Formation of a Pool with Essential Patents

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Abstract

We examine why cooperation among essential patent holders may not occur, despite significant gains for them and the users. We use the sequential coalition formation framework to show that no coalition may form when the number of patent holders is large, if a firm initiating the coalition can negotiate only sequentially and individually with the rest. Our results, complementing Ray and Vohra (1999) suggest that voluntary sequential negotiation cannot prevent the emergence of "tragedy of anticommons", even if side payments are allowed.

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1 Introduction

We examine whether the firms with the essential patents for a standard can voluntarily cooperate to form a patent pool. There is concern that the number of patents necessary to implement a technology can be so large that "tragedy of anticommons"(see Heller and Eisenberg (1998)) or the "patent thicket" (Shapiro (2001)) will stifle access and utilization of the technology. For example, more than 600 patents owned by 23 organizations is necessary to implement the MPEG-2 standard (see Table 1). In addition to the high transaction cost of acquiring licenses from different organizations, if each of these firms license separately, the total royalty to be paid by a licensee will become astronomical so that the use of the technology will be seriously hampered (double marginalization first pointed out by Cournot (see Shapiro (2001)). Standard implementation patent pools, such as MPEG-2, have been sanctioned by anti-trust authorities for this reason (Klein (1997)).

Lerner and Tirole (2004) have shown that a patent pool of essential patents is stable with respect to bypassing. That is, when there is a pool with essential patents, none of users will use the licenses independently offered from each essential patent owner. However, they do not examine whether the firms with essential patents can agree to from a pool. While there is a successful case of pool formation such as MPEG-2, this may be more an exception. In fact, DVD and 3G are standards where a single pool has not been formed (Table 1). What is the reason for their failure? We ask the question "how do we get to a patent pool?"

We formulate the patent pool formation process as sequential coalition formation game by Maskin (2003) for transferable utility and externality among coalitions. In cooperative game theory terminology, a patent pool formation is a coalition game with externality and transferable utility. There is externality because a patent pool's revenue depends on how other firms are organized as pools. The firms would have an incentive to design the distribution of patent pool revenue so as to promote the grand coalition. We know that inflexible distribution contributes to instability (Aoki and Nagaoka (2004)). Thus the game is with transferable utility.

We show that it is very difficult to form a patent pool. A patent pool is formed only when there are very small number of patent owners. The result is driven by the lack of super-additivity when there are many firms, due to externality. The grand coalition is always super-additive[1] but anything smaller is not. This means that the threat of other members not joining the coalition makes any coalition short of a grand coalition unattractive. Coalitions are not able to "build up" to a grand coalition, although all members know that independent licensing is undesirable.

Our approach has complements with Lerner and Tirole (2004), in which patent pool of complementary patents is shown to be stable with respect to bypassing. Most importantly, they simply assume that the firms with complementary patents agree to license the bundle of the patents from the pool, even though each of them may also independently license. We analyze whether such agreement is feasible. In addition, there are only two possible prices in Lerner and Tirole framework: patent pool price and independent licensing price where all firms set price independently. Although licensees can buy any number of independent licenses, smaller bundle of patents are not priced as a smaller bundle. In Lerner and Tirole, definition of complementarity means the size of the patent pool and price is determined by marginal contribution of member patents. The size of the pool is equal to the bundle necessary to implement a technology. Thus a licensee must purchase exactly the patents in the pool. Complementarity means sum of independent licenses are always more than the pool price and independent licensing is always rejected as result. The alternative is no coalition as with closed membership where all members must agree to form the pool. In Lerner and Tirole, unanimity (or lack of) is imposed by the licensee.

The economic literature on patent pools has developed with the legal, particularly

[1] A *game* in coalitional form is super-additive when $v(M_i \cup v(M_j) \geq v(M_i) + v(M_j)$ where M_i and M_i are *any* coalitions and v is the characteristic function. Here we abuse the term to mean $v(M) \geq \sum_{x \in M} v(x)$ where M is the grand-coalition.

the anti-trust, views. Typically, a patent pool has been characterized as a device for extending and possibly abusing market power of patents (Gilbert (2004)). For this reason, interests in patent pool of complementary patents, such as standard specification pools, sanctioned by anti-trust authorities (Klein (1997)) has been limited. The recent extensive examination of patent pools by Lerner and Tirole (2004) follows in this tradition and primarily focuses on trade-off between market power and efficient use of patents. Our interest is not this trade-off. We argue that even if the trade-off is in favor of pooling, potential efficiency may not always be realized. Our approach and interest is closer to issues related to the American Society of Composers, Authors and Publishers (Scotchmer (2004) Chapter 6), an organization where not all potential members join.

There are very few sequential coalition formation procedures when utility is transferable and there are externalities. Ray and Vohra (1999) has shown existence of stationary equilibrium in a procedure different from Maskin. In Ray and Vohra, a coalition and payoff distribution is proposed to all potential members at once. Given this simultaneous nature, payoff among members of a coalition is the same if the game is symmetric. As in Maskin, bids are made one by one on our framework. Thus distribution among members of differ.

In Ray and Vohra although proposing are made to a all potential members, the coalition will be formed even if someone rejects. Thus is has flavor of open membership[2] ((d'Aspremont et. al. (1983)) and the equilibrium coalitions are the same. On the other hand, threat to dissolve the pool if there is any objection with the conditional

[2]In *non-cooperative games*, moves can be simultaneous or sequential. In the open membership game, the strategies of the players (firms) to join (YES) or not to join (NO) a coalition (d'Aspremont et. al. (1983)). All firms that announced YES form a coalition. All those that announced NO remain independent (singleton coalition). Membership is open in the sense that anyone who wants to join can join the coalition.

There are two closed membership games (Hart and Kurz (1983)). Membership is closed because a member needs approval of other members to join a coalition. In the Γ-game, each firm announces a coalition, M that it wants to join. A coalition formed if and only if all members actually choose to join. If firm i announces M but firm j did not when $j \in M$, then M is not formed. In the Δ-game, all firms that chose the same coalition (same message) form a coalition. Not all potential members need to have chosen to join. The strategies in this game are more appropriately interpreted as messages and all those that choose the same message form a coalition.

coalition offers is similar to closed membership Hart and Kurz (1983) and it is possible to form the grand-coalition.

In section 2 we present patent pools as a game in coalitional form. In section 3, we formulate and characterize the sequential formation of patent pools. We finish with remarks including relationship to other sequential formation games in section 4.

2 Patent Pools as Coalitions

We formulate formation of the pool of essential patents as a coalition game in partition function form (Thrall and Lucas(1963)) with transferable utility. We use a partition function, where value of a set depends on how non-members of that set are organized, instead of a characteristic function, where the value of a set is independent of how non-members are organized. This is necessary because patent pools impose externality on other coalitions and non-member independent firms.

There are n firms that each own an essential patent to a standard. We denote by $\pi = \{M_1, M_2, \cdots, M_\ell\}$ the partition of the set $N = \{x_1, x_2, \cdots, x_n\}$ and $\sum_{i=1}^{\ell} |M_i| = n$, $\ell \leq n$. Each coalition represents a patent pool and coalition M_i charges royalty r_i to licensees.

We define the profit (equal to revenue since we assume no cost) for each coalition as the Nash equilibrium payoffs when coalitions play a non-cooperative royalty setting game, given the partition π. Demand for the number of licenses is $1 - r$ when total royalty payment by each licensee is r. If there is only one pool, then r is the royalty charged by that pool. If there are $\ell > 1$ pools (a pool may have only one member), then $r = \sum_{i=1}^{\ell} r_i$. Coalition M_i's profit is $r_i(1 - \sum_{i=1}^{\ell} r_i)$ which is the game payoff. Each coalition chooses its royalty simultaneously as a non-cooperative game. There is a unique symmetric pure strategy Nash equilibrium royalty, where all coalitions charge the same royalty,

$$r^* \equiv r_i^* = \frac{1}{\ell + 1}. \tag{1}$$

Note that royalty depends on the partition π but only through the number of coalitions, ℓ. Coalition M_i's equilibrium payoff is,

$$v(M_i|\pi) = \frac{1}{(\ell+1)^2}. \tag{2}$$

In the coalition game terminology, v is a *partition function* since it assigns a value to a coalition for each partition. Partition function captures two important aspects of our formulation: externality and transferable utility. A coalition's profit depends on how other firms are organized, i.e., there is externality. We do not *a priori* specify how profit is distributed among its members, i.e., utility is transferable among coalition members. We will use the following notation,

$$v(M_1|\ell) \equiv v(M_i|\pi) \text{ where } \pi = \{M_1, \cdots, M_\ell\}.$$

First, we note that there is positive externality from a merger:

$$v(M_i|\ell+1) < v(M_i|\ell).$$

When two coalitions merge so that the number of total coalitions is reduced from $\ell+1$ to ℓ, other coalitions benefit. This also means a firm always benefits from leaving a coalition,

$$v(x_i|\ell-1) > v(M \cup \{x_i\}\,|\ell).$$

This also illustrates that there is no core when there is positive externality.

The grand-coalition is super-additive:

$$v(N|1) > nv(x_i|n).$$

$v(N|1)$ is the value of the grand-coalition N, which is the only coalition, i.e., $\ell = 1$, and $v(x_i|n)$ is value of each singleton coalition when there are only singletons, i.e., $\ell = n$. This suggests that the grand-coalition is attractive and perhaps "stable" in some sense.

3 Sequential Coalition Formation

Extensive Form Game of Coalition Formation

We use the algorithm from Maskin (2003).[3] Firms, x_1, x_2, . . ., x_n, are offered bids to join coalitions in a predetermined order. We name the stages according to the identity of the firm that is getting offers. There is no stage 1 because the game begins with firm x_1 (only coalition at this stage) making an offer to firm x_2.

Stage 2: x_1 makes b_1 to x_2 to join the coalition (singleton). If x_2 accepts, coalition $M_1 = \{x_1, x_2\}$ is formed and there is only one coalition, $M = \{x_1, x_2\} \equiv x_1x_2$. If x_2 rejects, then there are two coalitions, $M_1 = \{x_1\}$ and $M_2 = \{x_2\}$.

At end of each stage, we can identify the number of coalitions that have been formed. In stage k, with $2 < k \leq n$,

Stage k: Suppose ℓ_k coalitions have been formed out of $k - 1$ firms up to this point ($1 \leq \ell_k \leq k - 1$). One of the coalitions, M_i, makes offer b_i, $i = 1, 2, \cdots, \ell_k$, to x_k to join the coalition. x_k can accept one of the offers or reject all of them. If x_k accepts M_i's offer, M_i turns into $M_ix_i \equiv M_i \cup \{x_k\}$ and the total number of coalitions is still ℓ_k, thus $\ell_{k+1} = \ell_k$. If x_k rejects all offers, it forms its own coalition $\{x_k\}$ and the total number of coalitions increases to $\ell_k + 1$ and $\ell_{k+1} = \ell_k + 1$.

The process continues until all players have either accepted or rejected offers.

[3]Maskin presents the sequential game to motivate a value of a game in coalitional form with externalities and super-additivity. Out game is not super-additive. But since there are externalities, there is no core.

The last stage is stage n after which there will be maximum of n coalitions ($\ell_{n+1} = n$), all of them singletons, and minimum of one (grand) coalition ($\ell_{n+1} = 1$). There is a partition of the n firms and sequence of bids that have been accepted associated with each terminal node.

Equilibrium

We are able to identify the unique subgame perfect equilibrium coalition and allocation. Allocation is determined by the final partition and the bids that have been accepted.

For illustrative purpose, we will solve the game for $n = 3$. There are 5 terminal nodes:

(1) $\pi_1 = \{x_1 x_2 x_3\}$, $(b_1, b_{1'})$, $\ell_4 = 1$

(2) $\pi_2 = \{x_1 x_2, x_3\}$, (b_1), $\ell_4 = 2$

(3) $\pi_3 = \{x_1 x_3, x_2\}$, (b_1), $\ell_4 = 2$

(4) $\pi_4 = \{x_1, x_2 x_3\}$, (b_2), $\ell_4 = 2$

(5) $\pi_5 = \{x_1, x_2, x_3\}$, no accepted bids, $\ell_4 = 3$

Allocation at node 5 is determined by the partition function, $v(x_i|3) = 0.0625$, $i = 1, 2, 3$. At node 4, $v(x_1|2) = v(x_2 x_3|2) = .111$. At stage 3 with $\ell_3 = 2$, x_3 will accept bid b_3 if $b_3 \geq v(x_3|3) = 0.0625$ while x_2 is willing to offer $b_3 \leq v(x_2 x_3|2) - v(x_2|3) = .111 - 0.0625 = 0.0485 < 0.625$. No acceptable bid will be offered. So the equilibrium of the subgame is $b_i > 0.0625$, $i = 1, 2$ and x_3 rejecting both offers. The subgame perfect equilibrium allocation is $w_i = v(x_i|3)$, $i = 1, 2, 3$.

Consider the other stage 3 node with $\ell_3 = 1$. The coalition $x_1 x_2$ will make offer b_3 such that

$$b_3 \leq v(x_1 x_2 x_3|1) - v(x_1 x_2) = 0.25 - 0.1111 = 0.1389,$$

while x_3 will accept offer greater than $v(x_3|2) = 0.1111$. The equilibrium is for x_1x_2 to offer $b_3 = 0.1111$ and x_3 accepts. The equilibrium outcome is node 1 with $b_3 = 0.1111$ and b_2 (yet to be determined). $w_1 = v(x_1x_2x_3|1) - b_2 - b_3 = 0.1389 - b_2$, $w_2 = b_2$ and $w_3 = b_3 = 0.1111$.

At stage 2. x_1 wants a bid such that $0.1389 - b_2 \geq v(x_1|3) = 0.0625$, or $b_2 \leq 0.0764$ to be accepted. x_2 will accept a bid if $b_2 \geq v(x_2|3) = 0.0625$. Thus the equilibrium is for x_1 to offer $b_2 = 0.0625$.

The subgame perfect Nash equilibrium outcome is: at stage 2, $b_2^* = 0.0625$, x_2 accepts; at stage 3 (ℓ_3 = 1), $b_3^* = 0.1111$, x_3 accepts. The terminal node 1 is the final equilibrium allocation $w_1^* = v(x_1x_2x_3|1) - b_2^* - b_3^* = 0.0764$, $w_2^* = b_2^* = 0.0625$ and $w_3^* = b_3^* = 0.1111$. We have shown the following,

Proposition 1. *Grand coalition forms for $n = 3$. The allocations are,*

$$w_3^* = b_3^* = v(\{x_3\}|2) = \frac{1}{9} = 0.111, \quad w_2^* = b_2^* = v(\{x_2\}|3) = \frac{1}{16} = 0.0625,$$
$$w_1^* = v(\{x_1, x_2, x_3\}|1) - b_2^* - b_3^* = \frac{1}{2} - \frac{1}{9} - \frac{1}{16} = 0.0764.$$

In order to characterize the equilibrium for larger n, we first make the following observation which follows immediately from (2),

$$v(M_j \cup M_i|\ell) > v(M_i|\ell+1) + v(M_j|\ell+1) \text{ when } \ell = 1, \tag{3}$$
$$v(M_j \cup M_i|\ell) < v(M_i|\ell+1) + v(M_j|\ell+1) \text{ when } \ell \geq 2. \tag{4}$$

Note that $v(M_i|\ell) = v(M_j|\ell)$ for all ℓ and for any coalitions M_i and M_j. In particular, M_i can be a singleton. We immediately can make the following claim.

Lemma 1. *At any stage, if there are 2 or more coalitions formed, the offer to a new firm will be rejected.*

Proof. We will start with stage n and work backwards.

We first note that because $v(M_i|\ell)$ depends only on ℓ, all bids that are accepted by x_k will be the same for all coalitions as we see from the following observation. A coalition M_i is willing to bid the marginal benefit from having x_k join the coalition. If its bid is rejected, x_k will either join another coalition or form a new coalition by itself. Coalition M_i's bid b_i satisfies,

$$b_i \leq v(M_i x|\ell) - v(M_i|\ell) \tag{5}$$

$$b_i \leq v(M_i x|\ell) - v(M_i|\ell + 1). \tag{6}$$

Marginal benefits are independent of any bids by M_i that have been accepted are sunk. Right-hand side of (5) is zero, so this cannot be the condition for a winning bid. Equation (6) is the same for all coalitions since it only depends on ℓ.

Suppose there are ℓ_n coalitions have been formed by the beginning of stage n. If a coalition's bids is accepted by x_n, there will be ℓ_n coalitions as result. The maximum bid a coalition is willing to make is,

$$v(M_i x_n|\ell_n) - v(M_i|\ell_{n+1}).$$

x_n will accept any bid greater than

$$v(x_n|\ell_n + 1).$$

Because of inequality (4), there will be no bid that is acceptable to x_n that M_i is willing to offer when $\ell_n \geq 2$.

Suppose no bid is accepted by x_{k+1} for all stages later than $k + 1$ when there are 2 or more coalitions. Now consider stage k with 2 or more coalitions, i.e., $\ell_k \geq 2$. If all bids are rejected, there will be $\ell_k + 1 \geq 2$ coalitions in stage $k + 1$. For all later stages no bids will be accepted. There will be $\ell_k + n - k + 1$ coalitions at the end of stage n. If x_k accepts a bid, there will be $\ell_k \geq 2$ coalitions in stage $k+1$. No bids will be accepted and there will be $\ell_k + n - k$ coalitions at the end of stage n. M_i is willing to bid up to

$$v(M_i x_k | \ell_k + n - k) - v(M_i | \ell_k + n - k + 1).$$

x_k will accept bid greater than

$$v(x_n | \ell_k + n - k + 1).$$

Again, because of inequality (4), no acceptable bid will be offered. □

We need to see what happens if only one coalition has been formed by stage k, i.e., $\ell_k = 1$:

Lemma 2. *For $n \geq 4$, no bid will be accepted at stage $k \leq n-2$ when $\ell_k = 1$. That is, even when only all invited firms participated in the coalition up to that stage, its bid will not be accepted if there are more than 3 stages left.*

Proof. If all bids have been accepted so that there is only one coalition in stage n, the coalition is willing to bid up to

$$v(Mx_n|1) - v(M|2)$$

which is greater than what x_n is willing to accept,

$$v(x_n|2),$$

because of (3).

If $\ell_{n-1} = 1$ and if the coalition's bid is accepted, it will be $\ell_n = 1$ in the next stage n in which case x_n will accept the bid of $v(x_n|2)$ and grand coalition will form . If the bid is rejected, then $\ell_n = 2$ in the next stage. We know from Lemma 1 that there will be 3 coalitions in the end. The coalition is willing to bid up to

$$v(Mx_{n-1}x_n|1) - v(x_n|2) - v(M|3) = \frac{1}{2^2} - \frac{1}{3^2} - \frac{1}{4^2} = \frac{11}{144}.$$

This will be accepted since x_{n-1} is willing to accept anything greater than,

$$v(x_{n-1}|3) = \frac{1}{4^2} = \frac{1}{16}.$$

If $\ell_{n-2} = 1$ and if the coalition's bid is accepted, it will be $\ell_{n-1} = 1$ in stage $n-1$. If the bid is rejected, then $\ell_{n-1} = 2$ and we apply Lemma 1. The coalition in stage $n-2$ is willing to offer up to

$$v(Mx_{n-2}x_{n-1}x_n|1) - v(x_n|2) - v(x_{n-1}|3) - v(M|4) = \frac{131}{3600}.$$

Firm x_{n-2} is willing to accept any bid greater than

$$v(x_{n-2}|4) = \frac{1}{25} > \frac{131}{3600}.$$

The bid will be rejected as a result if $\ell_{n-1} = 2$.

Suppose $\ell_{k+1} = 1$ but x_{k+1} rejects coalition's offer in stage $k+1 \geq n-2$. We show that the coalition's offer is rejected by x_k when $\ell_k = 1$ in stage k. The coalition is willing to bid up to

$$\underline{b} = v(Mx_k|n-k) - v(M|n+1-k),$$

and x_k will accept bid greater than,

$$\overline{b} = v(x_k|n+1-k).$$

$$\underline{b}-\bar{b} = \frac{1}{(n-k+1)^2} - \frac{2}{(n-k+2)^2} = \frac{-(n^2-2nk+k^2-2)}{(n-k+1)^2(n-k+2)^2} < 0 \text{ for } k \leq n-2.$$

There is no acceptable bid. □

When there are more than 4 firms, there are more than 3 stages left at stage 1. From Lemma 2 no acceptable bid exists in this stage. Thus, from Lemma 1, no acceptable bid exists at stage 2. Similarly at later stages, there are more than 2 coalitions. No acceptable bids will be offered at any stage in equilibrium.

Proposition 2. *When $n \geq 4$, no acceptable bids will be offered in subgame perfect equilibrium. No coalition will form in equilibrium. Equilibrium allocation is $w_i^* = v(i|n)$, $i = 1, 2, \cdots, n$.*

This result is in contrast to Vohra and Ray (1999) which also presents a sequential formation game for coalitions with transferable utility and externality. We may apply Theorem 3.6 (Vohra and Ray (1999)) focusing on Cournot competition, based on the following observation. The equilibrium royalty r_i^* given by (1) is equal to the Cournot equilibrium output with demand $p = 1-q$ and marginal cost 0 and $v(M_i|\pi)$ is the profit of cartel M_i if the partitions represented production cartels. Recall that the *minimal profitable coalition size* (Salant, Switzer, and Reynolds (1983)), m^*,

$$v(m, n-m+1) \geq mv(1,n) \quad \forall m \geq m^*.$$

Vohra and Ray result states that the subgame perfect equilibrium outcome will have partition,

$$\{M, x_i, x_{i+1}, x_n\}, \text{ where } |M| = m^*.$$

There will be coalition of minimal profitable coalition size and all other firms will remain independent.

In Ray and Vohra, an offer to join is made to a set of players and once players accept the offer and form a coalition, that coalition is unable to bid for additional members.

Because offers are made to a set of players, the outcome has a closed membership flavor.[4] In our formulation, offers to join are made to one player at a time, and all coalitions are able to bid for all players after them.

4 Conclusion

We have shown that even when pool revenue is distributed members flexibly, it is not possible to form a pool.

At the very early stage of establishing a standard, a patent owner agrees to the so called RAND (reasonable and non-discriminatory) condition when submitting a patent to be part of a standard. This is considered to be a way to control royalty pricing and help promote the standard. Non-discriminatory refers to licensing to anyone. What constitutes "reasonable" is not very clear. Here we consider several interpretations and see if and how they contribute to patent pool stability.

Interpreting "reasonable" to require independent royalty must be no more than the pool royalty is effective only if the pool is the grand coalition. Requiring a non-member charge no more than the pool without the pools is not effective. A restriction $r_i \leq r_0$ does not effect the Nash equilibrium royalty because $r_i^* = r_0^*$ without the restriction. There is incentive to license independently.

[4]For $n \leq 4$, there is no such $m^* < n$, meaning it is better not to form any coalition other than the grand coalition when total number of firms is equal to or less than 4.

When there are more than 4 firms, there are strategic coalition formation games where a non-trivial coalition that is not the grand coalition is formed in Nash equilibrium. In such cases, the coalition formed is either of size m^* or more.

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Table 1: Recent Standard Patent Pools

Name, Year	Admin.	Members	Licensing Policy	Patents	Other Info.
MPEG 2, 1997	MPEG LA	Originally 13 firms, 1 university; And any firm that has an essential patent can participate; currenlty 22 firms, 1 univ.	1. The contract term is from 10 and a half to 15 and a half years. 2. For MPEG-2 decoding products, the royalty is US $4.00 for each decode unit. A royalty of US $6 per unit applies to Consumer Products having both encoding and decoding capabilities. (Both of which prior to Jan. 1, 2002, and $2.50 from Jan. 1, 2002.) Etc. 3. Licensees have the right to renew for successive five-year periods for the life of any MPEG-2 Patent Portfolio Patent, subject to reasonable amendment of royalty terms and rates (not to increase by more than 25%). 4. New Licensors and essential patents may be added at no additional cost.	Originally 27 patents; currently over 640.	1. Each firms can license independently. 2. The allocation of royalties depends on the share of patents contributed to the pool.
DVD(3C), 1998	Philips	Philips, Sony, Pioneer	1. The contract term is 10 years. 2. Commitment to royalty (royalties of 3.5% of the net selling price for each player sold, subject to a minimum fee of $7 per unit, which drops to $5 as of Jan. 1, 2000 and $.05 per disc sold.) 3. A most favorable conditions clause. 4. An obligation for licensee to grant-back any essential patent on fair, reasonable and non-discriminatory terms.	115 patents for the manufacture of DVD players, 95 patents for the manufacture of the discs. Future essential patents	1. Each firms can license independently. 2. The allocation of royalties is not a function of the number of patents contributed to the pool.
DVD(6C), 1998	Toshiba	Hitachi, Matsushita, Mitsubishi Electric, Time Warner, Toshiba, Victor Company of Japan	1. The contracts run until Dec. 31, 2007 and renew automatically for 5-years terms thereafter. 2. Commitment to royalty (royalties of $.075 per DVD Disc and 4% of the net sales price of DVD players and DVD decoders, with a minimum royalty of $4.00 per player or decoder) 3. A most-favored-nations clause 4. An obligation for licensee to grantback any essential patent on fair, reasonable and non-discriminatory terms.	All the present and future essential patents	1. Each firms can license independently. 2. The allocation of royalties depends on the share of patents contributed to the pool.
3G Platform*	3G Patent Ltd**	19 firms (8 operators, 11 manufacturers)	1. Maximum Cumulative Royalty is 5%. 2. Standard Royalty Rate per certified essential patent is 0.1% (However, the option to negotiate a bi-lateral agreement is available)	All the essential patents of the member firms	1. Members able to by-pass and license independently with mutually agreeable terms. 2. The allocation of royalties depends on the share of patents contributed to the pool.

Source: Nagata(2002); http://www.3gpatents.com; http://www.mpegla.com; DOJ Review Letter from Joel Klein to Carey R. Ramos, June 10, 1999; DOJ Review Letter from Joel Klein to Gerrard R. Beeney, December 16, 1998.