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January 2002

ISSN 0019–5170

No. 326 JANUARY 2002 Vol. LXXXII

The Indian Journal of Economics

THE DEPARTMENTS OF ECONOMICS AND COMMERCE
UNIVERSITY OF ALLAHABAD
POST BOX NO. 2005, ALLAHABAD 211 002 (INDIA)
FAX : 0091—0532—609857

Internet Licensing : The Software Dimension[1]

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Abstract

Software cross-licensing on the internet has very different characteristics in comparison to hardware interconnection. The basic aim of this study is to highlight a few aspects of software licensing arrangements. The analytical approach developed here can explain the observed patterns of content of different websites; as well as the mergers, reorganization and shakeout that the .com companies are currently experiencing.

1. The Issues

From the viewpoint of every user of the internet there is a necessity for hardware as well as software connections. The hardware consists of a PC; a modern and telephone or a LAN connection, an internet service provider (ISP); and the world wide web itself[2]. The software consists of the various service providers like the .com and .org websites developed and maintained by diverse agencies. In the context of hardware requirements the user needs several connections in tandem to derive any benefit at all. By way of contrast the software services can be standalone portals[3] or interconnected websites.

A significant amount of work on the economics of hardware connectivity is already in progress[4]. See, for example, Berman and Dunn (1987), Bakos and Brynjolfsson (1997), and Greenstein (2000 a, b)[5]. However, the problems associated with site development and software cross-licensing appear to be different. This aspect did not receive an adequate attention so far. A few aspects were considered in Chuang and Sibru (1999), Oh and Chang (2000), Thomas and Wyatt (2000), and VanDijk (2000). However, some of the most fundamental issues have yet to be addressed. The lack of an appropriate conceptual basis is at the apex of the problem.

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The following issues regarding software licensing are pertinent.

(a) Given the variety of activities that can be built into a website how many services should a site developer include[6] ? What is the nature, in terms of complementarity or substitutability, of the services included in a particular site[7] ?

(b) Having limited the number and type of information offered a site developer realizes that a visitor to his site may like to get some related information that his site does not offer. Would it be feasible and economical from the viewpoint of the site developer to obtain a license to access alternative sites where that information is available ? If the answer is yes, how many such interconnections should he seek and what will be the quantum of payments for each such interconnection ?

(c) Would there be a situation where the number of licenses to obtain and their complexity would suggest that the owner of the site would find it economical if he merges with or takeover all such related sites ? More generally, what is the optimum number of sites and the efficient composition of each one of them[8] ? It is, however, necessary to recognize that cross- licensing may persist even after such consolidation.

(d) What is the generic structure of cross-licensing contracts for internet software ? What are the economic reasons for the efficiency of such contracts ?

The present study considers a few of these economic aspects of software cross-licensing[9]. This is important in the context of the likely shakeouts, mergers, and realignments of different websites already in progress.

The rest of the study is organized as follows. Section 2 argues that end user subscriptions and advertisements by firms constitute the basic pricing mechanism for the websites. It also provides the basis for the economics underlying the demand for and supply of information by a particular website developer. It will be argued that a simple modification of the horizontal integration logic will be pertinent. Section 3 formally examines the lower and upper limits on the information products that will be packaged into any specific website. The dynamics of the composition of these portals will be evident from this analysis. The different forms of cross-licensing contracts will be presented in section 4. For all practical purposes, the licenser may charge an upfront rent to cover his fixed costs and may seek a royalty based on the number of hits to his site. It will be argued that the accounting and monitoring costs may, however, make dependence on the second component less attractive. Section 5 identifies the conceptual difficulties that require further analysis to appreciate the software contracting and licensing on the internet.

2. The Basic Concepts[10]

There are some fundamental differences in the way output and cost are conceptualized in the context of the internet. They may be described as follows.

Consider any user of the internet. She will logon to the internet through a website each time. This may be to obtain specific information or a service. It may also consist of multiple services. The output desired by the user also consist of the number of times she visits this particular site or any other similar site over a specified interval of time. The output therefore consist of what site to visit, what specific services- provided by the site - to utilize, the number of sites to visit each time she connects to the internet, and the frequency with which visits to the internet are sought. Each of these aspects of internet connection have their values and costs to the user.

The website developer, on his part, has to decide the amount of information or services offered at his site. The range and variety of services offered is the general description of output from his viewpoint. Once a portal is setup the frequency of visits to the site does not, by itself, increase the costs to the site administrator. To that extent it can be claimed that the costs of production, as they are conventionally visualized in economic theory, consist of developing the website and maintaining it. Clearly, there are significant fixed costs of setting up a website. Further, they can be expected to increase with the number of services packed into the portal. That is,

$F(n)$ = fixed cost of developing a site consisting of n services

is such that $dF(n)/dn > 0$ and perhaps increasing[11]. The site developer has another option. He may choose to offer a small number n of services on his site and provide other services by obtaining an interconnection license from several related portals. Even in that case the costs are mostly fixed costs[12] and total cost of defining the website will be

$$T(m, n) = F(n) + L(m)$$

where

$L(m)$ = license fees paid to interconnect with m other portals and/or services offered by others[13].

The other cost incurred by the site developer is the cost of maintaining the website. It should be recognized that even this is generally a fixed cost. For, it does not depend on how many users visit the site and/or how frequently they visit the site. The variable costs, to the site owner, as they are conventionally understood[14], are negligible or minimal.

By way of contrast the user has significant variable costs. Initially, the user must obtain information shout the websites where a particular type of information

or a specific service is available. If all websites offer only specialized information the total cost to the user will depend on the extent of information required even if the cost of identifying each of these sites is a fixed amount. A composite site may offer some economies of scope and the transaction cost involved in getting to know the site may have the semblance of a variable cost. Secondly, once the site is spotted she has to use a modem and a telephone line each time a connection to the internet is setup. These costs depend on the bandwidth provided by the ISP[15], the delay and congestion involved in accessing a particular website, and the frequency of visits to one or more websites. The most important aspect of these costs is that they are variable with the level and type of service she seeks on the internet. Frequency itself does not pose any difficult problem. It may be at a constant marginal cost if there is sufficient bandwidth for all the users of the internet. As of now this is still valid since the congestion has not reached alarming proportions[16]. Thirdly, and somewhat asymmetric to the above two instances the variable cost of obtaining a given service depends on the scope (i.e., the range of services available from the website) offered by the website. Clearly, the scope may be built into it by the owner or cross-licensed from other portals. If (m + n) indicates the scope of the website that she visits it is expected that the variable cost, per visit to the website, to the user is

$$v = v(m + n);\ v_1 > 0$$

That is, whether she needs one service or many more, the cost at each visit increases with the number of sites packed into the portal. Similarly, it can be expected that the number (N) of visitors to the site increases with (m + n). That is,

$$N = N(m + n);\ N_1 > 0$$

Congestion on the website increases with (m + n) partly because of the increase in N. In either case, it is reasonable to expect that v will increase with (m + n).

From this it follows that one component of the price that the user pays for the services of the website is this variable cost. In conventional economic theory all the costs are borne by the producer and the consumer pays only a price per unit of service. In cyberspace, the price consists of this upfront cost to the user[17], of getting the service in addition to the subscription that must be paid to the owner of the portal[18].

To appreciate the full implications of the demand for web services it is necessary to examine the value to the user. A *priori* it is possible to arrange different services in decreasing order of value. Now let a specific portal offer (m + n) services. The value to the consumer can be expected to be[19]

$$u = u(m + n);\ u_1 > 0,\ u_{11} < 0$$

Indicating thereby that additional service availability is subject to diminishing returns. Strictly speaking the entire range of the law of diminishing value may be valid. That is, when the number of services offered is low the marginal value of that

portal may be low. The basic reason is that the transaction costs to the user, of getting to know the various portals from which she can obtain the requisite information, can be quite high. A composite site, and the knowledge that a variety of information services can be obtained from one portal, increases the value of that portal to the user[20]. In a similar fashion there may be diminishing value with respect to the frequency of visits to any one website. This will not be pursued further since it does not seem to offer any new conceptual challenges[21].

The mechanics of pricing of web services is not fully described as yet. One obvious feature is that a certain minimum of both hardware and software services had to be available before anyone could recognize its usefulness. That is, in the initial stages, the fixed costs of developing the world wide web were substantial and the recognition of the value of the services was low. As such the network was not commercially viable. The National Science Foundation took the initiative and funded the research. Even at the current stage of development some users are not as yet convinced of the advantages of and felicity of e-commerce[22]. The firms, which see the potential and wish to promote it, took it upon themselves to finance the developments by attracting advertisements of others. Since most of the costs of the site development and maintenance are fixed costs they need to cover these to facilitate further exploration. For all practical purposes they need to pay a fixed price for advertisements on any one website[23]. There is a feeling that it is advantageous in comparison to advertising spending which is made to depend on the volume of sales. Secondly, though advertising expenses in conventional media are also fixed costs, the potential exposure on the web is expected to be larger. Thus, e-commerce was visualized as an economical proposition. As the www reaches a reasonable maturation phase it can be expected that each user can be specifically identified, excluded if she is unwilling to join the select band of consumers to whom the service would be made available, and a fixed service charge imposed to obtain access[24]. In general, the price (subscription) expected from each user would be

$$S = S(m + n);\ S_1 > 0$$

Clearly, $S_1 > 0$ because there are additional fixed costs of developing and maintaining a more inclusive website[25].

The economic rationale for software interconnection and licensing is not transparent as yet. The developer of the website experiences significant and perhaps increasing fixed costs as the number of services packaged increases. Hence, there is a tendency to specialize in a smaller number of services based on their core competence. They can obtain other services from related websites. However, since the individual developers of the sites have intellectual property rights, access can only be through licensing. Since the website developer has a cost advantage due to cross-licensing it can be expected that the subscription rates will be lowered[26].

In general there are advantages to both the site developers and the users if there is cross-licensing of software on the internet. However, in practice, a variety

of combinations — from stand alone portals to exhaustive search engines — are discernible[27]. The next section will examine the economic reasoning underlying these choices in some further detail.

3. Scope of Licensing

Consider the cross-licensing issue from the viewpoint of the website developer. There are certain similarities and difference between hardware and software interconnections.

Specialized hardware modules can be developed and owned independently and interconnected for better functionality. The basic requirement is to arrive at efficient contracts keeping the network externalities in perspective. In general, these contracts also take the form of fixed subscriptions[28].

The software issue is also similar. For, the possible spectrum of internet services is indeed very large. As such no single website developer is likely to have an advantage in building a wide range of services. That is, there cannot be any significant economies of scope in the development of a vast number of services. The expertise necessary to develop different types of services also varies with the type of service. Similarly, the intensity of user preferences, as reflected in the value that any one user derives from any one service and the proportion of users seeking a specific service, are quite variable over the conceptual spectrum. Hence, based on their assessment of core competence, it is efficient for each website developer to offer a limited number of services. Once a .com company is recognized it enjoys a certain legal protection in the form of intellectual property rights. Consequently, any one .com company is unlikely to have proprietary control over all the essential complementary services that a particular user may desire. Cross-licensing becomes mandatory because the user requirements are variable. As Cohen *et al.*, (2000, pp. 19 ff) observed in a related context, "firms hold technologies that others need, and vice versa, creating a condition of mutual dependence that fosters extensive cross-licensing. ... reciprocal access to one another's technologies ... enables firms to steadily improve and expand their product lines." However, the nature of software contracts can be quite different unless the costs of identifying the level of service received from or provided to a cross-licensed site become insurmountable.

While considering horizontal integration issues as well as broad patent scope (that is, covering derivative producers of a patented process) it was noted that there are lower limits on product lines due to fixed costs and upper limits due to substitution effects and cannibalization of demand. It appears that there will be similar lower and upper limits on the number of services bundled into a website as well as the number of sites to which cross-licensing would be sought.

Consider the number of services that the user would expect from a particular website. Clearly, from her viewpoint, it makes little difference whether the website developer does it on his own or provides the service through cross-licensing from other portals. In general, as noted above, the value of an additional service may

increase initially but decreases as the number of services crosses a threshold limit. However, the cost of creating an extra service is either constant or increasing. That is, the net value exhibits an inverted u-shape when plotted against the number of services[29].

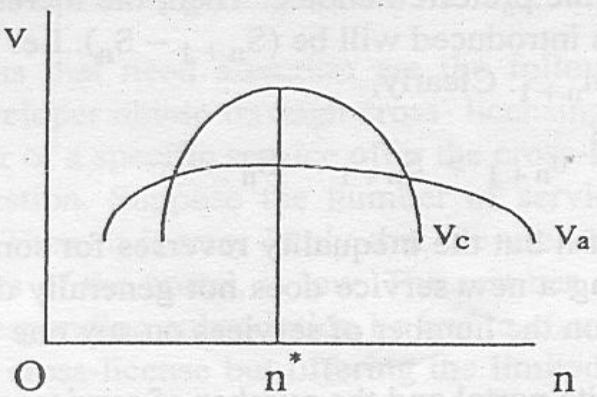

Fig. 1.

See Fig. 1. Consider a website that is already offering n services. The user has the option of obtaining the (n + 1)st service she needs from an independent portal or demand that it should be made available through the composite portal. If the first option is chosen the costs consist of (a) a transaction or search cost t_{n+1} to locate the website at which the service is available, and (b) the subscription that she has to pay, viz., s_{n+1}. By way of contrast, if it is built into the original portal she would experience two costs. (a) The increase in the subscription fees from S_n to S_{n+1} (where S_n is the subscription fees for a composite portal offering n services[30]), and (b) the cost of congestion and slower access due to the increased volume of services on the portal (denoted by c_{n+1}). Clearly, a composite portal would be preferred if and only if

$$t_{n+1} + s_{n+1} > \left(S_{n+1} - S_n \right) + c_{n+1}$$

When n is small t_{n+1} will be generally large since very little *a priori* information will be available regarding the appropriate portal. c_{n+1} is perhaps negligible. Further, more often than not, the user will not agree to

$$S_{n+1} - S_n > t_{n+1} + s_{n+1}$$

through it can be close to it as n increases[31]. Hence, the user would prefer a composite portal in the initial stages of exposure to the internet. Suppose n is fairly large *a priori*. Having gained some monopoly power, due to the knowledge that a composite portal is preferred, the site developer may charge a subscription rate that tries to capture all of the search cost that the user can avoid. However, c_{n+1} increases with n. There is a possibility that a standalone portal will then be preferred to obtain the (n + 1)st service. In other words, there is an upper limit on the number of services that the user would like to see packed into a website. One further observation is in order. The above analysis assumed that the (n + 1)st service will be

desired by the user and the organizational mode (stand alone vs. composite portal) is the only choice available. However, due to the diminishing value postulated for the (n + 1)st service as n increases, there is a possibility that the (n + 1)st service will not be demanded irrespective of the mode in which it is offered. In particular, suppose a composite site is the preferred choice. Then, the increase in subscription when the (n + 1)st service is introduced will be $(S_{n+1} - S_n)$. Let the value of the (n + 1)st service to the user be u_{n+1}. Clearly,

$$u_{n+1} > S_{n+1} - S_n$$

for some moderate values of n but the inequality reverses for some high enough n. For, the cost of incorporating a new service does not generally decrease. This will also place an effective limit on the number of services on any one website.

The offer of a composite portal and the number of services packed into it also depend on the valuation by the developer. For, when n is small and the fixed costs are large there may not be an adequate number of users to cover the fixed costs. However, when there is an increase in n and the number of users the developer may be able to make some profits after charging the users a reasonable and affordable subscription.

In general, when n is small standalone websites will emerge and much of the time they will be financed by government funding or advertising by firms. Moderately large values of n would enable the website developer to make the operation commercially variable by charging subscriptions. However, there is an upper limit on n mostly due to the diminishing value of additional services and congestion externalities. This is represented in Fig. 1. n* is the optimum number of services in the composite website. However, since there are only two alternative organizational mechanisms the observed n may be greater than n*. That is, excessive upgrading is possible in the expectation that (a) there will be an overall increase in the value of internet services, and (b) the portal will lose its market to competitors if n is not chosen in a forward looking manner. For a similar argument, though in a related but different context, see Ellison and Fudenberg (2000).

Once the developer has some idea about the optimum number of services he still has the choice of developing the services himself or cross-license them from some other portal. A number of considerations govern this decision. First, there are significant costs of building a portal to provide a service. There will be significant congestion on the network if several sites offer the same services. Hence, bandwidth assignments generally take this into account and some sort of a universal obligation is imposed. Clearly, this would not imply allowing free access to everybody who needs the service. Instead, it would be cross-licensed at some negotiated or regulated fees. Second, even developer of a website may find it advantageous to cross-license a service offered by another website rather than build it on his own when the number of users of his portal who demand that service turn out to be small. Third, from the viewpoint of the individual owning the intellectual property rights to the other site there will be an increase in revenue from cross-licensing. For,

the user may not actually use the service if it is not available through cross-license for the simple reason that the search cost plus the subscriptions may well exceed the value of service especially when the volume of service demanded is relatively low. In general, the owner of this portal has no reason to suspect that his product would be duplicated by the website that is getting access through cross-licensing[32].

The basic questions that need attention are the following. (1) How many services would a site developer obtain through cross- licensing ? (2) For how many websites would the owner of a specific service offer the cross-licensing arrangement ? Consider the first question. Suppose the number of services obtained through cross-licensing is small. Then, it is very likely that the use value of this site, from the viewpoint of the users of the portal, is low. The number of users may turn out to be small and the corresponding subscription he has to charge will not be viable. The cost of not taking a cross-license but offering the limited services he has may be more favorable. However, as the number of services that can be cross-licensed increases the value of his site increases. But there is a limit on this because as noted earlier the marginal value of additional sites to the user decreases as the number of services offered increases. Additionally, there can also be a problem of the number of users decreasing. Hence, there are lower and upper limits to the number of services that portal would obtain on cross-licensing. See Fig. 2. In this diagram n_L represents the number of services obtained from cross-licensing, v_n the value if an additional service is not cross-licensed, and v_c the value if it is. n_L^* represents the optimum number of services to cross-license. However, as pointed out earlier, there will be a tendency to over do it.

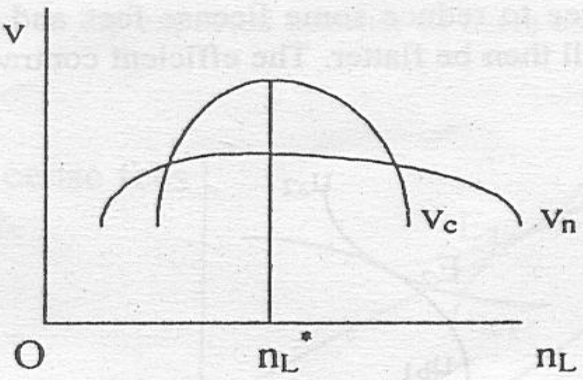

Fig. 2.

The second question may be approached in a similar manner. Suppose a site developer offers cross-license to very few other portals. Then, the potential users incur extra transaction costs and they may not find it useful to access the site independently. The demand increases as the number of other websites to which he provides access increases. However, due to diminishing returns, if he provides cross-license to too many there will be increased congestion and diminishing value. Once again it is clear that there are limits on the number of portals to which a website would offer the cross-licensing arrangement.

4. Licensing Arrangements

It is clear from the previous section that the extent of cross- licensing would depend on the types of contracts or the payments mechanisms. This is a fairly complex issue because the information requirements are extensive and in some cases uncertain. As such only an elementary exposition is attempted here.

Assume that the owner of a website a .com is contemplating the choice of the number of services he would offer on his portal and the possibility of cross-licensing his services to another portal, say b .com. The choices for a .com are then the fixed investment in a .com and the license fees that he would charge from b .com. On his part, the developer of b .com would assess the value of these services to his users and the license fees he has to pay. It is therefore necessary to characterize their preferences in order to systematize the conceptualization of the contract terms.

The a.com owner would expect proportionately greater license fees as the number of services he makes available on his portal increases. His indifference curves will be concave as represented by u_a in Fig. 3. For, the more composite his own portal the less he would be willing to cross-license his services to b.com. Clearly, for a given amount of spending, the greater the value to him the more the license fees. Hence, $u_{a2} > u_{a1}$. In his turn, b.com would prefer to have a proportionately lower share as the number of services offered on a.com increases. For, the owner of b.com would be less certain about the number of user for the large number of services being offered. That is, the indifference curves of b.com would be convex as represented by u_b. In the interest of long term contractual sustainability a.com may agree to reduce some license fees and exhibit bonding. The indifference curves u_a will then be flatter. The efficient contract will then be at points like E_1, E_2.

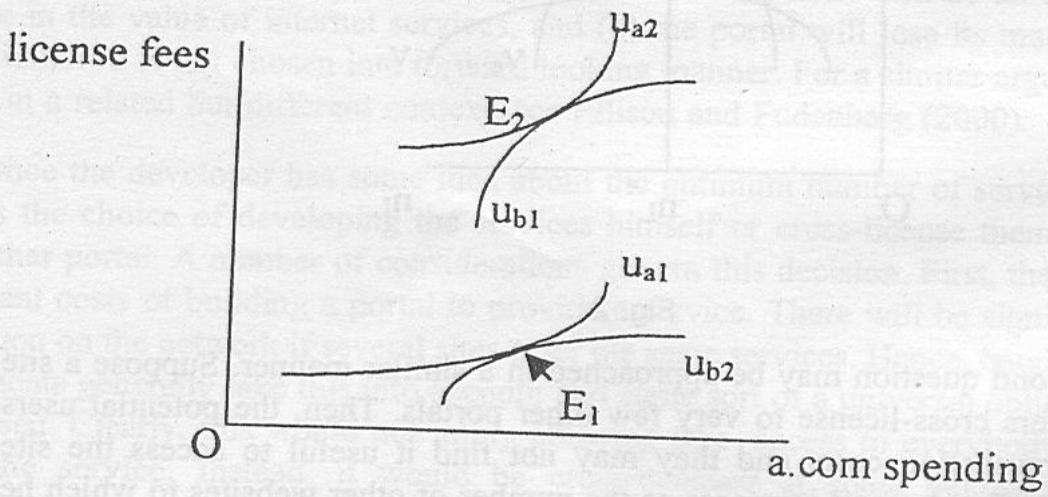

Fig. 3.

a.com may also fix the license fees based on the expected number of users of b.com who will also visit a.com if a cross-licensing arrangement is made. In

general, a.com will charge a proportionately greater license fees as N increases. On its part b.com would agree to pay proportionately less as N increases. For, there will be an increasing loss of the subscriptions that he can otherwise anticipate. Once again the likely equilibrium values are represented in Fig. 4.

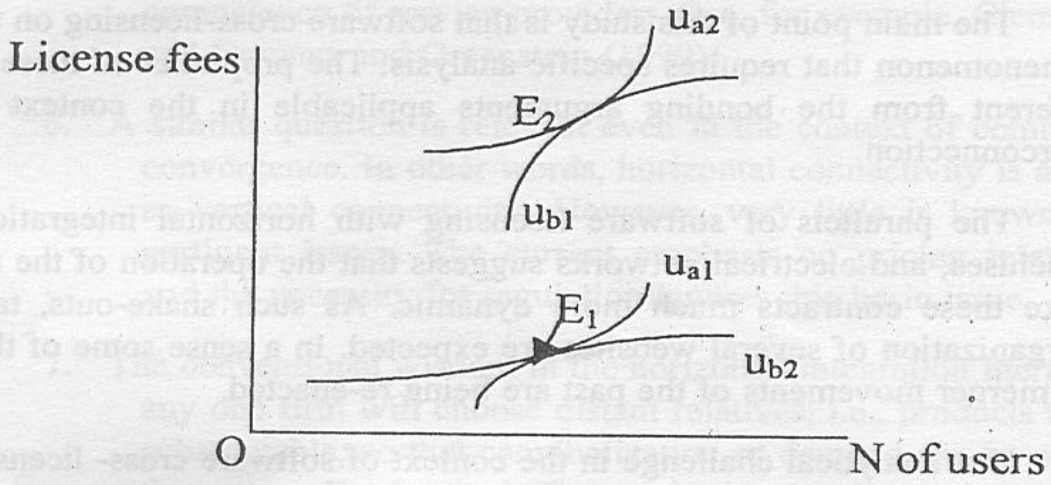

Fig. 4.

One significant aspect of such contracts may now be highlighted. If the investments in a.com are relatively small and/or it is offering few services then its dependence on cross-licensing is high. Conversely, the possibility that b.com will try to access its site are low. Consequently, a.com may accept a certain minimum of investment before any cross-licensing possibility arises. Similarly, if it makes a large investment (A) it will expect b.com to agree to an upfront rental (B) to share the fixed costs. This possibility is portrayed in Fig. 5. An analogous argument is valid with respect to the expected number of users as well.

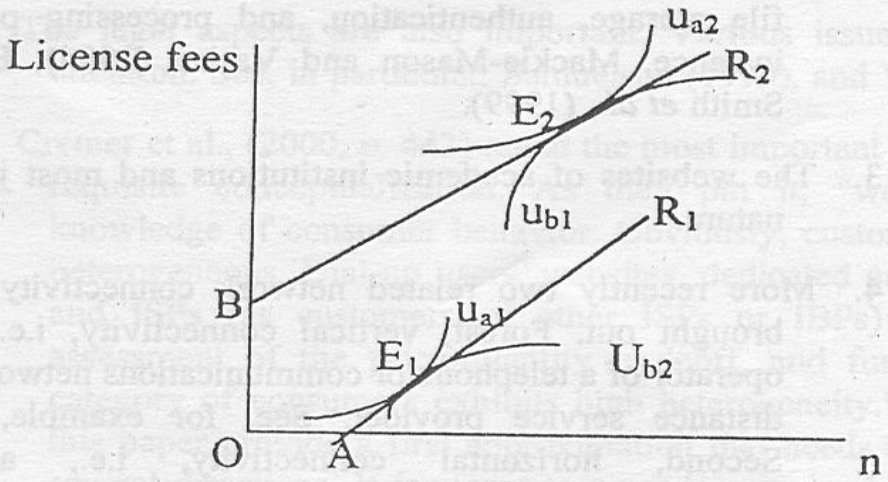

Fig. 5.

On the whole, it can be concluded that the contractual arrangements, the structure of the websites, and the sunk costs for each of the sites will be simultaneously determined.

Shake-outs and realignments are inevitable if the licensing arrangements favor one portal over another. This will happen even if the initial economic calculations of the website developers are accurate.

5. Conclusion

The main point of this study is that software cross-licensing on the internet is a phenomenon that requires specific analysis. The properties of these contracts are different from the bonding arguments applicable in the context of hardware interconnection.

The parallels of software licensing with horizontal integration, cable TV franchises, and electrical networks suggests that the operation of the market forces make these contracts much more dynamic. As such shake-outs, takeovers, and reorganization of several websites are expected. In a sense some of the features of the merger movements of the past are being re-enacted.

The analytical challenge in the context of software cross- licensing is to deal with information uncertainty in the presence of asset specificity. Significant work in this direction is already in progress in other contexts. Further progress is possible by suitably adapting those results to suit the present context.

End Notes

1. An earlier version of the paper was presented at the Indian Econometric Society meetings in Surat. We are aware of the fact that several studies on related topics are in progress and formal reporting has just begun. As such this study should be looked upon as the tip of an iceberg rather than anything final.

2. The file servers may perform a variety of interconnected services like file storage, authentication, and processing payments. See, for instance, Mackie-Mason and Varian (1994), Bailey (1995), and Smith *et al.*, (1999).

3. The websites of academic institutions and most journals are of this nature.

4. More recently two related network connectivity issues have been brought out. Forest, vertical connectivity, i.e., a short distance operator of a telephone or communications network accessing a long distance service provider. See, for example, Cambini (2001). Second, horizontal connectivity, i.e., a long distance communications provider accessing not only the voice over the internet protocol but also internet websites and entertainment channels using multimedia and cable television. See, as a representative sample, Brennan (1997). Many authors are currently examining the appropriate market structure in the context of communications convergence.

5. The distinctive strength of a distributed system is sharing. It becomes increasingly difficult to trust service providers, due to congestion externalities, as users interact more frequently with them. Hence, hardware interconnectivity, and the available bandwidth, become a major issue. Organizational efficiency depends on the integrity and competence of service providers. See, for example, Clement (1998), and Downes and Greenstein (1999).

6. A similar question is relevant even in the context of communications convergence. In other words, horizontal connectivity is as important as vertical connectivity. However, very little is known about the pertinent issues. The current emphasis on pricing interconnection and the necessity for regulation ignores this basic issue.

7. The conventional wisdom in the horizontal integration literature is that any one firm will choose distant relatives, i.e., products that are not substitutable, so that cannibalization of demand can be avoided. On the other hand, rival firms choose products that are closely substitutable to the offering of a rival firm. Similarly, it was noted in a somewhat related context that a firm does not generally develop substitutable derivative products if it is granted a broad patent on its basic patented process. The arguments of Merges and Nelson (1990, 1994) and Scotchmer (1996) are typical of this analysis. The extent to which this result carries over in the context of the internet is still not clear.

8. Interconnection issues of broadband communication networks are similar. See, for example, Faulhabar and Hogendorn (2000). However, the differences between the two cases are glaring.

9. The legal aspects are also important. Various issues are receiving attention. See, in particular, Samuelson (1999), and VanDijk (2000).

10. Cremer et al., (2000, p. 442) noted the most important difficulty in the requisite conceptualization. As they put it, "we have limited knowledge of consumer behavior. Obviously, customers are highly heterogeneous. Dial-up users, websites, dedicated access customers and ISPs (as customers of other ISPs or IBPs) have different assessment of the price-quantity tradeoff, and furthermore, each category of consumers exhibits high heterogeneity." The results of this paper provide a first approximation that needs to be refined in several directions. It is meant to provide some pointers rather than any final results.

11. As n increases there will be economies of scope in addition to economies of scale. Diseconomies of either kind cannot be ruled out when n becomes sufficiently large.

12. To a large extent this depends on the contract terms for cross-licensing. The following argument does not change materially even if some modifications are introduced.

13. As of now, where most of the websites depend on advertisers to cover their costs, this many not be significant. But, in a steady state, where e-commerce reaches its maturation phase, it should be expected that determining L(m) will become an important issue. The communications networks literature is currently addressing related issues.

14. That is, made a function of output. In the present case, the output is the number of visits to the website. The site developer has no additional cost even if the number of hits varies. The variable cost, if any, is the upfront cost of connection and it is borne exclusively by the user of the website.

15. Note that bandwidth represents the bytes of information per second that can be transmitted on any pair of nodes of the network. It depends on the capacity of the fiber optic cable as well as the switching equipment at both the ends. This is the kind of difference reported regarding the DSL (Digital Subscriber Line; the conventional twisted copper cable) and HFC (hybrid fiber coaxial network) technologies.

16. Technological developments involving fiber optic cables, packet switching and multiplexing, terabit capabilities, and corresponding switching equipment enabling coding and decoding will perhaps provide a guarantee that the desired bandwidth will be available even in a regime of communications convergence.

17. Comprising (i) the initial transaction cost incurred in identifying the appropriate location where the requisite information is available, and (ii) the use of the telephone line.

18. The discerning reader will argue that this conceptualization holds even in the context of durable consumer goods. The price paid to get the service then consists of a vector with two components : the price paid for the possession of the durable good, and the price paid in the form of the average cost for the use of the service. Unfortunately, conventional demand theory is not developed with this idiosyncrasy in perspective.

19. A somewhat more general formulation can be offered. Consider the symmetric case where the number of services alone, and not the actual content of the portal, accounts for the value to the user. The value to the consumer can be written as

$$u = u\,(m + n, N)$$

The transaction cost of identifying the existence of such a website and the subscription rate can be represented by

$$S = S(m + n)$$

The upfront variable cost to the user is

$$v = v\,(f, m + n, N)$$

where

f = frequency or the number of visits per unit of time.

Basically, as N increases, there is greater congestion in accessing the website. To some extent, all the three variables in this function reflect different forms of congestion. The consumer then chooses (m + n) and f given a N to maximize

$$V = fu\,(m + n, N) - S(m + n) - v\,(f, m + n, N)$$

Or, if a somewhat more inclusive perspective is adopted, even N may be a choice variable. But it would be more realistic to view N as a decision of the website developer. The details of the demand curves will not be pursued further in this study.

20. Such positive network externalities have been highlighted very often. In particular, see Cremer (2000).

21. This feature of diminishing returns is valid with respect to the number of visitors to the website as well.

22. If the transactions through the website eventually results in the exchange of physical goods it must be through some other medium like the snail mail. It is perfectly legitimate to ask why the consumer would find it advantageous to buy through the internet rather than buy directly from a conventional store. The economies and advantages of mail order and catalogue stores are well documented. But related work on trading commodities through the internet is in its infancy. A few case studies, relating to automobile parts and electronics, have been reported only recently. The protection for the consumer against passing on "lemons" and other irregularities demand laws across different countries in the context of internet e-commerce. But such provisions are not likely to be enacted very soon. This also limits the optimism exhibits by the site developers and e- commerce in general.

23. Firstly, there is a feeling that it is advantageous in comparison to advertising spending that is made to depend on the volume of sales. Secondly, though advertising expenses in conventional media are also fixed costs, the potential exposure on the web is expected to be larger. Thus e-commerce can be viewed as an economical proposition.

24. To an extent it is already clear that B2C e-commerce has limited potential. Hence, some advertisers, who are currently paying for the maintenance of certain websites, will withdraw. This will necessitate payments by the subscribers themselves. As recorded in recent times, some email services are already converted to subscription only facilities.

25. The caveat to this argument is that the number of users will increase more than proportionately to the cost itself at least for some values of (m + n). In that phase, there is a distinct possibility that $S_1 < 0$.

26. Observe that there will be significant congestion if every website tries to duplicate the same services. It is this feature which necessitates cross-licensing. Even when this feature is acknowledged, most of the portals duplicate services like the e-mail. The economic reasons for this phenomenon require further analysis.

27. In general, a website developer targets n, m, and N so as to maximize

$$\pi = S(m + n)N + A(m, n) - F(n) - L(m) - b(m + n, N)$$

where

A = advertising revenue, and

b = cost of providing the adequate bandwidth to maintain a satisfactory level of service. A market for web services and an equilibrium choice can be conceptualized.

28. There are two basic reasons for this. First, much of the expenditure for providing interconnectivity is of the fixed cost nature. Second, even when operating expenses — such as switching, power consumption, billing etc. — are variable, the monitoring of individual usage is expensive. This is the primary reason for the ISPs charging a monthly rental to provide a fixed number of hours of connectivity.

29. Note that the value functions do not start at the origin primarily due to the differences in fixed costs associated with the two types of portals. The basic lower limit on n, for a given choice of content and interconnection, will depend on the fixed cost.

30. In general, S_n will not be equal to $\sum S_j$, where the summation is over

j = 1, 2, ..., n. The difference depends on the economies of scope in developing the composite site and the number of users of the portal.

31. As n increases the website developer has a greater monopoly power due to something akin to brand loyalty. This inertia to switching from one portal to another is also a result of the search costs. Advertising by different websites on conventional media, and not just the www, can be justified primarily on this basis.

32. The problems associated with IPRs, encryption, and some sort of password protection cannot be wished away. However, they will not be pursued in this study.

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