Chapter 9

Wireless Services and Network Economics

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1. INTRODUCTION

Wireless telecommunications have become very commonplace in today's life. Cellular telecommunications have expanded rapidly, and governments around the world have reaped huge sums of money for the use of airwaves by mobile operators. However, to assess their evolution to broadband, 3G, and to other technologies it is very useful to take a step back, examine which services the present technologies provide, what future technologies can provide, and how any new technology would integrate in the evolving telecommunications services and equipment industries.

Wireless communications are necessary for communications needs that are (i) time-sensitive; (ii) location-specific; and (iii) actionable. Clearly the need for wireless telecommunications arises when communication has to be initiated or terminated at a specific location and results in some decision and/or action. At the present cost, most wireless telecommunications are used for time-sensitive communication. If wireless communications costs were significantly lower, wireless technology could be used as a substitute for tasks that are now done traditionally in a non-time sensitive manner, such as sending documents through an express delivery service, or as a substitute to services provided through fixed (wired) telecommunications. For sufficiently lower wireless costs, most importantly lower spectrum costs, not

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only will wireless be an economically comparable substitute for fixed telephone service, but also for overnight document delivery service, and even for delivery of music and video in digitized form. So, the markets in which wireless presently participates are defined by its cost limitations.

Moreover, the interfaces and appliances that are used for wireless telecommunications are, to a large extent, defined by the cost limitations of wireless transmission rather than by the cost of the equipment used. Since wireless equipment is mostly made of computer parts, Moore's laws and similar laws on storage of digitized information lead to drastic reductions of equipment costs in the wireless network and are not the present bottleneck in wireless costs. Instead, it is the limits of the present cost-effective capabilities of the wireless telecommunications networks that define the features of the wireless appliances. Given the present interface and bandwidth requirements for cellular communications, calls also have to fit a narrow bandwidth and text and graphics have to fit in a small screen.

Of course, wireless communications are not limited to mobile communications, and, moreover, mobile communications are not confined to the traditional cellular networks that guarantee seamless transition (hand-over) from cell to cell and continuous coverage for a moving caller. For example, wireless at fixed locations (so-called "fixed wireless") can be used a substitute for a wired local loop to a specific fixed location. Or, computers or hand-held devices can utilize wireless connections at a number of different locations even if the wireless "network" is unable to hand them from one location to another. When mobility while connected is not necessary, services may be offered at a grid of locations, such as airports, coffee shops, copy shops, parks, etc. at substantially lower prices than traditional wireless mobile services. Similarly, wireless services offered at a single location (home or office) may be offered at even lower cost.

As the cost of appliances keeps declining while the cost of bandwidth remains almost constant, wireless may be used in many new situations that require a cheap appliance but infrequent transmission. For example, fixed appliances such as air conditioners may be fitted with wireless telephones that call a number once a week to provide their vital statistics to a central computer, and, of course, also call when the self-diagnostic of the appliance detects imminent failure. Most devices that have mechanical moving parts do not fail abruptly, but rather give advance signs of failure. Often these signs remain undetected because the machines are not under constant surveillance, and, without intervention, failure results. Such failures can easily be prevented by a deployment of wireless devices. Again, wireless does not have to be mobile; wireless at stationary locations may be optimal when it is difficult, costly, or not aesthetically-pleasing to use a wired technology.

Many different types of wireless communications exist or can be developed. In very broad terms, wireless communications can be divided in (i) consumer to consumer ("C2C") communications; (ii) business to consumer ("B2C") communication; and (iii) business to business ("B2B") communication. In terms of the entities that interact, wireless telecommunications can be divided in (i) person to person communication (e.g. voice); (ii) person to machine communication (e.g. reservation to airline reservations system initiated by a person); and (iii) machine to machine communication (e.g. inventory inquiry by a computer to a computer).

In every wireless service market, each firm has to decide the extent to which it will allow its products to be compatible with those of others. We discuss this in detail in the next section.

2. COMPATIBILITY AND INTERCONNECTION ISSUES

In almost all high technology industries, each firm faces the choice of defining the extent to which it will allow its products to be technically compatible with products of competitors. In telecommunications, technical compatibility means interconnection with other networks and interoperability in features. The mandatory interconnection of telecommunications networks has benefited wireless networks tremendously since it has allowed wireless customers to reach non-wireless customers (and vice versa) and thereby to reap the positive network effects of a larger network. However, interoperability across networks remains disabled in other dimensions. For example, text messaging exchange is limited to customers within a particular carrier (network), although clearly it would be desirable to reach customers across networks. There are no interoperability requirements for data applications.

In general, each firms wants to have a common platform to take advantage of network externalities, but, at the same time, wants to be by itself so that it faces less competition. In some cases, it makes sense to be compatible with competitors in some dimensions but be incompatible in others. For example, mobile and fixed wireless operators have benefited tremendously from mandatory interconnection with the PSTN. This regulatorily-imposed compatibility allowed the wireless to reap the network effects of the worldwide fixed and wireless telecommunications network. However, US common carriers in wireless telecommunications have decided

to be incompatible in the transmission standards and the appliances subscribers of their networks use.

The FCC has failed to take steps to impose compatibility in transmission standards and appliances that would increase competition in wireless telecommunications and would reduce prices. On the traditional fixed telephone lines we are used to changing long distance (and recently local) providers without a change of equipment. Not so in the U.S. wireless world! There are three different incompatible PCS communications standards (CDMA used by Spring PCS, TDMA used by AT&T, and GSM used by Omnipoint, VoiceStream and others). Each standard requires a different appliance; different analog service providers also require different appliances. Changing service providers almost always requires buying a new appliance. This makes it difficult and more expensive to change providers and, everything else being equal, keeps mobile communications prices high. The irony is that there was a unique opportunity to standardize to a single technical standard so that all appliances would be interchangeable: the FCC could have imposed a single standard when it was auctioning the spectrum for PCS service. Moreover, the Telecommunications Act of 1996 allowed customers to change their fixed local telephone service provider without changing their phone number. Wireless providers do not have this obligation. This creates extra friction in changing providers and keeps wireless service prices high.

There is no mandatory compatibility in data standards and application protocols that define higher consumer services and machine to machine services, and this problem becomes more acute as we move to 2G, 2.5G, and 3G networks. Many of the incompatibilities of the applications developed for each type of advanced network have already become apparent. The lack of compatibility of the proposed advanced networks limits the positive network effects that will accrue to consumers. It is ironic that in a market where network effects are most important and the regulator controls a key input (spectrum) and has authority to intervene, the inaction of the regulator allows the development of a regime characterized by a lack of utilization of network effects.

A number of incompatible standards, including various versions of the 802.11 and the Bluetooth protocols, as well as incompatibilities with cellular wireless protocols have delayed the development of short-range notebook computer and handheld devices wireless communications and their integration with wireless telecommunications networks.

3. DISTORTIONS IN THE US TELECOMMUNICATIONS AFFECT THE WIRELESS SECTOR

A number of key distortions in the US telecommunications sector affect wireless sector. The first key distortion that affects wireless most acutely is the spectrum allocation process and the resulting high prices for spectrum. The second distortion arises from the "hands-off" policy in setting technical compatibility standards and allocating spectrum among several uses, including broadcasting and telecommunications, and we have already discussed it. The third distortion is the imposition by the FCC of the "receiver pays" regime in which a wireless subscriber is obligated to pay when he receives a call. The fourth distortion arises from the artificially high price of voice telecommunications compared to data, which is an artifact of the regulatory system. The fifth distortion is the high prices for the monopolized fixed local loop, offered as a collection of unbundled network elements as a consequence of the Telecommunications Act of 1996. We discuss the distortions other than the compatibility issues below.

3.1 Spectrum Allocation Issues

The FCC lacks a unified philosophy and process for allocating electromagnetic spectrum. Large amounts of spectrum are available for some functions for free. Other functions are limited to very small amounts of spectrum and have to pay very high prices for it. Too little spectrum has been available for telecommunications because it is taken by (i) the military; (ii) TV broadcasters; (iii) others who received an allocation when it was not clear that spectrum was required for valuable applications. In recent years, very large amounts of spectrum were allocated to broadcasters to broadcast high definition television. It is worth noting that this spectrum was given to the broadcasters for free despite the fact that it can be used for alternative telecommunications uses, and it could have fetched high prices if it were offered for telecommunications. Presently, there is no coherent principle that guides the spectrum allocation process.

The FCC has allocated relatively small portions of the spectrum for telecommunications use. As a consequence, the available spectrum ended up being very expensive and this created significant problems in the profitability of wireless firms and their network investment and coverage. Shortage of spectrum has reduced the number of competitors in the market and their coverage, and this has hurt consumers who end up paying higher prices and have less choice of carriers.

The FCC used a number of ascending price auctions to distribute spectrum for telecommunications use. In some auctions, only small businesses were allowed to participate. Since these businesses did not have the required assets to pay for the spectrum they would buy, they were allowed to pay in installments over a period of years. Thus, in a very awkward way, the auction process put the FCC in the role of (i) regulator; (ii) seller; (iii) creditor for some auctions. This created a significant conflict of interest for the FCC. As a regulator, the FCC would like to see the highest investment in the wireless telecommunications network for the maximum benefit of consumers. As a spectrum seller, the FCC would like to sell at the highest price. But, if a company spends more money on spectrum, it will have less to invest in its network infrastructure. Thus, the first two objectives of the FCC are in conflict. In the small business auctions, the FCC found itself as a creditor as well.

Under pressure from Congress, the FCC auctioned one of the bands (the C-band) to undercapitalized "small businesses," and gave them the possibility of paying their auction bids in installments with favorable interest rates. The favorable financing and the possibility of bidding with other people's money lead bidders in the C-band to bid, on the average, approximately four times higher than in other similar spectrum auctions. All three top winners of the C-band defaulted into bankruptcy after paying only 10% of the value of their winning bids. The FCC took away their licenses but also kelp their money. This started a series of legal battles, most of which are still unresolved. As a result, the C-band spectrum has been held hostage and unused for a number of years and the number of competitors in PCS is smaller and prices are higher.

Overall, it should be remembered that a coherent spectrum allocation policy and wide availability of wireless bandwidth could radically change the wireless landscape for the better.

3.2 Caller Pays vs. Receiver Pays

Unlike most of the world, in the United States the receiver pays a per-minute charge for mobile phone calls. As a result, many consumers do not give out their mobile phone number except to a few friends and business associates. This reduces usage and does not allow the mobile phone to become a realistic substitute to the fixed telephone line. The FCC objects to the receiver pays regime because of the possibility of very high termination fees imposed by rogue wireless carriers. I believe that the problem could be easily fixed by an automatic announcement of charges at the beginning of a

call to a cellular number which would give the option to the originator of the call to hang up.

3.3 Regulation Has Been Set up to Keep Voice Prices High

In the US, regulation kept price of voice telecommunications high while price of data telecommunications followed the natural decrease of costs. The complex regulatory framework helped and sustained the ability of local exchange carriers to keep high local access charges origination and termination for long distance calls. To the extent that wireless calls are terminating to fixed networks, wireless is hurt by high termination prices. To the extent that wireless calls are originating in fixed networks, wireless networks can benefit by setting high termination prices. Overall, on balance, wireless networks seem to have benefited by setting high termination charges.

3.4 Monopoly Distortions at the Local Loop Level

Some distortions created by regulation unintentionally help wireless communications. Ironically, it is the failure of the Telecommunications Act of 1996 that creates the biggest promise of a new market for wireless services. The Telecommunications Act of 1996 ("Act") was supposed to open the local exchange networks to competition. According to the Act, incumbent local exchange carriers are obligated to lease parts of their local telecommunications network (unbundled network elements, "UNEs") to entrants at cost. This was supposed to have allowed entry and competition in the local exchange. Legal challenges, an extraordinarily long process of regulatory implementation of the Act, and lack of punishments in the Act for delays in its implementation, lead to very little competition in the local exchange over six years after the passage of the Act.

High prices for voice telecommunications allowed a cushion of profitability of wireless services. The lack of competition in the local exchange and the relatively high prices of UNEs create a very important opportunity for the wireless industry to provide a substitute for the fixed local loop. A wireless local loop could become a reality for many customers if prices for wireless services fall at least 25% from current levels. This is not unfeasible or out of the question but requires increased competition in the wireless industry and better capitalized networks with more excess capacity.

4. CONCLUDING REMARKS

Despite the widespread use of mobile phones, the United States lags behind Finland, Sweden and other European countries in market penetration, and has higher prices than some countries. A nexus of old fashioned regulatory rules that, among others, have not promoted technical compatibility in wireless telecommunications is the culprit. As we go toward new generations of wireless telecommunications, I hope that the United States will avoid the mistakes of the past so that it will be at the forefront of technology and use in the mobile world as it is in most other areas. A single technical standard for newer generations of wireless networks and phones, the establishment of the caller-pays principle, and a coherent electromagnetic spectrum allocation policy that would allow for more and cheaper spectrum to be used for telecommunications are the primary necessary changes to achieve this goal.