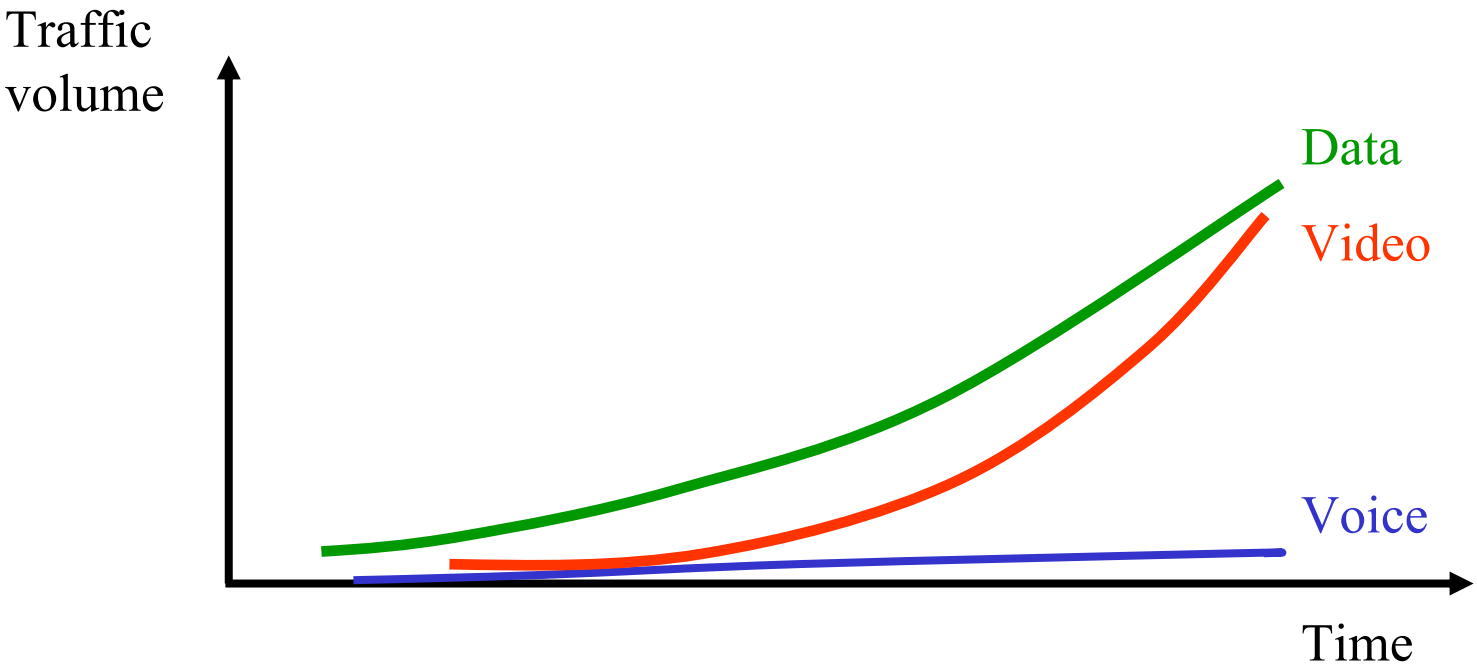
Source: Ericsson, 2003

Potential of Internet nodes



Source: Forrester Research, May 2001

Internet traffic – big picture



- Internet traffic continues doubling per year (Odlyzko, 2002)
- Traffic volume = number of sources * traffic per connection
- Voice has an upper limit, data does not
- Man is 90% a visual animal (consider e.g. webcams)

Evolution of network value

Positive Network Externality

1. Sarnoff's Law
   - Value ≈ N (viewers in TV/radio broadcast networks)
2. Metcalfe's Law
   - Value ≈ N^2 (two-way connections in phone and data networks)
3. Reed's Law
   - Value ≈ 2^N (social groups in group-forming networks)

Value of Internet evolves favorably also because

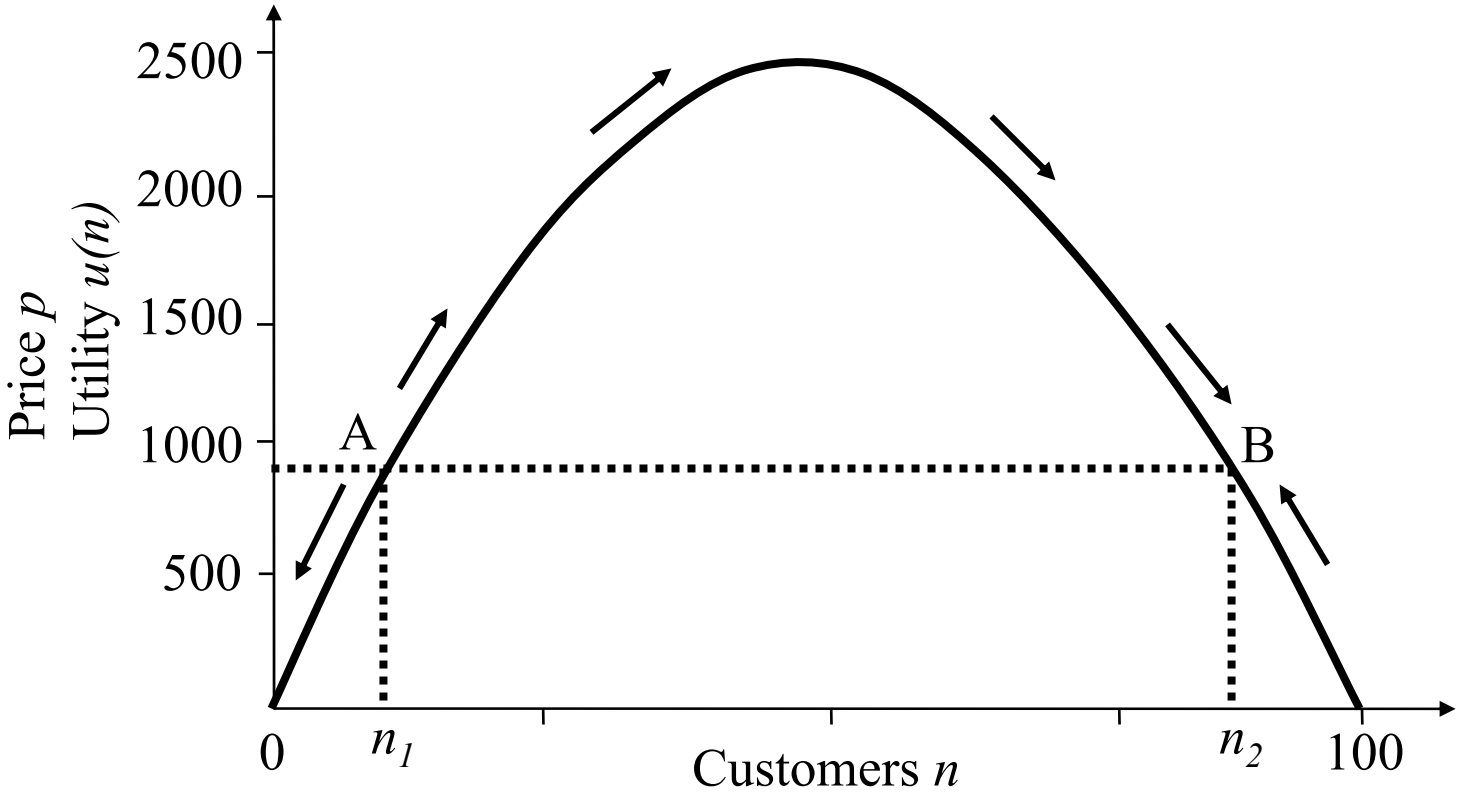
- N grows (PCs, cars, mobiles, automatic devices)
- usage time per N grows (always-on)
- new service types
  - new delivery techniques (datacasting, audio&video, multicast)
  - new interaction techniques (MMS, chat, conferencing)
- more applications and content (commercial and user-created)

Network externality: example

- Assume market of N potential customers, $N = 100$
- Willingness to pay, utility, $u_i(n) = ni$, $i = 1 \ldots N$
- Utility is uniformly distributed among customers
- Market is dynamic, i.e. refunding works well
- Given price p
  - Potential equilibrium of demand is at n customers
  - The ”indifferent” customer is $i = N\text{-}n$
  - For $u_i(n) = p = ni = n(N\text{-}n)$
  - Demand curve shows three possible equilibria: 0, A, B

Source: Courcoubetis&Weber/2003

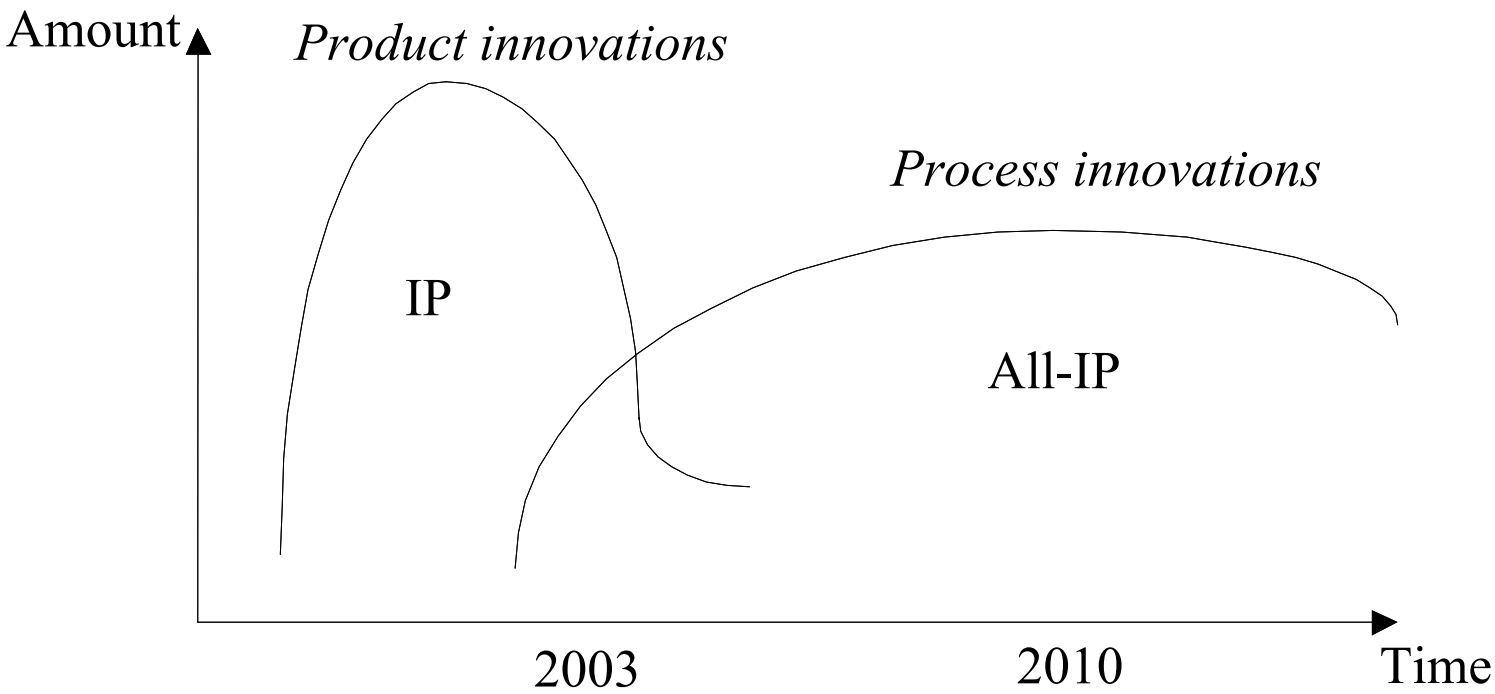
Network externality: example



- Perturbation at A leads to 0 or B which are stable equilibria
- Market failure happens unless positive feedback brings to B
- Critical mass depends on p which depends on costs
- Derivative on social welfare is positive at n_2..100 (social subsidies!)

Source: Courcoubetis&Weber/2003

Innovation model for Internet technologies



- Compare with the invention of electricity
- Processes and business models change slowly

Technology vision

Wireless systems

2005

- 28kb+ packet IP in all new handsets (GSM & WCDMA)
- Multiradio handsets spreading (GPRS & WLAN & Bluetooth)
- Bluetooth common in lightweight apps, and WLAN in heavy apps
- GPRS handset positioning common (GSM, GPS)

2010

- 100kb+ subscriber speed common in cellular (WCDMA)
- Energy conservation efficiency only tripled (fuel cells, solar cells)
- Seamless support for multiradio common (WCDMA & GSM & WLAN & PAN)
- Spectral efficiency of antennas clearly improved (adaptive antennas, MIMO)
- UWB (Ultra Wide Band) competing with BlueTooth and WLAN
- 4G spec maturing if WRC2006 has allocated bandwidth

Battery and radio are the bottlenecks

Source: TEKES NETS, 2003

Technology vision

Broadband packet networks

2005

- 512kb+ packet IP common in homes (ADSL, HFC)
- Access operators starting the prioritisation of traffic (diffserv, less than best effort)
- Optics increased in core and access networks (DWDM, MPLS)
- Ethernet changing the architecture of access networks

2010

- 10Mb+ IP common in homes (VDSL, HFC)
- Roaming common in fixed networks (WLAN/BlueTooth in homes)
- Increased capacity and operability in optical networks (all-optical, switching)

Network is the bottleneck, not terminal

Source: TEKES NETS, 2003

Technology vision

Services and applications

2005

- Mobile Internet services as common as those of wireline Internet
- Users can access their files from home, office, and on the move
- IP audio delivery common (plus broadcast radio in wireline Internet)
- Voice-over-IP emerging in wireline (WWW push-to-talk, chat, SIP)
- New services are based on open standards (IETF, 3GPP, W3C, OMA), but applications remain proprietary

2010

- Content adapts to environment (place, radio, device, user profile)
- IP audio/video has become efficient (multicast) and controlled (QoS)
- Voice-over-IP common in public networks (wireline and wireless)
- User controls (home) devices independently of place and time

Usability is the bottleneck

Source: TEKES NETS, 2003