

Economics and Management of Intellectual Property
HSE, Spring 2008

Lecture 8

“Cumulative Innovation and IP”

Tuomas Takalo,
www.takalo.net

Feb 11, 2008

Outline of Core Lectures

1. Basics of IP Law (Välimäki)
2. Use of IPRs (Välimäki)
3. Basic Economics of IP
4. Designing Optimal IP Policy
5. Competition Policy and IP
6. Microsoft Cases in the US and Europe (Välimäki)
7. Economic arguments used (and not used) in selected legal cases (Välimäki)
8. Cumulative Innovation and IP
9. Basic IP Management
- 10-11. Industry studies: IP in Financial Services etc

- So far, stand-alone innovations: innovations isolated events with no bearing on future innovations
- In practice, innovation builds on the existing knowledge and previous innovations, “standing on the shoulders of Giants”

e.g.,

Windows-95 had e-mail,

Windows-98 e-mail + internet explorer,

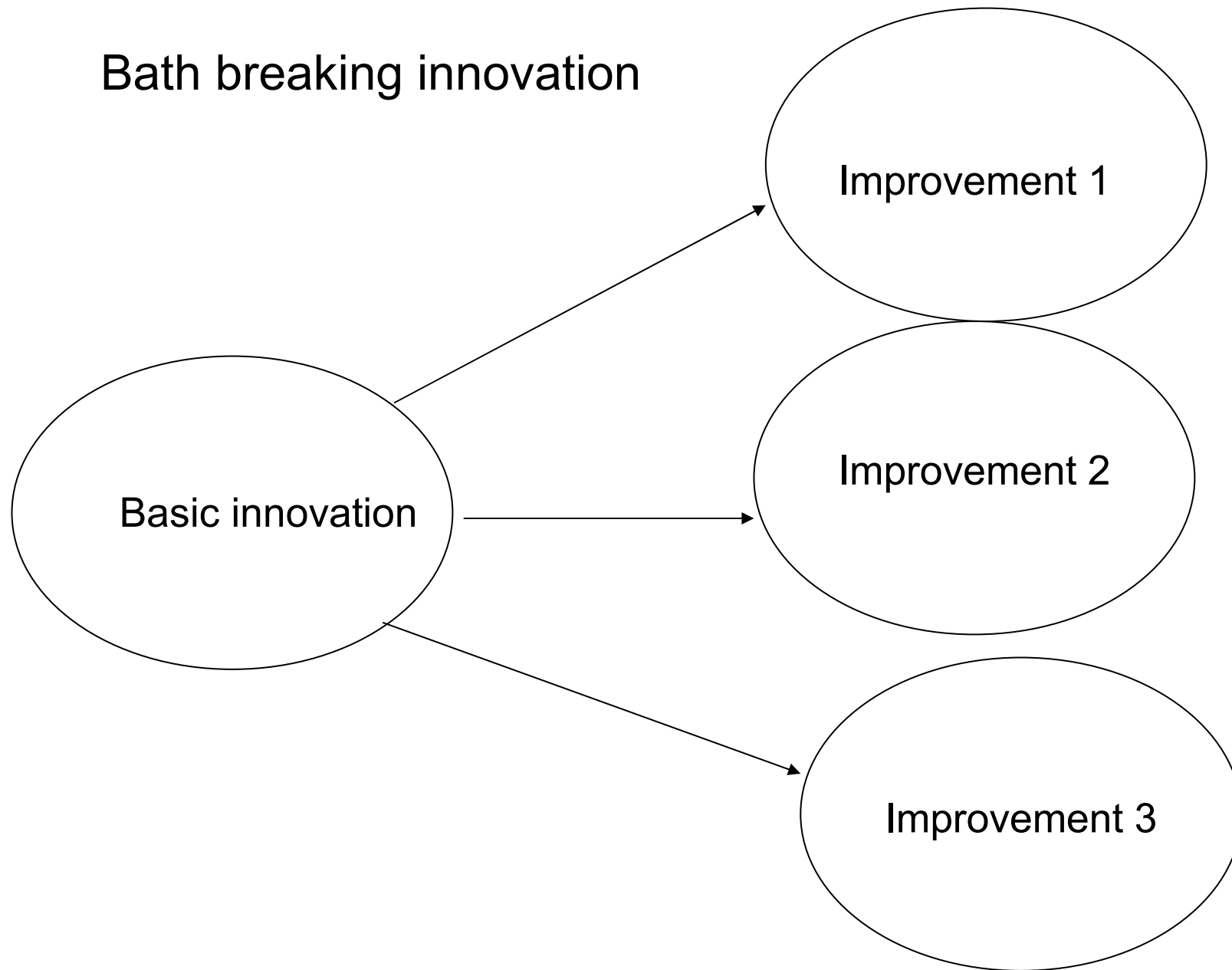
Windows-XP e-mail + internet explorer + media player,

Windows Vista e-mail + internet explorer + media player+
search engine...

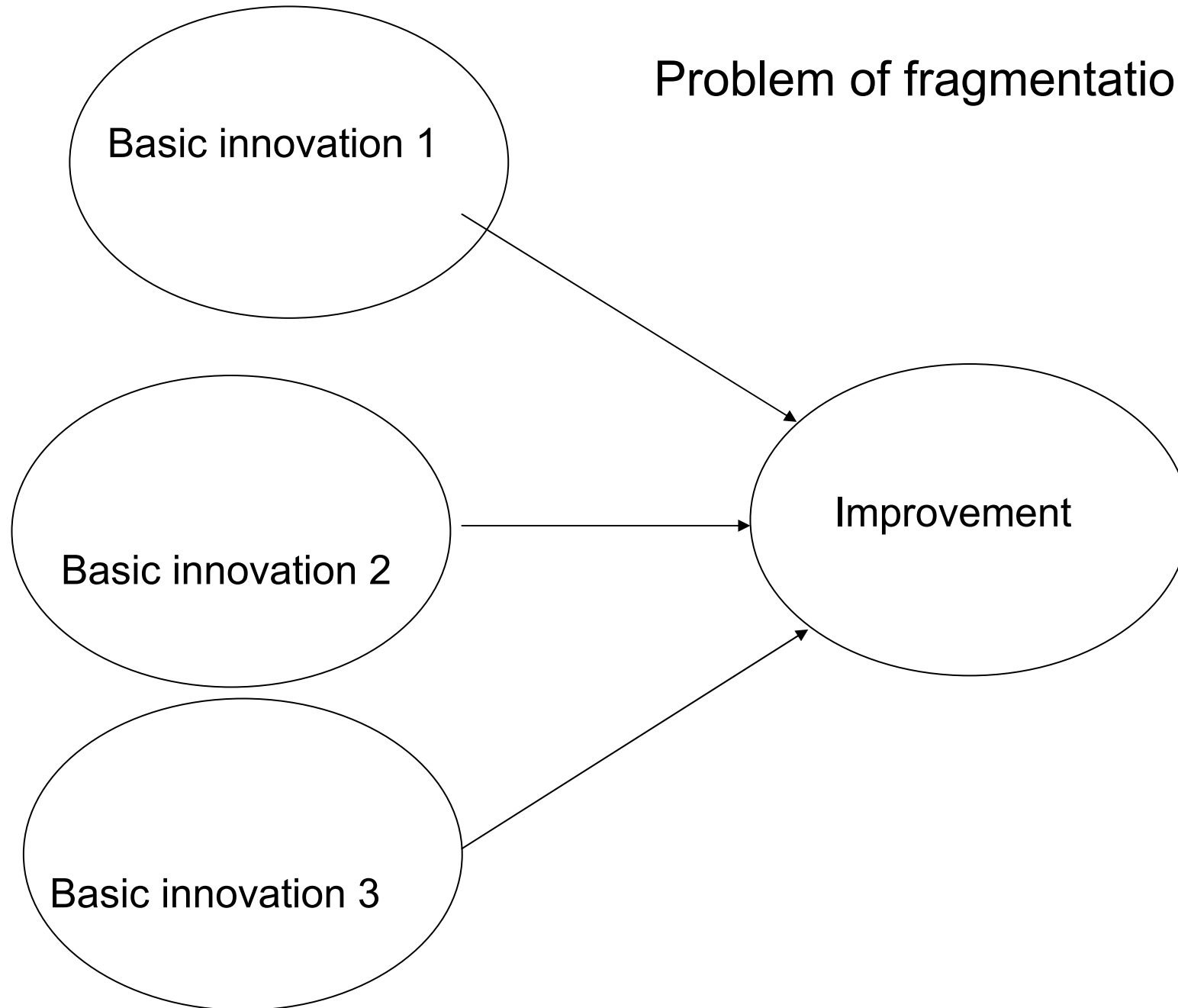
- The basic trade-off between the creation of incentives (ex ante) and the use of innovation (ex post) hangs around, but
 - it will be modified
 - with cumulative innovation
 - social value of an innovation includes the incremental value of future discoveries the innovation enables
 - private value depends on the inventor's ability to appropriate the value of future discoveries
- ⇒ the "basic" tradeoff of the cumulative innovation:
how to secure the incentives to innovate the first innovation without stifling the incentives to create future discoveries?

- Cumulative innovation can consist of
 - improvements on the existing products
 - creation of basic technologies (e.g., research tools) and their (commercial) applications
 - cost reductions for producing earlier products

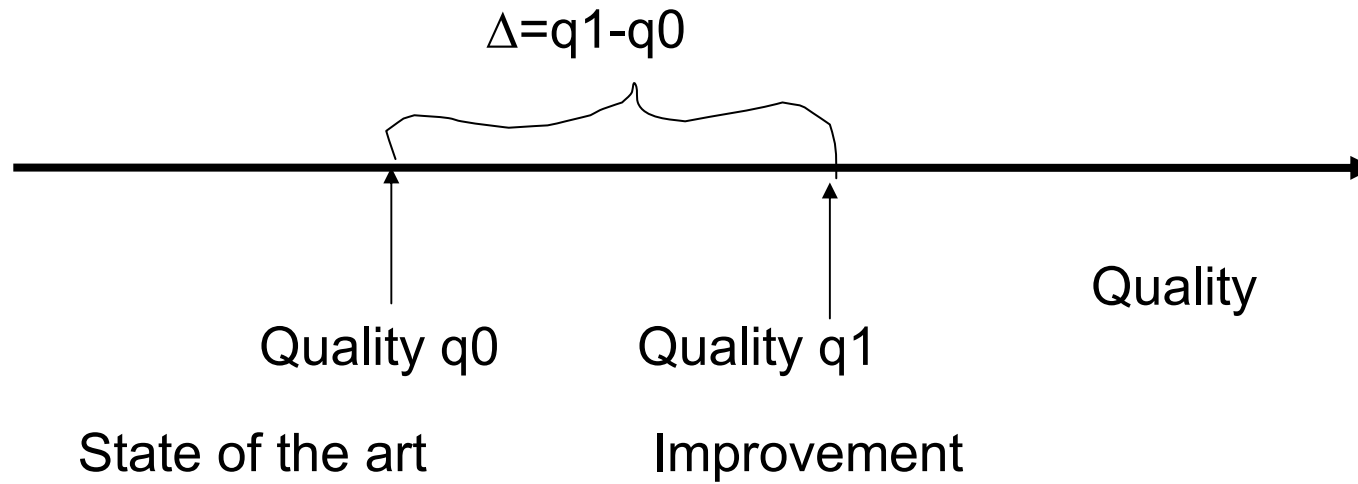
Bath breaking innovation



Problem of fragmentation



Quality Ladder



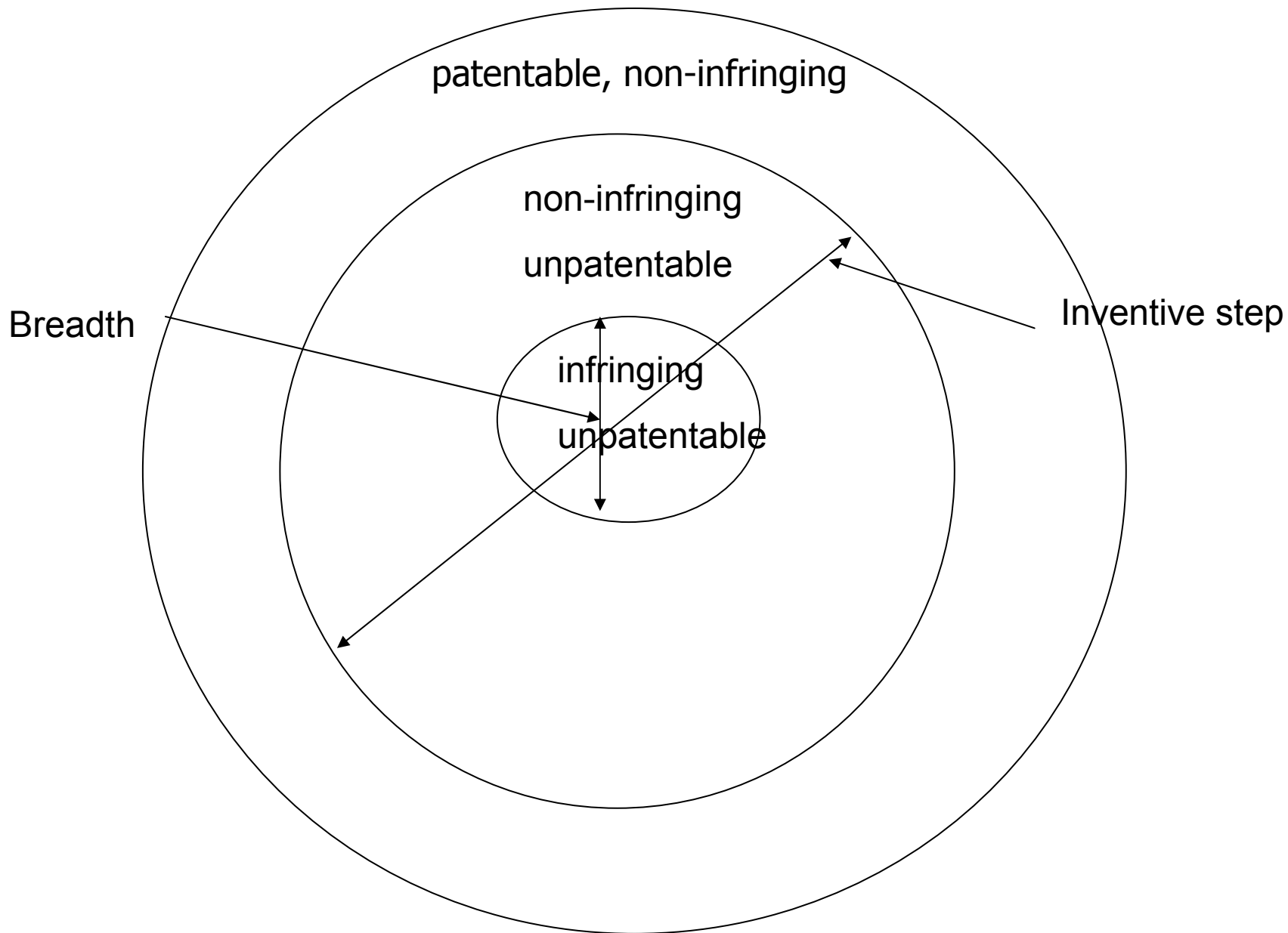
- Problems:
 - the later innovations may render the previous ones obsolete
 - the 'first' and 'second' innovations can be made by different firms
- ⇒ how to split the cake?
- ⇒ what about if the second one infringes the IP of the first innovator?
- A new concept: *forward protection* measuring how well an innovation is protected against future ones.

- For the sake of concreteness, let us focus on *patents*
- Forward protection of patents combines
 - *Inventive step = non-obviousness + novelty* determining patentability
 - I.e. novelty is not enough: an invention has to be also non-obvious to be patentable
 - *(Leading) breadth* determining whether there is an infringement or not

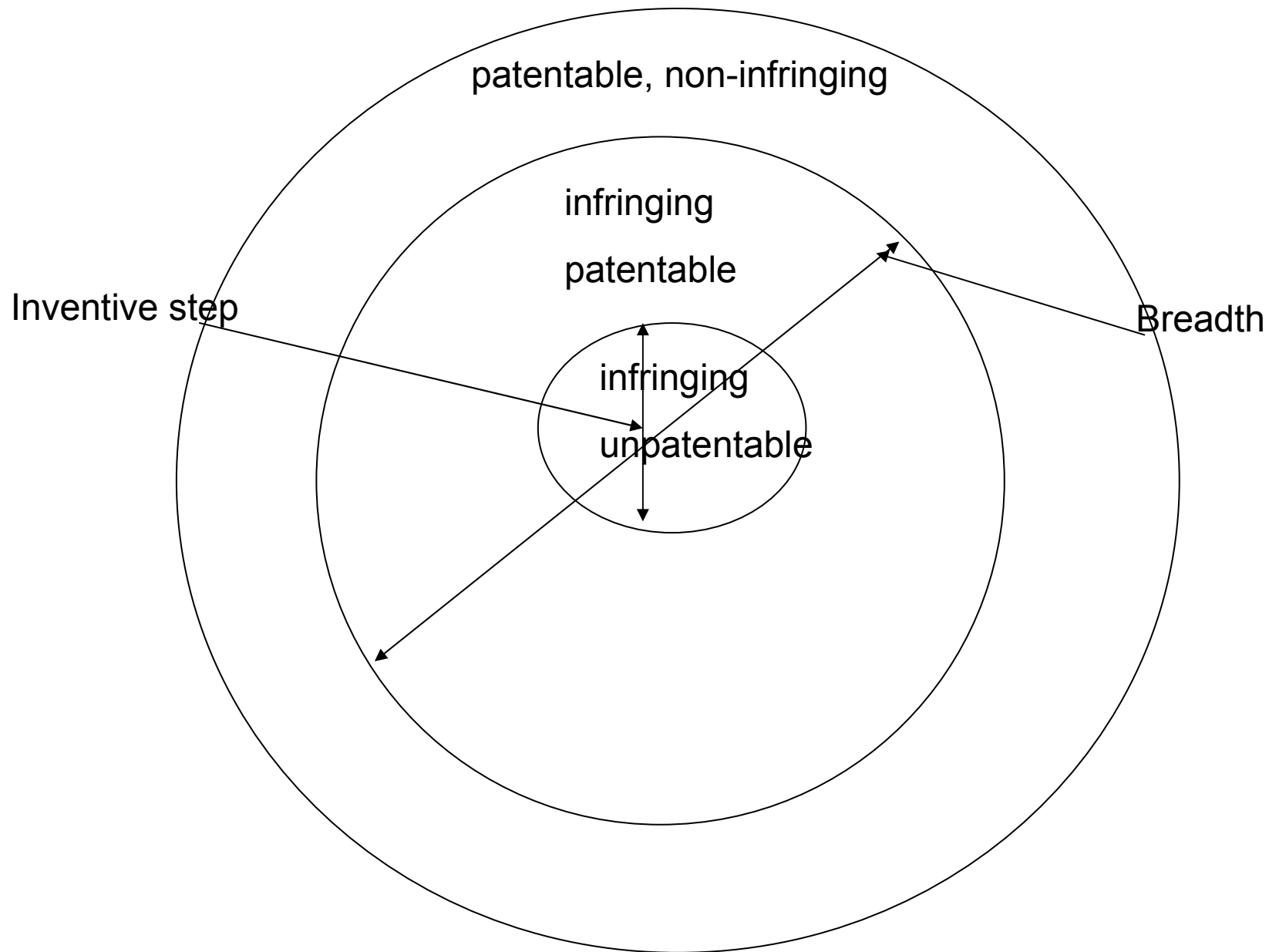
- Novelty: invention not used nor published previously
 - Non-obviousness: invention not obvious to someone with ordinary skills in the technology
- ⇒ Inventive step: a minimum amount that an invention must advance technological progress to be patentable
- Benchmark: prior art
 - (Leading) breadth determines how different another product or technology must be to escape *infringement*
 - Determines a minimum difference between inventions

- Tempting to think that breadth and inventive step are equivalent:
 - if an invention is patentable, it cannot infringe
 - if an invention infringes, it is not patentable
- But this is *wrong*. An invention can be
 - unpatentable, infringing
 - patentable, non-infringing
 - patentable, infringing (blocking patents)
 - unpatentable, non-infringing

A narrow patent, large inventive step



A broad patent, small inventive step



IN SUM:

- the “basic” trade-off of the cumulative innovation: how to create the incentives to innovate the first innovation without stifling the incentives to create future discoveries
- IP tries to solve the problem via forward protection: how well the first innovator is protected against future improvements
 - *Inventive step* = eligibility for IP protection, e.g. patentability of inventions, originality of new artistic works
 - (leading) breadth: whether future innovations infringe

Basic Technology and Its Application

- Consider basic research firm (1st innovator) with little commercial value which can create scope for commercial applications
- analogous to the case where the inventor does not practice the innovation
 - E.g. upstream innovator – downstream manufacturer

- Assume deterministic innovation
 - the costs of creating the basic technology: $\mathbf{c_B} > 0$
 - the commercial value of the technology as such is zero
- another firm (2nd innovator) has an idea of how to make a commercial application of the basic technology
- the cost of making commercial application: $\mathbf{c_A} > 0$
- Assume that the application can be protected by IP (e.g. a patent)

- the private value of the application: $\mathbf{P}(\mathbf{T})=\pi\mathbf{T}$ where \mathbf{T} is the (discounted) IP duration, $\mathbf{P}' > 0$
- the social value of the application:
 $\mathbf{S}(\mathbf{T})=\mathbf{W}^c/\mathbf{r}-\mathbf{T}*\mathbf{DWL}$, $\mathbf{S}'<0$

⇒ the net social value of the basic technology is at least

$$\mathbf{S}(\mathbf{T})-\mathbf{C}_A-\mathbf{C}_B$$

- If the basic technology is not protected by IP
→ 1st innovator has no incentives to invest
- payoff zero, you have to pay $\mathbf{C}_B>0$
- The problem of cumulativeness: how to transfer surplus from the second innovator to the first innovator?

- if the application infringes the IP covering the basic technology, the second innovator forced to acquire a license
- if no infringement, no way to transfer the profits
- If no transfers of profit, no investment in the first innovation
 - ⇒ no investment in the second innovation
 - ⇒ IP creates the market for technology

- Assume potential infringement
 - No certainty about infringement \Rightarrow IPRs are *probabilistic* property rights
- Consider licensing negotiations between the first innovator (who owns the IP) and the second innovator
- Are negotiations made *before* or *after* the application is made?
 - Which is more realistic? Why?
- Consider first *ex post licensing*,
 - negotiations occur only after the application is ready for production
 - i.e. $\mathbf{c_A}$ has been sunk

- the available cake is $\mathbf{P}(\mathbf{T})$, the first and the second innovator should find a way to divide it
 - β = the share of the first innovator
 - $1-\beta$ = the share of the second
 - β reflects the bargaining power of the first innovator
 - if no good reasons to assume otherwise, set $\beta=1/2$ (Nash-bargaining solution, solution for Rubinstein alternating offer bargaining)
- ⇒ the payoff of first innovator $\Pi_{\mathbf{B}} = \beta\mathbf{P}(\mathbf{T}) - \mathbf{c}_{\mathbf{B}}$
- ⇒ the payoff second innovator: $\Pi_{\mathbf{A}} = (1-\beta)\mathbf{P}(\mathbf{T}) - \mathbf{c}_{\mathbf{A}}$

- β affected by *IP strength* = the probability that the IP is valid and cannot be infringed \sim breadth
 - In case of patents, assume the first innovator has full bargaining power but the patent is of imperfect *quality*
 - **b** = strength of forward protection = probability that both the patent validity and the infringement holds in the court
- \Rightarrow with pr **b**, the first inventor makes a take-or-leave it offer
 \Rightarrow demands the whole cake $P(T)$
- \Rightarrow with pr $1-\mathbf{b}$, the second inventor is free to use the basic technology \Rightarrow gets the whole cake $P(T)$

$$\Rightarrow \Pi_B = \mathbf{b}P(T) - c_B \quad \& \quad \Pi_A = (1-\mathbf{b})P(T) - c_A$$

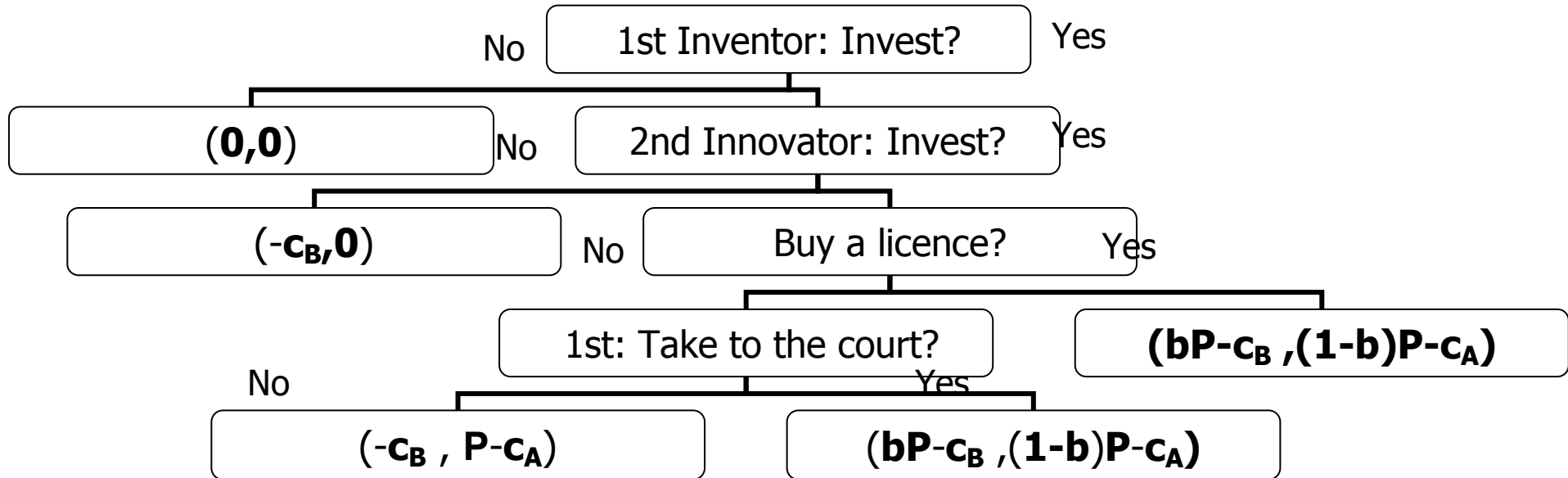
i.e. $\mathbf{b} = \beta$

Note: this abstracts from costs of litigation. They are huge in practice. For patents,

- 1-3 million USD
- 50.000-500.000 EUR

\Rightarrow why infringement disputes ever reach courts?

An extensive form of the investment game (a game tree)



- The basic tradeoff of the cumulative innovation:
 - $\mathbf{b} \uparrow \Rightarrow$ the incentive to create the basic technology \uparrow
the incentive to create the application \downarrow
 - it is possible that there is no incentive to make the commercial application even if $\mathbf{P}(\mathbf{T}) > \mathbf{c}_A$,
 - \Rightarrow there is no incentive to make the basic technology!
- increasing \mathbf{T} could be a solution: both Π_B and Π_A are increasing in \mathbf{T}
 - If $\mathbf{T} \geq \max \{ \mathbf{c}_B / \mathbf{b}\pi, \mathbf{c}_A / (\mathbf{1} - \mathbf{b})\pi \}$ then both innovations are made
- But the basic tradeoff of the stand-alone innovation appears (recall $\mathbf{S}(\mathbf{T}), \mathbf{S}' < 0$)

- This is a manifestation of *a hold-up problem*
 - the second innovator realizes that she will be held-up in the negotiations over the license
- the problem emerges from *contract incompleteness* and *relation-specific investment*
 - these concepts underlie the modern theory of a firm (cf. Williamson, Hart)

- Consider next *ex ante* licensing: negotiations over the license can be conducted before the commercial application is made (c_A is not sunk)

⇒ There is no hold-up problem!

- the first innovator has an incentive to secure that the commercialization is made, i.e., that $(1-b)P(T) - c_A \geq 0$

⇒ the first innovator requires at most $b^{\max} \leq 1 - c_A / P(T)$
even if $b > b^{\max}$

⇒ the commercialization will be made, if it is profitable, even if the first innovator has full bargaining power & perfect forward protection!

⇒ the available cake is $P(T) - c_A$

- the payoff of first innovator: $\beta(P(T) - c_A) - c_B$
- the payoff second innovator: $(1 - \beta)(P(T) - c_A)$
- forward protection (b) increases β only in so far $b < b^{\max}$, i.e., $\beta = b$ if $b \in [0, b^{\max}]$ but $\beta = b^{\max}$ for $b \in [b^{\max}, 1]$

⇒ forward protection cannot be used to secure the incentive to make the basic technology if $b^{\max}(P(T) - c_A) \leq c_B$

- the IP duration works, i.e., set $T \geq T_{\min}$ such that $\beta(P(T_{\min}) - c_A) - c_B = 0$

$$\Leftrightarrow T_{\min} = (c_A + c_B / \beta) / \pi$$

- but the basic trade-off of the static model looms...

Notes

1) Unconstrained optimal IP duration solves

$$P(T^*) - c_A - c_B = 0$$

$$\Leftrightarrow T^* = (c_A + c_B) / \pi^P$$

- a longer IP duration would unnecessarily prolong monopoly distortions
- a shorter IP duration would not create incentives to innovate

2) $T^* < T_{\min}$

3) if the innovators collude or if innovation is concentrated in the same firm, the IP duration can be set at the optimal level

- The profit of a merged firm: $P(T) - c_A - c_B$

$\Rightarrow T = (c_A + c_B) / \pi$ guarantees the incentive to innovate

\Rightarrow competition policy in “Schumpeterian” industries is complicated issue!

- More generally, when hold-up problems are severe, vertical integration works \Rightarrow a reason why we have firms (cf. Holmström and Milgrom, JEP-98, Hart-95)

- 4) IP *reduces* the hold-up fear of the first innovator, because the infringement forces licensing, creating the market for technology
- Suppose that there is no infringement.
 - The first innovator fears the hold-up (after she has invested and created the basic technology, no body is willing to pay for it) and does not invest,
 - Collusion or vertical integration would be the only way to induce the investment in the basic technology

5) With ex ante licensing, the second innovation will be made if $\mathbf{P(T)} > \mathbf{c_A}$.

⇒ no hold-up problem about the second innovation

but: the hold up problem about the first innovation can remain even with ex ante licensing and IP

⇒ the key problem is to compensate early innovators

⇒ how to increase their bargaining power?

6) If ex ante licensing is not feasible, the hold-up problem concerns the second innovation

Why is ex ante licensing often infeasible?

1) Asymmetric information

- the second innovator has private information about the costs or the value of her innovation
 - clear incentive to overstate costs and understate value
 - private info about the value can be mitigated e.g., by using royalty licensing but how to overcome the private information about the costs

2) Other contracting problems

-the second innovator may need to disclose her idea to the IP holder

⇒ the IP holder can walk away with the idea, make the invention and patent it

- For the same reason it may be difficult to find funding for innovation

3) Costs of monitoring rival patent portfolios:

- Firms should examine what has been patented prior investing in innovation
- This can be costly as patents are written in obscure manner
 - in particular if your goal is to be a troll you do not want that your patents are found prior investments
- Investment takes long time, even if you did not find any previous patent ex ante there may be some ex post
 - Pending applications are kept secret

⇒ continuous monitoring rival patent portfolios, while important, can be costly (trolls: you do not know who is your rival)

- Can weaken bargaining position ex post
“Willful” infringement can increase damages

Benefits of non-monitoring:

- not all firm carefully monitor their own patent portfolios and do not notice infringements
 - the more successful your product, the less likely it will be that infringement goes unnoticed

4) Fragmentation problem, "anticommons"

- suppose three essential patent/IP holders

- it costs c to make the application, profits π .

⇒ The ex ante cake $\pi - c$.

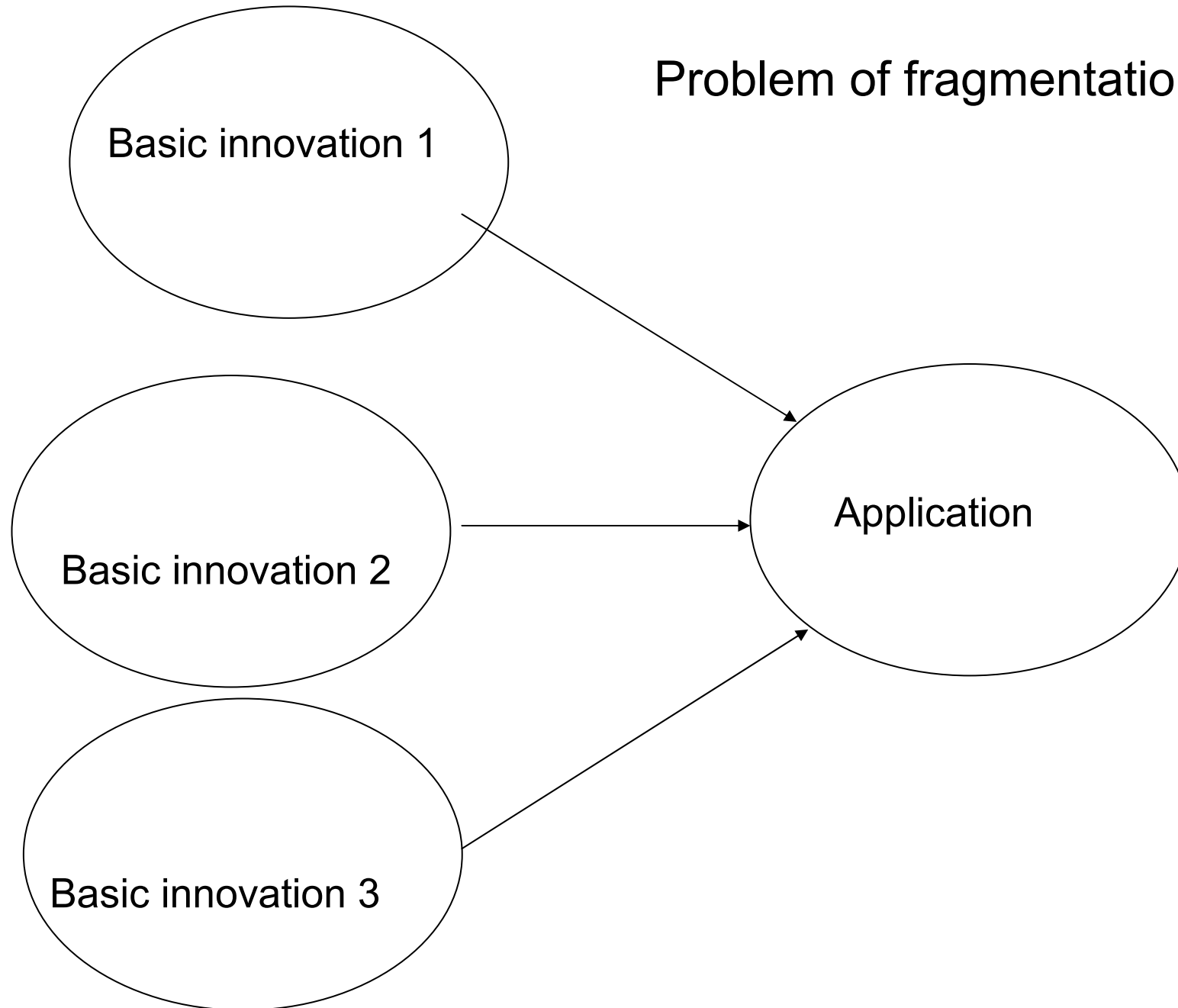
- The inventor of the application negotiates with each holder separately

- Assume equal bargaining power.

⇒ The inventor of the application should pay $(\pi - c)/2$ to each IP holder ⇒ impossible!

⇒ The IP holders should form a (patent) pool, collude or merge
⇒ antitrust problems

Problem of fragmentation



Examples of the second innovator hold-up problem: “Patent Trolls/Sharks”

Case 1) RIM-NTP case on BlackBerry patents

- A Canadian firm Research in Motion (RIM) established in 1984 by a couple of engineering students
- 1999 Launch of BlackBerry – a wireless email.
 - Becomes hugely popular in the US
 - 10 million users today
 - A major competitor to Nokia
- 2000 an US firm NTP says that RIM’s BlackBerry violates its patent from 1991 and requires RIM to license ⇒ the firms go to the court
 - NTP is a firm that only owns the patents of an individual inventor Thomas Campana, died 2004, and employs lawyers

- 2002 a federal jury upheld infringement \Rightarrow NTP won 23.000.000USD of damages and an injunction
 - Injunction, however, postponed pending appeal
- 2005 firms make an out of court settlement of USD 450.000.000 but that unravels soon afterwards (why?)
- Meanwhile, the court processes proceed and USPTO reexamines NTP patents.
- 23.2.2006. USPTO finds that at least one of the five key patents is invalid, serious doubts about the validity of the others
- 4.3. Firms settle: RIM pays 612.500.000 and NTP drops all cases.

What should we think about this?

- Sounds absurd but suppose NTP patents were valid.
- Then this is an instance of the later innovator hold-up
 - NTP held the basic technology, RIM made the commercial application
 - When the firms negotiated, the development effort of RIM were sunk and the RIMs technology was useless without permission to use the basic technology
- Defending IPR system good for the incentives to create basic technologies and there might be a lot of future
Thomas Campanas

- However, it seems that NTP patents were not valid.
- Then this is very bad, we have indeed a troll that exploits the patent system without creating nothing
- ⇒ there will be more trolls that wait that products become successful and attack from “ambush”
- ⇒ potential innovators puts some probability of ex post hold up by trolls
- ⇒ society gets more DWL and less innovation

- Why did RIM settle?
 - The courts put pressure to settle
 - The uncertainty was biting the demand
 - Its share price jumped up after the settlement
 - Not settling and fighting would have been public good production, like an investment in innovation without IP protection

Case 2) Ebay vs. MercExchange

- Same kind of story with the following twist:
 - In 2003 a lower court found that EBay infringed MercExchange patents, awarded damages but not an injunction because MercExchange was not using the process itself (a patent troll)
- MercExchange was not satisfied
- ⇒ the special IP appellation court CAFC reversed the decision 2005
- ⇒ went to the Supreme Court which decided 15.5.2006 that injunctions should not be automatic and send the case back to the district court

Taking stock

- The basic problem of cumulative innovation is to make sure that there is incentive to make the first and later innovations
- There is a trade-off: if try to make sure that first innovation is made, this may put the later ones in jeopardy and vice versa.
- The nature of trade-off depends on the feasibility of ex ante licensing

- Ex ante licensing is generally good for 2nd innovator & society as it never puts 2nd innovation jeopardy
 - Generally not good for 1st innovator
 - Incentive to “hide” and “attack from ambush” (trolls)