from monopolistic to perfectly competitive. See J. Tirole, The Theory of Industrial Organization (Cambridge, MA: The MIT Press, 1988) 225-308.

Viewed in its proper light, CMRS is emerging as a highly dynamic and competitive marketplace.

> Contributing to the increasing number of subscribers and the accompanying increase in the volume of use has been a steady decline in the costs of owning and using cellular telephones. For example, the real, i.e., inflation-adjusted, unweighted average of the lowest published rate for access and 250 minutes of usage during prime time in the ten largest cellular service areas in 1991 was only 62 percent of its 1983 level. [Source cited: Herschel Shosteck Associates, Ltd., Cellular Market Forecasts, Data Flash, September 1992).] Similarly, the average of the lowest real price for the purchase or 150 minutes of airtime in the top 30 markets declined by 27 percent between January 1985 and January 1991. [Source cited: General Accounting Office, Concerns About Competition in the Cellular Telephone Service Industry, GAO/RCED-920-220, 1992, p. 22.]
>
> The same general pattern of decline in real prices can be observed for cellular systems owned by GTE. The unweighted average of the lowest real prices for systems in the top 100 MSAs in which Contel Cellular Inc has at least a 90 percent ownership interest declined by more than 20 percent between 1989 and 1993 for 30, 160 and 250 minutes of monthly use. (Calculations assumed 80 percent peak and 20 percent off-peak usage.) For Contel systems, although the unweighted average of the lowest real prices for 30 minutes of monthly use were essentially unchanged between 1989 and 1993, average rates for 160 and 250 minutes declined by 18 and 19 percent, respectively. (Collection of data and computation of averages performed by GTE; inflation adjustments performed using the CPI.)

Besen at 6-7.

III. CONCLUSION

By amending the Communications Act of 1934, Congress intended to harmonize the regulation of commercial mobile radio services, and thus of cellular services. See OBR. Congress recognized that continued State regulation was, in the main, a serious impediment to further competition in the CMRS marketplace, and hence contrary to the public interest. The FCC, in turn, has sought to implement the clear intent of Congress, and has established the framework for a relaxed--but not abandoned--and uniform regulatory regime in the provision of CMRS services. See 2nd R&O. In the areas of rate and market entry regulation, this framework is intended to be ruled by federal law, subject to a narrow right of States to petition to continue rate regulation.

Claims that the cellular marketplace is anti-competitive are unpersuasive. Attacks on the duopoly system of cellular facilities are also unavailing; the FCC has rejected this superficial approach to justify continuing rate regulation. See 47 C.F.R. § 20.13. Instead, concrete, empirical evidence of market failure are required.

WHEREFORE, because the Petitions to Extend Rate Regulation have not satisfied the burden of proof required by Section 20.13, these Petitions must be denied.

Respectfully submitted,

GTE SERVICE CORPORATION
ON BEHALF OF
GTE MOBILNET INCORPORATED
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CONCENTRATION, COMPETITION, AND PERFORMANCE IN THE MOBILE TELECOMMUNICATIONS SERVICES MARKET

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September 9, 1994

CRA

EXECUTIVE SUMMARY

This paper examines both the performance of the mobile telecommunications services industry during its first decade and the impact of changes in industry structure and capacity that will occur in the next. It concludes that the performance of the cellular industry has been consistent with what would be expected in a competitive market and that industry concentration will decrease greatly with the advent of the use of PCS and ESMR technologies. The effect of these developments is to reduce further the need for new regulations of cellular services. The entry of new firms and the introduction of new capacity promise soon to do effectively what regulation can do only highly imperfectly -- reduce the prices and improve the service offerings that are available to mobile service consumers.

INTRODUCTION

In a series of decisions extending over a number of years, the Federal Communications Commission has demonstrated an increasing recognition that the market for mobile telecommunications services is broad and growing, and that its regulation warrants a flexible approach. In its 1981 Report and Order authorizing cellular communications systems on a commercial basis, the Commission concluded that licensing two cellular carriers in each service area would best serve the public interest, convenience, and necessity. In establishing this duopoly structure, the FCC sought to balance the benefits arising from economies of scale with those resulting

from competition.[1] Subsequently, the Commission determined that it should license additional spectrum to the two cellular carriers as the services they offered proved highly popular with users.[2]

More recently, in its various Personal Communications Services (PCS) orders, the Commission has expanded on its flexible approach to the regulation of mobile telecommunications services.[3] First, it has allocated a substantial amount of additional spectrum for the provision of these services, further expanding the resources that are available for their provision. Second, it plans to auction a number of large spectrum blocks, and will permit subsequent combinations of blocks, to permit economies of scale in the provision of mobile services to be exploited. Third, while recognizing the importance of these scale economies, in order to limit industry concentration, the Commission has constrained both the amount of PCS spectrum that can be licensed to any single entity in a given geographic area and the amount of spectrum that can be licensed to cellular incumbents in either the PCS auctions

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[1]Report and Order in the Matter of an Inquiry into the Use of the Bands 825-845 MHz and 870-890 MHz for Cellular Communications Systems; and Amendments of Parts 2 and 22 of the Commission's Rules Relative to Cellular Communications Systems, CC Docket No. 79-318, adopted April 9, 1981; 86 FCC 2nd 469 (1981). Only seven years before, noting the technical complexity and expense of cellular systems, together with the large amount of spectrum required for their economic viability, the FCC had concluded that only one cellular system should be licensed in each service area (Second Report and Order in Docket No. 18262, 46 FCC 2nd 752 (1974)).

[2]Amendment of Parts 2 and 22 of the Commission's Rules Relative to Cellular Communications Systems, 2 FCC Rcd 1825 (1986).

[3]See, e.g., Amendment of the Commission's Rules to Establish New Personal Communications Services, GEN Docket No. 90-314, Adopted September 23, 1993.

or the aftermarket.

Finally, and perhaps most importantly, by broadly defining PCS as "a family of mobile or portable radio communications services which could provide services to individuals and business, and be integrated with a variety of competing networks,"[4] the Commission has chosen to give substantial latitude to operators to offer a wide range of services under the PCS rubric. Thus, if some mobile services prove popular, and thus profitable to provide, PCS operators will be able to offer these services without seeking regulatory approval to do so.[5]

The flexibility being afforded to PCS operators, which will permit them to offer either "traditional" cellular telephone service or newer value-added services, is especially appropriate in view of the significant uncertainty about precisely which mobile telecommunications services consumers will desire. At present, PCS remains a somewhat vaguely defined term, with a wide range of interpretations. Some have described PCS as the third phase in the

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[4]Notice of Proposed Rule Making and Tentative Decision, In the Matter of Amendment of the Commission's Rules to Establish New Personal Communications Services, GEN Docket No. 90-314, ET Docket No. 92-100, released August 14, 1992, para. 29 (hereinafter "Notice").

[5]The Commission has also granted flexibility to cellular incumbents to offer PCS-like services in Report and Order In the Matter of Liberalization of Technology and Auxiliary Service Offerings in Domestic Public Cellular Radio Telecommunications Service, 3 FCC Rcd 7033 (1988); Memorandum Opinion and Order In the Matter of Liberalization of Technology and Auxiliary Service Offerings in Domestic Public Cellular Radio Telecommunications Service, 5 FCC Rcd 1138 (1990); and Second Report and Order In the Matter of Amendment of the Commission's Rules to Establish New Personal Communications Services, 8 FCC Rcd 7700 (1993).

evolution of cellular technology, following service to automobiles and portable telephones. A second view has PCS comprising several varieties of digital communications technologies slated to become competitive alternatives to cellular services -- for example, CT-2 (second-generation cordless telephones) or Enhanced Specialized Mobile Radio (ESMR). A third view is that PCS is simply a synonym for wireless or mobile telecommunications services, one of which is cellular radio. Finally, perhaps the most amorphous characterization of PCS is "more spectrum for something else," that is, any and every new wireless concept that is proposed.[6]

While providers of cellular telephone services now offer a number of value-added services, including voice mail, call waiting, call forwarding, portable facsimile, and wireless transmission for laptop computers, PCS firms will be able to supplement these services by providing similar communications opportunities for customers in a host of possible environments (e.g., inbuilding, neighborhood, pedestrian), using various registration modes ("home," "roam"), and an array of voice or data instruments offering a range of integrated enhanced services.[7]

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[6]See G. Calhoun, Wireless Access and the Local Telephone Network (Boston: Artech House, 1992), p. 573.

[7]Telocator lists 18 "Existing PCSs" and 5 "Emerging PCSs." Yet even these numbers understate the array of available service options, since there are many variations of each service. The FCC has authorized over 150 PCS experimental licenses in the past few years. Other possible offerings include advanced digital cordless phone service, wireless private branch exchange (PBX), wireless local area networks (LANs), wireless data transfer and advanced paging, high-speed local-area data communications services connecting personal computers ("Data-PCS"), and wireless local loop service; see the Notice, paragraphs 9, 10, and 18.

The term "cellular radio/telephone" was initially restricted to describing in-vehicle ("mobile") communications while "PCS" has often been used to describe handheld ("portable") communication devices. However, because the firms that will employ these technologies can compete to provide the same services -- cellular operators currently offer portable services while PCS suppliers are expected to offer mobile services -- they are all in the mobile telecommunications services market. Thus, whatever particular services are eventually offered by PCS and cellular providers, the introduction of PCS will increase both the amount of spectrum available to supply mobile services and the number of different firms that furnish these services.

PERFORMANCE IN THE PROVISION OF CELLULAR SERVICE

From its beginning, the business of supplying mobile telecommunications services using cellular technologies has been characterized by rapidly increasing volume, declining real prices, expanded service offerings, growing capacity, and significant technological change. In December 1984, there were fewer than 100,000 cellular subscribers in the United States with average monthly expenditures on cellular service of almost $500. The cumulative capital investment in the industry was then about $450 million and there were about 1,400 cell sites. Less than ten years later, in December 1993, there were more than 16 million cellular subscribers, average monthly expenditures were about $60, the industry was investing at a rate of more than $2.5 billion per

year, and there were almost 40,000 cell sites.[8] In addition, innovations in analog technologies (e.g., adjusted power input, antenna tilting, dynamic channel assignment) have enabled cellular operators to expand their capacity, while even more dramatic advances are expected from the further development and application of digital technologies.

By any measure -- subscribers, capital investment, cell sites -- the growth of the cellular industry has been spectacular during the first decade of its existence. Annual growth rates have been 77 percent for subscribers, 49 percent for cell sites, and 48 percent for capital investment over the period since 1984.[9] And the rates of growth of these indicators continue to be exceptionally strong. Between December 1992 and December 1993, the number of cellular subscribers increased almost 50 percent, cumulative capital investment grew by 22 percent, and the number of cell sites grew by more than ten percent.

Contributing to the increasing number of subscribers and the accompanying increase in the volume of use has been a steady decline in the costs of owning and using cellular telephones. For example, the real, i.e., inflation-adjusted, unweighted average of

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[8] The data on which these figures are based are from the Cellular Telecommunications Industry Association End-of-Year Data Survey. Revenue and capital investment data have been converted to 1993 dollars using the CPI All Services index for revenues and the PPI Capital Equipment index for capital investments. Average monthly expenditures are calculated as six-month revenues divided by 6 divided by the number of subscribers at the end of the period. Because subscribership is growing, this tends to understate the average subscriber bill during any period.

[9] Op. cit.

the lowest published rate for access and 250 minutes of usage during prime time in the ten largest cellular service areas in 1991 was only 62 percent of its 1983 level.[10] Similarly, the average of the lowest real price for the purchase of 150 minutes of airtime in the top 30 markets declined by 27 percent between January 1985 and January 1991.[11]

The same general pattern of declining real prices can be observed for cellular systems owned or controlled by GTE Corporation.[12] The unweighted average of the lowest real prices for systems in the top 100 MSAs in which Contel Cellular, Inc. had at least a 90 percent ownership interest declined by more than 20 percent between 1989 and 1993 for 30, 160, and 250 minutes of monthly use.[13] For GTE Mobilnet Incorporated systems, although the unweighted average of the lowest real prices for 30 minutes of monthly use were essentially unchanged between 1989 and 1993, average rates for 160 and 250 minutes declined by 18 and 19 percent, respectively.[14]

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[10]Data are from Herschel Shosteck Associates, Ltd., Cellular Market Forecasts, Data Flash, September 1992.

[11]General Accounting Office, Concerns About Competition in the Cellular Telephone Service Industry, GAO/RCED-92-220, 1992, p. 22.

[12]GTE Corporation is the parent company of both GTE Mobilnet Incorporated ("GTEM") and Contel Corporation ("Contel"). GTEM and Contel have numerous cellular subsidiaries.

[13]The calculations assume 80 percent peak and 20 percent off-peak usage.

[14]Collection of the underlying data and computation of the unweighted averages were performed by GTE. Inflation adjustments were performed using the CPI.

On an industry-wide basis, the monthly cost of a mobile cellular telephone has declined by even more than carrier charges, from $79 in 1983 to $7 in 1991. During the same time, the quality of mobile telephone service was enhanced by improvements in functions and features. When adjusted for inflation, the total cost of owning and using a cellular telephone in 1991 was only 44 percent of its cost in 1983.[15]

It is important to recognize that the growth in subscribership and the reduction in prices have occurred in an industry in which only two firms were licensed to serve each geographic area and the amount of spectrum available to provide cellular service was severely limited by government regulation. However, the industry is about to experience a significant increase both in the number of firms that supply mobile communications services and in the amount of spectrum that has been allocated for this purpose. At least three, and perhaps as many as six, new PCS firms will operate in each geographic area, and the amount of spectrum available for the provision of mobile services will more than triple.

Moreover, even this understates the amount of additional capacity that will be available to serve subscribers since the new operators will use digital technologies that are more efficient than the analog technologies that have been used by incumbent

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[15]Data are from Shosteck, op. cit., and measure the "drive away" price of a single mobile telephone, including antenna, installation, and first-year maintenance.

cellular operators.[16] To this must be added the effect of the introduction of Enhanced Specialized Mobile Radio (ESMR) in the near term and satellite mobile service somewhat later, both of which will add further to the number of firms providing mobile services and the amount of spectrum devoted to this purpose. By any standard, industry concentration will decline greatly -- the question is how soon and by how much -- and limitations on industry growth that have resulted from government-imposed limits on available spectrum will be greatly relaxed.

COMPETITION IN CELLULAR SERVICE

Although, at first glance, the predominantly duopolistic structure of the current mobile telecommunications market might tend to raise anticompetitive concerns, the realities of the market dynamics outlined above support the view that there has been substantial competition between the two cellular operators. In seeing how such a result may come about, one must first recognize that the performance of a market can be competitive even when its structure is not. Although economists consider the number and size distribution of firms in a market to be important initial indicators of the likelihood of noncompetitive behavior,[17] a number of characteristics of the supply of cellular services

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[16]Of course, the incumbents are also converting to digital technologies, but the pace at which they can do so is limited by their continuing obligation to provide service to customers with analog equipment.

[17]M. Spence, "Tacit Co-ordination and Imperfect Information," Canadian Journal of Economics XI (1978), pp. 497 and 499.

support the view that competition between cellular operators is substantially more vigorous than is suggested by the duopolistic industry structure.

Economists have identified a number of factors, in addition to the number of its rivals, that influence the strategies each firm pursues, and thus help to determine how close to the competitive outcome the industry's performance will be.[18] Many of these encourage highly competitive behavior even when the number of firms is small, and several of these factors are present in the cellular service industry.[19]

First, the rapid technological change in the provision of cellular service imparts a high degree of variability to the services offered and the prices of those services. When firms are continually modifying, improving, and adding new products and services, the price of each new service must be integrated into the existing price structure. In these circumstances, there may be significant disagreement about the "appropriate" prices to charge for the new services because it is difficult for rivals to

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[18]G. J. Stigler, "A Theory of Oligopoly," Journal of Political Economy 74 (1964), pp. 44-61.

[19]For a more extended discussion of these factors as they apply to the mobile telecommunications services market, see S.M. Besen, R.J. Larner, and E.J. Murdoch, The Cellular Service Industry: Performance and Competition, Appendix to Reply Comments of the Cellular Telecommunications Industry Association In the Matter of Amendment of the Commission's Rules to Establish New Personal Communications Services, January 1993.

determine what these prices are.[20]

Second, when markets are growing rapidly, the elasticity of demand tends to decline. In such circumstances, which certainly characterize the provision of cellular services, the gains from deviating from a collusive pricing agreement are increased.[21]

Third, with rapid technological innovation, there may be gains to pricing aggressively. These gains arise because a firm can achieve cost savings more rapidly as it moves more quickly down its learning curve, and firms may have difficulty coordinating the rate at which they acquire these learning economies.[22]

Fourth, newcomers in an industry have strong incentives to compete aggressively to attract market shares from existing firms. Early in the history of cellular services, when the wireline carriers already were established and the nonwireline carriers were just beginning to serve customers, the new providers had an especially strong incentive to initiate price reductions. Similarly, aggressive pricing can be expected from PCS entrants as they seek to increase their shares of the mobile services market.

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[20]Rapid technological change may itself be a source of conflict. As Scherer and Ross note: "The more rapidly producers' cost functions are altered through technical change and the more unevenly those changes are diffused throughout the industry, the more likely there will be conflict regarding pricing choices." F.M. Scherer and D. Ross, Industrial Market Structure and Economic Performance, Third Edition (Boston: Houghton Mifflin, 1990), p. 285.

[21]J.J. Rotemberg and G. Saloner, "A Supergame-Theoretic Model of Price Wars During Booms," American Economic Review 76 (1986), pp. 390-407.

[22]A.M. Spence, "The Learning Curve and Competition," The Bell Journal of Economics 12 (1981), pp. 49-70.

Fifth, collusive behavior is generally believed to occur much less frequently in industries, like mobile telecommunications services, in which a significant portion of a firm's costs must be incurred regardless of the level of its output, i.e., when fixed costs are high relative to variable costs.[23] In such circumstances, there are considerable incentives for firms to reduce prices if demand falls short of capacity. Since much investment is both expected, and will have to be made, in anticipation of sizeable demand growth, there are likely to be many situations in which some firms will have substantial excess capacity, precisely the circumstances in which economic analysis indicates that vigorous price competition will prevail.[24]

Finally, although the quality of airtime may not vary significantly across providers, an array of service packages is typically offered. These packages differ by whether or not they include equipment, in the nature of the peak-off peak pricing differentials they contain, and in the discount arrangements, e.g., free weekend service, they provide, among other features. As a result, these packages may not be directly comparable between competing providers.[25] The lack of an obvious basis for comparing

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[23]Scherer and Ross, op. cit., pp. 286-290, discuss the effects of such a cost structure.

[24]It is important to note that excess capacity as defined here in economic terms may differ from engineering estimates of excess capacity.

[25]The quality of airtime will vary from time to time, however, if cellular providers fail to anticipate the growth in subscribers, leading to increased traffic congestion.

service and equipment prices -- which makes it difficult to distinguish price changes that reflect differences in service quality from those that undercut a tacit agreement -- increases the cost of monitoring and punishing deviations from any such agreement.[26]

The combined effect of these factors is to make it difficult for cellular firms to coordinate their pricing behavior. As a result, it would be a mistake to conclude that cellular firms do not compete.

PCS, ESMR, AND CHANGES IN MARKET STRUCTURE

It is important to recognize that the advent of PCS will have two logically separable effects on the mobile telecommunications services market. First, it will substantially increase the number of firms and reduce the market shares of the incumbent cellular firms. Second, it will increase the capacity of the industry by adding 120 MHz of spectrum to the 50 MHz now employed by the incumbents. One would generally expect prices to decline as a result of the increase in spectrum availability whether or not the incumbent firms are behaving competitively. The proper test for determining the extent of current competition is to ask how prices would change if the existing amount of spectrum were divided among a larger number of firms.

The structure of the mobile telecommunications services

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[26]K.W. Clarkson and R.L. Miller, Industrial Organization: Theory, Evidence, and Public Policy (New York, NY: McGraw-Hill Book Company, 1982), pp. 335-336.

industry will become substantially less concentrated with the advent of PCS services, and competition will become even more vigorous. Given the wide range of mobile telecommunications services, the best approach to developing a market definition is from the supply side.[27] Because there is substantial supply-side substitutability, so that all mobile telecommunications licensees -- including those providing cellular, PCS, and Specialized Mobile Radio services -- can provide the same range of services, they should all be considered as being in the same antitrust market.[28] In these circumstances, the capacity of each firm to transmit information over its licensed bandwidth, without regard to the uses to which that bandwidth is put, is the correct measure of firm shares, and market concentration can be measured using these

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[27]Market definition generally follows the approach in the "Department of Justice and Federal Trade Commission Horizontal Merger Guidelines," Special Supplement, Antitrust & Trade Regulation Report, Published and Released on April 2, 1992. A market is defined as "a product or group of products such that a hypothetical profit-maximizing firm that was the only present and future seller of those products ('monopolist') likely would impose at least a 'small but significant and nontransitory' increase in price." If such a hypothetical monopolist would not find the price increase to be profitable, "then the Agency will add to the product group the product that is the next-best substitute....The Agency generally will consider the relevant product market to be the smallest group of products that satisfies the ['small but significant and nontransitory' increase in price] test." Market definition has both product and geographic dimensions.

[28]For a more extended discussion of the principles of market definition and their application to the mobile telecommunications services market, see S.M. Besen and W.B. Burnett, "An Antitrust Analysis of the Market for Mobile Telecommunications Services," Appendix A to Petition for Reconsideration of the Cellular Telecommunications Industry Association In the Matter of Amendment of the Commission's Rules to Establish New Personal Communications Services, December 8, 1993.

shares.[29]

The key to this conclusion is that providers are legally able to shift or substitute rapidly among the various services available for provision, and can do so at modest cost. If all firms can easily offer the same range of services, they are in the same market.

A number of factors support the view that all mobile service providers -- cellular, PCS, and ESMR -- are in the same market:[30] (1) the absence of legal or regulatory restrictions on spectrum use, permitting a licensee to shift from provision of one mobile service to another in response to a service price increase; (2) the ability to use all portions of the electromagnetic spectrum allocated to the provision of mobile services to provide all of the same services and at similar costs ("bandwidth fungibility"); (3) the ability of suppliers to obtain equipment that can be used to provide more than one service, a factor that will be enhanced by the introduction of Cellular Digital Packet Data (CDPD) modules; and (4) the ability of consumers to obtain equipment that can be used to obtain service from suppliers using different frequencies, a factor that is enhanced by the FCC's decision to consolidate PCS assignments in a continuous band.

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[29]It must be noted that there is not a one-to-one correspondence between bandwidth and capacity. The capacity to transmit information is a function both of bandwidth <u>and</u> the technology used; analog technologies are inherently less capable than digital technologies. Capacity is based on <u>effective</u> bandwidth.

[30]Besen and Burnett, <u>op. cit.</u>, discusses these factors in more detail.

After the market is defined, shares must then be assigned to each supplier in order to measure market concentration. As mentioned above, effective capacity to transmit information is the appropriate measure of market shares within the market for mobile telecommunications services, particularly given the ease with which firms may switch from the provision of one service to another.[31] The decision by the Commission to award licenses to PCS providers, combined with the introduction of ESMR, will greatly expand the number of firms supplying mobile telecommunications services in each geographic area within the United States and will dramatically reduce the level of market concentration.

Measuring the magnitude of the change can be demonstrated by comparing the current Herfindahl-Hirschman Index (HHI), the sum of the squared market shares of the incumbent cellular operators, with the HHI that will prevail after the introduction of PCS and ESMR.[32] The current HHI is 5000, since each of the incumbents has

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[31]Within a given allotment of spectrum, newer, digital systems have a far greater capacity than do older, analog ones. Because incumbent cellular operators will, for some time, be required to continue to serve customers that have invested in analog equipment, they will have lower effective capacity and market share per unit of allocated bandwidth than will firms with licenses for the same amount of bandwidth that employ only digital equipment. Existing cellular operators will suffer this "analog handicap" for as long as they must serve customers using the old technology. The share of the mobile telecommunications market held by cellular firms will be less than their share of assigned bandwidth, and this factor must be taken into account in measuring market concentration and the effects of spectrum license acquisitions.

[32]The HHI is the most widely used measure of market concentration and appears prominently in the DOJ/FTC Horizontal Merger Guidelines.

one-half of industry capacity.[33] The significant reduction in the HHI that will accompany the introduction of PCS and ESMR can be expected to increase industry competitiveness.

Ignoring ESMR for the moment and concentrating solely on PCS, the "worst," i.e., most concentrated, case, occurs where each of three newcomers acquires licenses to use both a 30 MHz and a 10 MHz assignment, the maximum bandwidth that can be acquired under FCC rules. Even in this case, the HHI declines by more than half to 2278.[34] Significantly, the cellular carriers each have only about 11 percent of industry capacity while each of the newcomers has more than 26 percent.

In the "best," i.e., least concentrated, case, three new licensees each have a 30 MHz allocation and three new licensees each have a 10 MHz allocation. In these circumstances, the HHI is 1514, less than one-third of what it had previously been[35], with the cellular carriers again each having only an 11 percent share.

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[33]The HHI is calculated as $2(50)^2$, since each of the two cellular suppliers is licensed to use 50 percent of industry capacity. In this calculation, we ignore the presence of other suppliers of mobile services, which has the effect of increasing the HHI.

[34]This assumes that digital capacity has 6 times the throughput as analog and that the incumbent cellular carriers must reserve 10 MHz to service customers using analog equipment. The details of this and the following calculations are presented in Tables 1 and 2. D.P. Reed, Putting It All Together: The Cost Structure of Personal Communications Services (Federal Communications Commission, Office of Plans and Policy, November 1992, pp. 66-69) provides references to many of the estimates of the advantages of digital over analog transmission.

[35]Actually, concentration can be less than this if the initial PCS licenses are subdivided. The calculations presented here are conservative in that they assume no subdivision occurs.

Indeed, even if a cellular carrier were to acquire a 10 MHz allocation, the maximum it can obtain, its share would rise to somewhat less than 18 percent, which would still be smaller than the share of each of the three newcomers with a 30 MHz allocation.[36]

When ESMR is taken into account, the market becomes even less concentrated. If the ESMR is assigned a bandwidth of 10 MHz, the worst case HHI is 2045 and the best case HHI is only 1370. Here, the share of an incumbent cellular carrier is reduced to only about 10 percent if it does not acquire a 10 MHz license, and it is somewhat less than 17 percent if it does. By contrast, a PCS newcomer with a 30 MHz license has a share of more than 18 percent, while one with both a 30 MHz and a 10 MHz license has a share of more than 24 percent.

These calculations strongly support two conclusions. First, overall industry concentration will decline greatly as the result of the introduction of PCS and ESMR, with the precise extent determined by the identities of the successful bidders in the PCS auctions and on transactions in the aftermarket. In no case does the HHI fall by less than half, and it could decline by more than two-thirds. Second, the shares of the incumbent cellular operators, as measured by their shares of effective capacity, will

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[36]The reason, as mentioned, is the continuing analog obligation.

decline precipitously with the introduction of PCS and ESMR.[37]

Conclusion

We are about to enter a new era in which the number of firms supplying mobile telecommunications services will more than double, effective industry capacity will increase more than fourfold, measured industry concentration will decline by more than half, and the share of the effective capacity of the industry licensed to each of the two current cellular providers will decline by more than two-thirds. As the number of carriers increases, and industry concentration as measured by the HHI declines, the industry is likely to become more competitive. Given the quite remarkable performance of the cellular industry with only two carriers and much more limited capacity, the future of the mobile services industry is likely to be especially bright, with firms offering a wide array of new services and even lower prices than in the past for existing ones. In these circumstances, the best approach for regulators is to eliminate regulatory-imposed barriers to entry as rapidly as possible so that competitive market forces can determine the performance of the industry. Regulators would be at odds with developing market forces if they were to impose more stringent

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[37]We do not mean to suggest that the newcomers share of output will increase as rapidly as will their share of capacity. The point is, rather, that the existence of this large amount of capacity will immediately serve to discipline the pricing behavior of the incumbent cellular operators. The behavior of their output shares will depend in part on how they adjust their prices to the new entry. It should also be emphasized here that prices will likely fall simply because of the large increase in capacity.

requirements on cellular carriers just as industry concentration is declining so dramatically.

Table 1

HHI Calculations Without ESMR

Digital : Analog / 6 : 1

Cellular Operators' Bandwidth Devoted to Analog : 10 MHz

Firms	Bandwidth	Effective Capacity*	Market Share	HHI Contribution	Bandwidth	Effective Capacity*	Market Share	HHI Contribution
Cellular 1	25	100	10.9%	118	25	100	10.9%	118
Cellular 2	25	100	10.9%	118	25	100	10.9%	118
3	30	180	19.6%	383	40	240	26.1%	681
4	30	180	19.6%	383	40	240	26.1%	681
5	30	180	19.6%	383	40	240	26.1%	681
6	10	60	6.5%	43	0	0	0.0%	0
7	10	60	6.5%	43	0	0	0.0%	0
8	10	60	6.5%	43	0	0	0.0%	0
Totals	170	920		1,512	170	920		2,278

* Effective Capacity is defined as bandwidth devoted to digital multiplied by the ratio of digital's advantage over analog plus bandwidth devoted to analog.

SOURCES: FCC, Second Report and Order; Charles River Associates.