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**Should FRAND royalties be based on
SSPPU or downstream prices?
An analytical framework**

Policy Brief IPR/2018/01

Intellectual Property Rights

Standard Essential Patents

Digital India

Innovation enables growth but it is also a national imperative for India in a knowledge-driven global economy. Given young India's young population, the size of its markets and the nature of its problems, India has great potential of being at the forefront of new technologies.

Two requirements for transforming India into a knowledge-based society are growth in human capital and the establishment of an innovation ecosystem. Neither will be possible without strategic government interventions in formulating laws and policies and, in developing the right institutions to create and nurture technological discoveries.

However, even these initiatives will come to nought if the intellectual assets generated by the human capital is not managed appropriately. Value generated from intellectual assets should not only be maximized, it must also be distributed widely among the Indian population.

This series focuses on the role played by intellectual property laws, competition policy and other institutions in defining the innovation ecosystem.

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An analytical framework

Brief

Standard Essential Patents in the family of patents has assumed a significant role in applications of AI extending beyond ICT to digital India. Standards fixed by Standard Setting Organizations and the requirement of licensing on FRAND (Fair, Reasonable and Non-Discriminatory) conditions have raised several debates on the fixing of royalty. The central argument arises from whether FRAND royalties should be based on SSPPU (Smallest Saleable Patent Practising Unit) or on downstream prices. We also examine the case when royalty is charged on the chipset and not on the product. The significance of royalty payments where SEPs are concerned and their widespread application prompted the DIPP to come out with a concept-paper.

Phone manufacturers (semi-assemblers) in India in their complaint to the Competition Commission of India have alleged violation of FRAND commitments, insisting that royalty payments be based on SSPPU. In this paper we examine outcomes if royalty is levied on the downstream price as against SSPPU. An important consideration is whether royalty based on the downstream price facilitates access to the phone set market for a larger number of consumers for whom price is an important consideration.

Using a simple analytical framework, the paper shows that in the vertically differentiated phone-set market, end-consumers (users of phone sets) gain when royalty is charged on the basis of a percentage of downstream price than on the basis of SSPPU as argued by phone set manufacturers. If the royalty is levied on the SSPPU then all quality differentiated manufacturers pay the same royalty per product irrespective of the product price. An important policy implication is that royalty charged on the basis of SSPPU diminishes the market size and with it the scope for employment generation.



An important and significant issue of patent licensing in FRAND (Fair, Reasonable and Non-Discriminatory) is in the determination of royalty payments. Should the royalty chargeable to a Standard Essential Patent (SEP) be levied on the downstream price of the product using the SEP, or should it be the same as that charged on the Smallest Saleable Patent Practising Unit (SSPPU)? If the royalty is levied on the downstream price, manufacturers have to pay a royalty depending on the price of the product. If the royalty is levied on the SSPPU then all quality differentiated manufacturers pay the same royalty per product irrespective of the (final) product price. There is yet a third argument that royalty be charged on the chipset rather than on the product though consumers derive no direct value from the chipset.

A Department of Industrial Policy and Promotion (DIPP) discussion paper quotes the Competition Commission of India (CCI) to point out that using the “*downstream product’s sale[s] price as a royalty base [can be seen] as being excessive and having no link to the value of the SEP*”. The comment provokes the following two questions: Do consumers really benefit from royalty being charged on SSPPU rather than on the product price? Does royalty being charged on SSPPU result in more consumers buying the product?

The focus of the paper is to develop the basic analytical framework that offers a balanced perspective for assessing outcomes on end-consumers in three suggested methodologies of charging royalty for SEP license. Later briefs will analyse related arguments of fixing royalty on the basis of downstream price.

Vertically differentiated products

The analysis is set in the market for vertically differentiated products. The handset phone and mobile market is a typical market for vertically differentiated products with a wide range of products and prices offered by firms. However, for our analysis it is sufficient to consider any two varieties. As will be obvious, the analysis holds irrespective of the number of varieties.

We make the following assumptions:

- a) There are two vertically differentiated products indexed i , $i = 1, 2$. The price for product i is p_i and its quantity is q_i . The utility value (consumer benefit) of i is u_i and $u_1 > u_2$
- b) Both have to meet the same standard for which the SEP is required. (For this analysis, it does not matter if the SEP is one patent or a set of patents or a pool of patents that has the SEP(s).)
- c) To simplify the algebra, we will assume that there is zero material cost of producing the output and the profit has to be shared between the manufacturer and the SEP holder.

Three scenarios labelled Case I, II, and III are developed. The three cases constitute the core of the arguments surrounding FRAND royalty payment for SEPs. The optimizing value of

output in each case is derived in simple algebraic terms. Case I is when royalty is a percentage of downstream price; Case II is when it is fixed at SSPPU and Case III is of royalty charged on the chipset instead of the chipset using product that generates utility value to a final consumer. (The consumer derives no utility from the chipset but derives utility from a device that has the chipset in it.)

Case I: All manufacturers pay a royalty that depends on the downstream price of its products.

Let r be the royalty rate charged on product i with price p_i and quantity q_i . The (inverse) demand function for product i is given by $p_i = p_i(q_i)$.

Profit of the patent holder is equal to $rp_1(q_1)q_1 + rp_2(q_2)q_2$

Profit of manufacturer $i = [p_i(q_i) - rp_i(q_i)]q_i = (1 - r)p_i(q_i)q_i$

Case II: Royalty is charged to the manufacturer of the SSPPU. Producers of devices that have applications and features not contained in the SSPPU do not pay any royalty based on the consumer valuation of these additional features. In our example, the lower quality product ($i = 2$, since $u_1 > u_2$) is the SSPPU. If R is the royalty (or price of the SEP) for the lower quality product, it is also the same for the higher quality product. In this case:

Profit of patent holder = $Rq_1 + Rq_2$

Profit of manufacturer $i = [p_i(q_i) - R]q_i$

We can observe the following:

In Case I, since the value of q_i that maximizes $p_i(q_i)q_i$ is the same as the value that maximizes $(1 - r)p_i(q_i)q_i$, each producer's optimization (output) is unaffected by the royalty rate. In Case II, however, for any positive R , the optimizing value (output) of q_i is less than the case with $R = 0$ and the optimal q_i falls with R . The profit maximizing q_i in Case II is smaller than that of q_i in Case I. While there is intuitive logic in these observations the results are worked out in the Appendix.

Case III: In the cases above we have assumed that the SSPPU is a consumer product. Now let us assume that the SEP is embedded in a chip that has no value to the consumer but can be used by a producer to produce a product that has value to the consumer. (A chip that goes into a hand-set has no value by itself but the hand-set is valued by the consumer.) In this case the chip has a cost of production c , and is sold at a price x . The question then becomes: should the SEP holder charge a royalty to the chip manufacturer or should the SEP holder charge royalty to the producer of hand-sets? The market norm is the latter while the policy being suggested by a manufacturer, to CCI, is that it should be the former.

Let us see what it means if the chip manufacturer were to pay the royalty. Suppose the royalty rate is r_c . Then if Y is the amount of chips sold, the chip manufacturer earns a profit given by

$$\pi_c = [(1 - r_c)x - c]Y$$

If the chip manufacturer is competitive, it makes zero profit and, hence, $\pi_c = 0$, implying,

$$x = \frac{c}{1 - r_c}$$

Both hand-set producers buy the chip at the same price x and, hence, each i makes a profit given by

$$\pi_i = [p_i(q_i) - x]q_i$$

Since $x > 0$, as shown in the comparison between Cases I and II, the optimal q_i in Case III will be less than that of each q_i , $i = 1, 2$ in Case I. The main point to note here, therefore, is that regardless of what r_c is, our analyses of Cases I and II show that the total size of the market, $q_1 + q_2$ will be less in Case III compared to Case I.

Policy implications

Competition ensures that new companies coming in with new ideas can commercialize their efforts. Without this, growth and the discovery of better quality products are hampered. The efficacy of this approach is measured by the ultimate improvement in consumer benefits and this we know increases as more is produced and/or when consumer prices fall. Our analysis suggests that royalty fixation under the SSPPU approach *reduces* both the *measure (or number)* of consumers enjoying a surplus as well as the *amount* of surplus enjoyed by each consumer buying the product when compared to that of charging a royalty based on the end-product price.

These findings stand in direct contrast to the opinion expressed by CCI in their prima facie orders. In other words, royalty payments on the basis of a percentage of downstream price facilitates expansion of the hand-set market enabling more consumers to access the market. Our understanding is that if CCI is particularly interested in the growth of the hand-set market, and in ensuring a greater consumer surplus for consumers. As we have shown, this happens when royalty is charged on the downstream price.

Non-Producing Entities

Many SEP holders are non-producing entities. In other words, they do not produce the products that final consumers are buying. They can extract a value for their SEP only if (hand-set) producers use their SEP. Producers will use SEPs only if consumers demand the hand-sets where these SEPs have to be used. In the current situation, the SEP holder gets a percentage of the revenue (rpq) in the hand-set market. Therefore, for a given r , the SEP holder is benefited as pq increases. Given that the market demand for any hand-set is highly elastic, revenue increases as price falls. In other words, the SEP holder has an interest in growing the market for products that uses its SEP. As explained above, one of the objectives of CCI is to grow markets and in this, the CCI's and the SEP holder's objectives are aligned. The SEP holder has an incentive to increase the size of the market by making products more affordable.

Producers of hand-sets

Consider the producer of quality 1, or the higher priced variety. She pays a royalty of r_1p_1 for each unit of hand-set, which is greater than what is paid on the lower quality product, r_2p_2 , for all $r_1 \geq r_2$, since $p_1 > p_2$. This may lead some to argue that she would want to pay the same royalty as that paid for the lower quality i.e., make the royalty price SSPPU-based as that would increase her profit. What is being missed in this argument is that the SEP holder will then find it in its interest to raise r_2 to recover the losses (in royalty received) on the sale of the higher quality product. At the very least, it will reduce the profit made from the sale of the lower quality product and also increase the price for the lower quality product. In other words, the poorer consumers who buy the lower quality, will pay more now so that the richer consumers, who buy the higher quality, can do so at a lower price. Moreover, as argued above, this could lead to a lower number of people buying hand-sets ($q_1 + q_2$). And, indeed, the fact that r_2 can be increased suggests the possibility that the producer of the higher quality may not end up making a higher profit.

Of significance is also the fact that the SSPPU approach does ensure that market size diminishes and as a consequence employment falls if higher production is associated with greater employment.

Conclusion

In this paper we have shown that in the vertically differentiated phone-set market, end-consumers (users of phone sets) gain when royalty is charged on the basis of a percentage of downstream price than on the basis of SSPPU as argued by Micromax and by CCI in their prima facie order. An important consideration is that royalty based on the downstream price facilitates access to the phone set market for a larger number of consumers for whom price is an important consideration. Moreover, as shown, royalty charged on the basis of SSPPU diminishes the market size and, with it, the scope for employment generation.

Appendix

It helps to think about this game in two stages. In stage 1, the patent holder sets the royalty rate/royalty per product. In stage 2, each manufacturer chooses the price by choosing the quantity to be sold.

Case I

Profit of manufacturer $i = \pi_i^M = (1 - r)p_i(q_i)q_i$

First order condition for profit maximization = $\frac{d\pi_i^M}{dq_i} = (1 - r) \left[\frac{dp_i(q_i)}{dq_i} q_i + p_i(q_i) \right]$

$$\frac{dp_i(q_i)}{dq_i} q_i + p_i(q_i) = 0 \quad (1)$$

q_1^* and q_2^* are the profit maximizing quantities which can be obtained by solving the above equation. Note that for all $1 > r_k > 0$, $1 > r_l > 0$, $r_k \neq r_l$, $q_i^*(r_k) = q_i^*(r_l)$, $i = 1, 2$. In other words, the optimal quantities are independent of the royalty rates.

Case II

Profit of manufacturer $i = \pi_i^M = [p_i(q_i) - R]q_i$

First order condition for profit maximization = $\frac{d\pi_i^M}{dq_i} = \left[\frac{dp_i(q_i)}{dq_i} q_i + p_i(q_i) - R \right]$

$$\frac{dp_i(q_i)}{dq_i} q_i + p_i(q_i) - R = 0 \quad (2)$$

Let q_1' and q_2' be the profit maximizing quantities.

Case III

Profit of manufacturer $i = \pi_i^M = [p_i(q_i) - x]q_i$

First order condition for profit maximization = $\frac{d\pi_i^M}{dq_i} = \left[\frac{dp_i(q_i)}{dq_i} q_i + p_i(q_i) - x \right]$

$$\frac{dp_i(q_i)}{dq_i} q_i + p_i(q_i) - x = 0 \quad (3)$$

Let q_1'' and q_2'' be the profit maximizing quantities.

For the equilibria in all cases, the second order conditions must hold, i.e., the LHS of each of the equations (1), (2) and (3) must be decreasing in q at values where the equations hold. If we plug in q_i' and q_i'' in equation (2) and (3) respectively, we have $\frac{dp_i(q_i')}{dq_i} q_i' + p_i(q_i') = R > 0$ and $\frac{dp_i(q_i'')}{dq_i} q_i'' + p_i(q_i'') = x > 0$. This means that $q_i^* > q_i'$ and $q_i^* > q_i''$ whenever $R > 0$ and $x > 0$.

Note that given the second order conditions and the fact that quantity bought increases if price falls, $p_i(q_i') > p_i(q_i^*)$ and $p_i(q_i'') > p_i(q_i^*)$, i.e., the (net) consumer surplus of each



buyer, measured as $u_i - p_i(q_i)$, improves as price falls. Thus, Case I also gives a higher consumer surplus.

Thus, pricing following the SSPPU approach (Case II) reduces the market size and the consumer surplus (compared to Case I). Also, if royalty is charged on chip producer rather than handset producer (Case III), it reduces market size and consumer surplus (compared to Case I)

About the institute

India Development Foundation (IDF) is a private, non-profit, research foundation set up as a Trust in 2003. Guided by the principles of equality and non-discrimination, IDF works on a variety of issues with a view to inform policymakers. One of its focus areas is to develop awareness about how markets work, why they are desirable and how to develop them. IDF aims to help policymakers transform emerging economies into market-based societies.

An important dimension of policy analysis is the linking of law and economics. At IDF a separate centre called the Ambedkar Centre for Law and Economics was created in memory of the man who intellectually and effectively combined the two aspects of policy making. These policy briefs are from the Ambedkar Centre for Law and Economics.

About the project

This project is on Intellectual Property Rights, Standard Essential Patents and Digital India. It is increasingly clear that several questions and doubts, raised in various fora of the government, regulatory bodies and the public, indicate misconceptions on intellectual property and the associated rights. It is important to not only clarify misconceptions but to provide a reasoned perspective and encourage a vibrant debate among the major players on this important subject.

Research undertaken in this project use economic reasoning to focus on how markets in the area of high technology work. Short Policy Briefs that address these issues are planned for public consultation and to be distributed to the relevant ministries and departments of the government regulatory bodies and trade bodies.

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