Exhibit 1

MCI WorldCom Local Facilities
MMDS Assigned Frequencies
MMDS PSA and BTA Map

Exhibit 1

MCI WorldCom Local Facilities

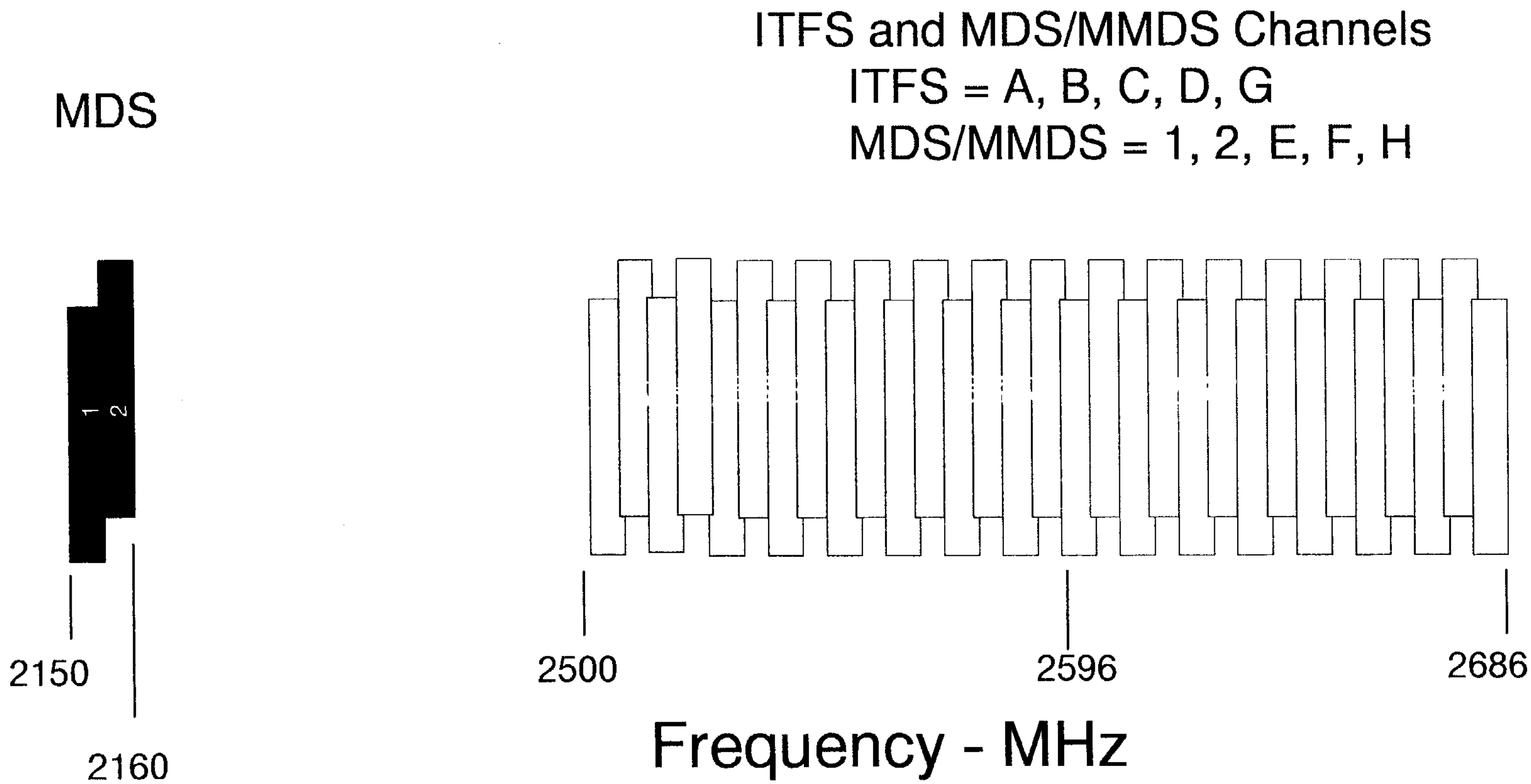
Principle City	St
Albany	NY
Albuquerque	NM
Atlanta	GA
Austin	TX
Bakersfield	CA
Baltimore	MD
Begen-Passaic	NJ
Boston	MA
Buffalo	NY
Chicago	IL
Cincinnati	OH
Cleveland	OH
Dallas	TX
DC/MD/VA	DC
Denver	CO
Detroit	MI
Fort Worth	TX
Fresno	CA
Ft. Lauderdale	FL
Grand Rapids	MI
Hartford	CT
Houston	TX
Indianapolis	IN
Jackson	MS
Jersey City	NJ
Kansas City	MO

Principle City	St
Knoxville	TN
Lansing	MI
Little Rock	AR
Long Island	NY
Los Angeles	CA
Manchester	NH
Memphis	TN
Miami	FL
Milwaukee	WI
Minneapolis	MN
Nashau	NH
New Brunswick	NJ
New York City	NY
Newark	NJ
Oakland	CA
Oklahoma City	OK
Orange County	CA
Orlando	FL
Philadelphia	PA
Phoenix	AZ
Pittsburgh	PA
Portland	ME
Portland	OR
Providence	RI
Provo	UT

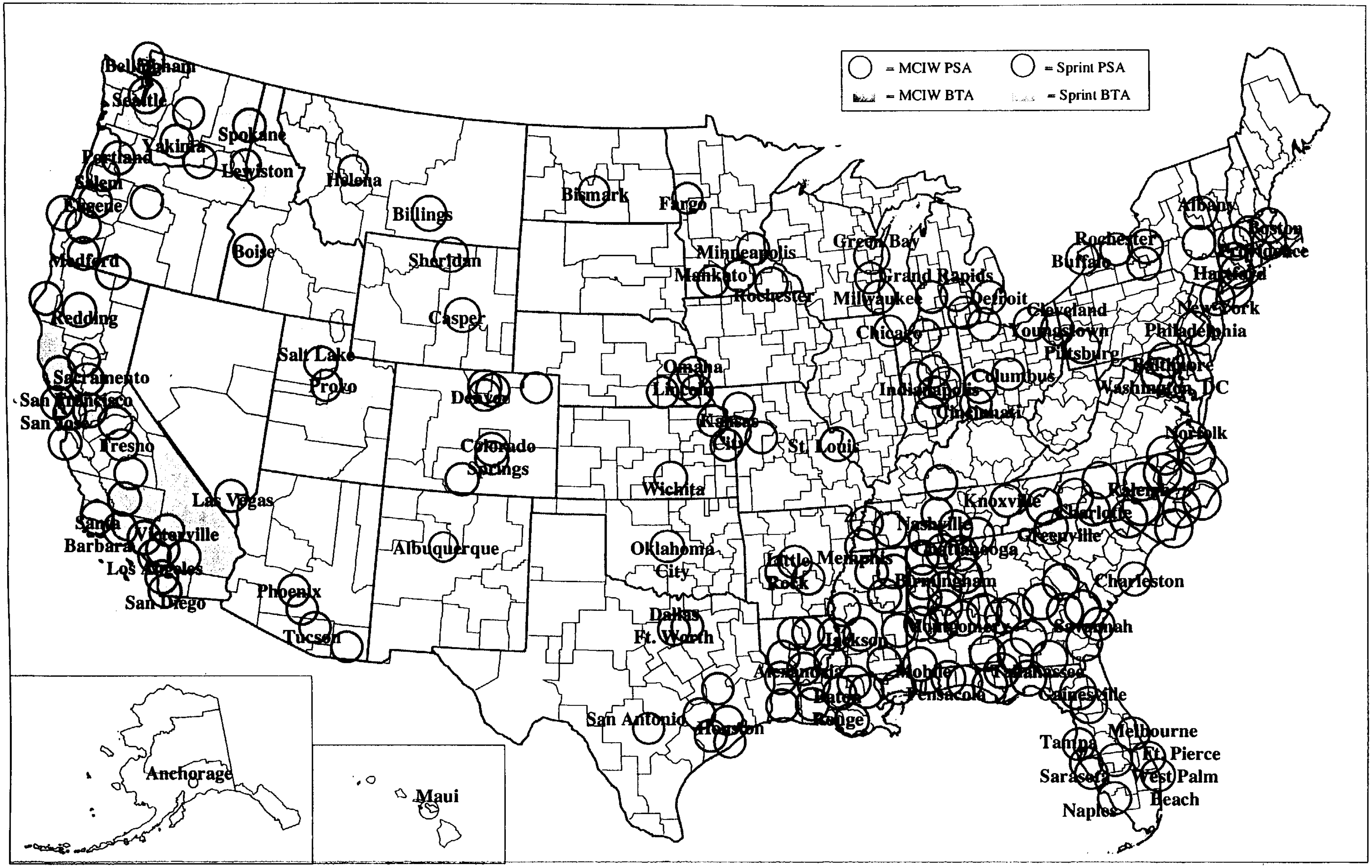
Principle City	St
Raleigh	NC
Reno	NV
Richmond	VA
Rochester	NY
Sacramento	CA
Salt Lake City	UT
San Antonio	TX
San Diego	CA
San Francisco	CA
San Jose	CA
Seattle	WA
Springfield	MA
Springfield	MO
St. Louis	MO
Stamford	CT
Stockton	CA
Tampa	FL
Toledo	OH
Traverse City	MI
Trenton	NJ
Tucson	AZ
Tulsa	OK
Waco	TX
White Plains	NY
Wilmington	DE

MSAs with either or both a fiber network and local switching
in some part of the MSA as of 9/30/99

MDS-ITFS-MMDS Assigned Frequencies



Sprint & MCI Worldcom MMDS PSAs & BTAs



A

Appendix A

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

In re Applications of	)	
	)	
SPRINT CORPORATION,	)	
Transferor,	)	
	)	
and	)	
	)	
MCI WORLDCOM, INC.,	)	CC Docket No.
Transferee,	)	
	)	
for Consent to Transfer Control	)	
of Corporations Holding Commission	)	
Licenses and Authorizations Pursuant	)	
to Sections 214 and 310(d) of the	)	
Communications Act and Parts 1,	)	
21, 24, 25, 63, 73, 78, 90, and 101	)	

DECLARATION OF DANIEL KELLEY AND ROBERT MERCER

DECLARATION OF DANIEL KELLEY AND ROBERT MERCER

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DECLARATION OF DANIEL KELLEY AND ROBERT A. MERCER

1. We have been asked by MCI WorldCom, Inc. ("MCI WorldCom") and Sprint Corporation ("Sprint") to assess the economic welfare effects of the proposed MCI WorldCom-Sprint merger in light of technological changes taking place in telecommunications markets.

I. Qualifications

2. I am Daniel Kelley. My current position is Senior Vice President of HAI Consulting, Inc. (formerly Hatfield Associates, Inc.). My professional experience began in 1972 at the Antitrust Division of the U.S. Department of Justice where I analyzed mergers, acquisitions and business practices in a number of industries, including telecommunications. While at the Department of Justice, I was a member of the U.S. v. AT&T economics staff. In 1979, I moved to the Federal Communications Commission ("FCC") where I held several positions, including Special Assistant to the Chairman, Senior Economist in the Policy and Rules Division of the Common Carrier Bureau and Senior Economist in the Office of Plans and Policy. After leaving the FCC, I was a Project Manager and Senior Economist at ICF, Incorporated, a public policy consulting firm. From September 1984 through July of 1990, I was employed by MCI Communications Corporation as its Director of Regulatory Policy.

3. In my present position, I conduct economic and policy studies on a wide variety of telecommunications issues, including local exchange competition, dominant firm regulation, and the cost of local service. I have advised foreign government officials on telecommunications policy matters and have taught seminars in regulatory economics in a number of countries.

4. Of particular relevance to this proceeding, I have participated in preparing two major studies of the prospects for local competition. These are the Enduring Local Bottleneck, released in 1994 and Enduring Local Bottleneck II, released in 1997. These studies focused on the economics and technology of alternative competitive local telephone technologies.

5. I have testified on telecommunications issues before the California, Colorado, Connecticut, Florida, Georgia, Hawaii, Maryland, Massachusetts, Michigan, Oregon, Pennsylvania and Utah Commissions, as well as the FCC and the Federal-State Joint Board investigating universal service reform.

6. I received a Bachelor of Arts degree in Economics from the University of Colorado in 1969, a Master of Arts degree in Economics from the University of Oregon in 1971, and a Ph.D. in Economics from the University of Oregon in 1976.

7. I am Robert A. Mercer. I am the President of HAI Consulting, Inc. ("HAI"), a telecommunications consulting firm created in 1997 from the employees of the former Hatfield Associates, Inc. The firm specializes in engineering, economic, and policy studies in the telecommunications field.

8. I received a Bachelor of Science degree in Physics from the Carnegie Institute of Technology (now Carnegie-Mellon University) in 1964, and a Ph.D. in Physics from Johns Hopkins University in 1969. After holding a faculty position in the Physics Department of Indiana University from 1970 through 1973, I joined Bell Telephone Laboratories in 1973. From then until 1984, I held a number of positions of increasing management responsibility at Bell Labs and at the AT&T General Departments, culminating in my position as Director of the Network Architecture Center

at Bell Labs. In that capacity, I directed an organization that was responsible for planning and systems engineering for the Integrated Services Digital Network ("ISDN") and for advanced data services.

9. Upon the AT&T divestiture in 1984, I transferred to Bell Communications Research ("Bellcore," now Telcordia Technologies), where I was the Assistant Vice President of Network Compatibility Planning. In that capacity, I managed Bellcore's support of the BOCs in meeting the technical equal access requirements of the Modification of Final Judgement ("MFJ"), conducted technical fora with the IXCs and other carriers on behalf of the BOCs, managed the North American Numbering Plan, directed Bellcore's involvement in standards-making efforts, and directed technical analyses of various federal regulatory proceedings matters, including an ISDN inquiry, the application of Computer II rules to the divested BOCs, Computer III, and Open Network Architecture ("ONA"). I also played a substantial role in the formation of a new U. S. standards committee, Committee T1, and was a member of the Board of Directors of the American National Standards Institute ("ANSI").

10. Leaving Bellcore in late 1985, I held positions with BDM Corporation and AT&T Bell Laboratories before joining Hatfield Associates in early 1987. Since then, I have served as Senior Consultant, Senior Vice President, and President of Hatfield Associates and HAI. At HAI, I am responsible for research and education related to public and private telecommunications infrastructures, with a particular emphasis on the Internet, broadband integrated networks, intelligent networks, local exchange competition, and private enterprise networking.

11. I have testified on a variety of telecommunications issues before various state Commissions and in Canada.

12. I am a co-author of The Enduring Local Bottleneck and the Enduring Local Bottleneck II, both of which deal with the ability of alternative providers to enter the local exchange telecommunications business. More recently, I co-authored The Economics and Technology of Broadband Deployment, a report that addresses the prospects for broadband competition and the need for competitive safeguards in broadband markets.

13. I am currently an adjunct faculty member in the Interdisciplinary Telecommunications Program at the University of Colorado, where I have taught a graduate level course on advanced data communications and computer networking for several years and participate on thesis committees for the Master of Science in Telecommunications degree. I have also served as an adjunct faculty member at Pace University, teaching courses and seminars on telecommunications topics ranging from network management to voice communications to ATM and other fast packet switching technologies.

14. As a result of these activities in a variety of different positions with different firms and universities in several different contexts, I am thoroughly familiar with 1) the technology of local exchange and exchange access services, both as deployed by incumbent telephone companies and as being deployed by competitive local exchange entities; and 2) the operational and financial resources required by such competitive entities if they are to deploy local exchange networks capable of serving substantial numbers of customers.

II. Introduction

15. The telecommunications industry is experiencing rapid technological change. No public interest review of the proposed MCI WorldCom-Sprint merger can be complete without an understanding of how technological change is influencing telecommunications markets or how the merger might influence technological change.

16. We conclude that the merger is likely to produce public interest benefits by accelerating the deployment of new, competitive technologies in the local exchange market. At the same time, technological and market changes affecting the long distance business reduce any theoretical concerns about anticompetitive effects flowing from the merger.

17. An understanding of technological change is important for this merger review for three reasons. First, the merger could increase the pace of technological change in local exchange markets, providing direct welfare benefits to consumers. Second, technological change is blurring the distinctions among traditional telecommunications markets. An analysis of the merger must take into account the ways that technological change is changing the markets in which the two firms are participating. Third, even in the context of traditional telecommunications markets, technological changes affect the ability of firms to engage in cooperative or anticompetitive behavior. Everything else equal, it is more difficult for firms to cooperate to raise prices to supracompetitive levels in a market experiencing rapid change.

18. Section III discusses the economics of technological change. Section IV describes the many technological and organizational changes that are taking place in

traditional telecommunications markets. The role of the Internet is discussed in Section V. Section VI explains how the merger can increase economic welfare by promoting the introduction of new competitive technologies into local exchange markets. Finally, Section VII addresses long distance competition in a world in which boundaries are changing due to both technological and regulatory change.

III. The Economics of Technological Change

19. Economists have long recognized that technological change is a powerful source of increases in economic welfare.[1] Technological change comes from invention and innovation. Therefore, changes in market structure that promote invention and innovation should be encouraged. As discussed below, the proposed merger between MCI WorldCom and Sprint has the potential to change the overall structure of telecommunications markets in ways that will promote technological change and thereby significantly increase consumer welfare.

20. Technological change has (at least) two dimensions. First, technological change is the process through which existing forms of production or service delivery are replaced or enhanced by newer, more efficient ones. Second, technological change can result in the introduction of entirely new products and services. The introduction of digital switching and fiber optic transmission are examples of new processes developed to deliver traditional services – local and long distance telecommunications – more efficiently. Cellular radio and the Internet are examples of technological change that

[1] See Wesley M. Cohen and Richard C. Levin, "Empirical Studies of Innovation and Market Structure," in Handbook of Industrial Organization, Volume II, edited by Richard Schmalensee and Robert D. Willig (1989), p. 1060 ("the potential tradeoff between static and dynamic efficiency is therefore central to evaluating the performance of alternative modes of firm and market organization.").

have caused enormous increases in consumer welfare through the creation of entirely new markets.[2]

21. Of particular interest to the evaluation of the proposed MCI WorldCom-Sprint merger is the possibility that the merged company can bring to bear new technologies to challenge the present local exchange monopoly. Technological change is often an opportunity for new firms to compete with older ones – especially those that are not performing well because they are monopolies.[3] Timothy Bresnahan has recently described the benefits of dynamic competition in the following way: "It means that the inventive abilities of a number of different firms come into play. These firms have different ideas and inspirations. They also have different incentives."[4] In other words, firms compete through innovation to eliminate market power, create new markets, and thereby increase consumer welfare.[5]

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[2] Jerry A. Hausman estimates that cellular telephone services produce consumer welfare gains of $50 billion per year." See "Valuing the Effects of Regulation on New Services in Telecommunications," Brookings Papers on Economic Activity (1997) p. 2.

[3] The importance of technological change to increasing consumer welfare was emphasized by Joseph Schumpeter, The Theory of Economic Development (1934). His approach has sometimes been characterized as a defense of monopoly. In this view, monopoly is seen as an efficient shelter for the risk required to invent and innovate and a means of appropriating any resulting benefits. The Declaration by Stanley M. Besen and Steven R. Brenner concludes that the proposed MCI WorldCom-Sprint merger is not likely to produce market power. Therefore, the advantages of dynamic competition discussed here do not rely on monopoly power.

[4] See Timothy F. Bresnahan, "New Modes of Competition: Implications for the Future Structure of the Computer Industry," June 1998, p. 7. This paper can be found at www.pff.org/pff/microsoft/bresnahan.html.

[5] The U.S. Department of Justice, recognizes that firms use research and development to challenge market dominance. See Antitrust Guidelines for the Licensing of Intellectual Property, Section 3.2.2, April 6, 1995.

22. Scherer and Ross describe technological change as a five-step process consisting of invention, entrepreneurship, investment, development, and diffusion.[6] An idea for a new process or new service (invention) is only the first step in creating technological change. An entrepreneur willing to raise the capital necessary to develop the invention and bring it to market (investment, development and diffusion) must sponsor the idea.[7]

23. Bringing a new technology to market requires several steps beyond the invention stage. The innovating firm must take the risk inherent in developing the invention beyond the initial idea by investing the perhaps considerable sums needed to develop and deploy the technology. Marketing is also an important part of the diffusion process. Customers must be induced to take the risk associated with using a new technology.

24. Generalizations about the relationship between technological change and market structure are difficult to make.[8] Nevertheless, it is often the case that the resources required for invention are quite small in relationship to the resources required to introduce new technologies to the market.[9] In other words, small firms may have a role at the early stages of innovation but may not always have the resources required to develop the idea into a commercial reality. As we discuss further below, even very large

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[6] See Frederick M. Scherer and David Ross, Industrial Market Structure and Economic Performance, 3rd ed. (1990), p. 616.

[7] Innovations do not have to be based solely on technology inventions. As Gerald Faulhaber points out, entrepreneurs used AT&T's In-WATS service in a multibillion dollar transformation of the retailing industry. See Gerald R. Faulhaber, Efficiency and Productivity, in Barry Cole, ed., Breaking Up Bell, (1991), p. 425. Today's entrepreneurs are doing the same thing with the Internet.

[8] See Cohen and Levin, *supra.*, note 1, for a survey of the literature.

firms may not have the internal resources to develop and rapidly deploy capital intensive, high sunk-cost technologies throughout the nation.

25. Thus, for instance, there have been many innovations in the delivery of telecommunications services to customers' premises. These include Digital Subscriber Line ("DSL") technologies for transmitting high-speed digital signals over copper lines, cable modems for doing the same over combined fiber optics and coaxial cable networks typically deployed by cable television companies, and broadband wireless systems for delivering high-bit-rate signals over the ether. Yet, to date, no entrant has been able to use any of these technologies to eliminate, or even substantially reduce, the market power of the incumbent telephone companies.

IV. Technological Change in Telecommunications

26. The structure of the traditional telecommunications industry is well known. Local, long distance and wireless carriers each account for a significant portion of total industry revenue. It will be useful here to lay out the broad features of the industry in terms applicable to a dynamic analysis. The dominant technological force in telecommunications today is the growth and development of the Internet. Technological change specifically related to the Internet is discussed in the next section.

A. Mobile and Long Distance Markets

27. There is rapid innovation in both the mobile and long distance markets. If the key to dynamic efficiency is the rapid introduction of new technology, then both the mobile and long distance industries are poster children for the concept. Cellular

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[9] See Scherer and Ross, *supra.*, note 6, p. 619 (" . . . outlays much greater than those incurred during the original conceptual stages are necessary before an innovation is brought to the point of commercial utility.")

providers have cut their prices and are moving more rapidly to digital technology in the face of PCS competition.[10] Third generation technology is on the drawing boards.[11]

28. Long distance companies have evolved from analog to digital microwave and then from single wavelength transmission on single mode fiber to wave division multiplexing.[12] Data switching has evolved from circuit switching to packet switching to fast packet switching in the space of twenty years. Just within the past few years, several major facilities-based carriers have emerged.[13] These carriers are building their networks by relying heavily on Internet Protocol ("IP") packet switching technology. As a result, they are able to both offer innovative broadband data services and compete with traditional providers of voice services.

B. Innovation and the Local Exchange

29. Technological change has also come to local markets. Digital switching, fiber optics in the interoffice and feeder portions of the network, Signaling System 7 ("SS7") and advanced Operations Support Systems ("OSS") capabilities have all been deployed in local networks. DSL technologies are being deployed selectively to allow broadband transmission over loops that formerly only supported narrowband transmission. Unlike cellular and long distance, however, local markets have not yet

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[10] See Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, Fourth Report, FCC Document 99-136, released June 6, 1999. The FCC's CMRS rules, including the restriction on consolidation of the limited spectrum resource, have encouraged competition and innovation. See 1998 Biennial Review of Spectrum Aggregation Limits for Wireless Telecommunications Carriers, WT Docket No. 98-205, released September 22, 1999. There are no barriers in the long distance market analogous to scarce spectrum.

[11] This is the next generation of digital mobile communications that will provide higher bandwidth and greater functionality to subscriber units.

[12] Wave division multiplexing is the transmission of multiple broadband signals over a single fiber strand, each at a different wavelength or "color" of light.

become competitive. Regardless of the technologies employed by the Incumbent Local Exchange Carriers ("ILECs"), the entire history of telecommunications markets has been characterized by one key economic and technological constant – the last mile is a bottleneck.

30. The New York City metropolitan area is arguably the most competitive local market in the country. Nevertheless, local exchange competitors have managed to acquire less than six percent of that market. That share is heavily focused on large business subscribers.[14] With few exceptions, residential consumers do not have a choice of local providers. Realistically, only a limited number of large businesses in the core urban areas of large cities have a choice of a local provider.[15] Access to building rights-of-way and the high cost of extending fiber rings make it impractical or prohibitively expensive to reach some locations, even in core urban areas. As a result, long distance, mobile and Internet providers are all dependent to one degree or another on connections to the local networks owned by the ILECs.

31. In spite of the fact that local exchange carriers have deployed new technology, the economic performance of local markets lags behind that of the vertically related and dependent long distance, mobile and Internet markets. Prices for many

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[13] These carriers include Global Crossing, GTE, IXC, Level 3, Qwest and Williams. See Besen and Brenner for additional discussion of long distance entry.

[14] See Affidavit of A. Daniel Kelley on Behalf of AT&T Corp., AT&T Exhibit 1, In the Matter of Application by New York Telephone Company (d/b/a Bell Atlantic-New York), Bell Atlantic Communications, Inc. NYNEX Long Distance Company, and Bell Atlantic Global Networks, Inc., for Authorization to Provide In-Region, InterLATA Services in New York, FCC Docket No. 99-295, October 19, 1999.

[15] RCN in Manhattan and a handful of other metropolitan areas is providing facilities-based residential service to large apartment buildings. See Id., p. 11.

services exceed costs, sometimes by orders of magnitude.[16] Broadband technology has been present in local networks for many years, but telephone companies have apparently been reluctant to roll out consumer services for fear of cutting into their substantial T1 revenue base.[17] At least one local telephone company has been repeatedly criticized for poor customer service in multiple states.[18]

32. The stability of the local exchange monopoly, and the resulting poor performance, is not because competitive local exchange technologies have not been invented. There are many potential sources of invention for telecommunications markets. A robustly competitive telecommunications equipment market has developed in the wake of the AT&T divestiture. These equipment vendors are developing new technologies at a rapid rate; either due to research they initiate or due to requests from the service providers they supply. The convergence of the computer industry and the communications industry, discussed for decades but now becoming a reality, only adds to the inventive capacity of the industry. Thus, for instance, modern telecommunications equipment supports advanced signal processing that enables the transmission of much higher-speed signals in a more reliable fashion, new service features and functions that involve sophisticated information processing,[19] and adaptation to the differing needs of different users.[20]

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[16] Access charges are far in excess of forward looking costs. See HAI Consulting, HAI Model, Release 5.1 for estimates of the economic cost of access.

[17] T1 is a high capacity transmission service that transmits at 1.544 Megabits per second.

[18] See e.g., "Arizona Residents Complain to Commission of US West's Poor Service," Arizona Republic, November 11, 1999.

[19] An example is the ability to look up a telephone listing in a PC database displayed on the PC's monitor, then instruct the computer to actually dial the call instead of dialing it manually.

[20] A telephone terminal that can respond to oral commands rather than dialing, facilitating the use of the equipment by people with manual disabilities, is an example.

33. Competitive Local Exchange Carrier ("CLEC") fiber ring networks, cable telephony, and wireless are all potential substitutes for the existing local exchange. However, to date, none of these technologies has made effective inroads in local exchange telephone markets. These potentially competitive technologies are discussed in greater depth next.

C. Potential Competitive Technologies for the Local Exchange

34. Fiber rings are limited to central business districts or a few outlying business centers of major urban areas. The technology of fiber rings and fiber ring deployment requires a high fixed investment per customer. It is simply not economical in less dense areas populated by most consumers and businesses to deploy fiber rings. This is due, in part, to the length of the fiber rings that would be required. As noted above, even in dense urban areas, it is not economical to extend the rings to every potential customer. This implies that competitive fiber rings will never by themselves serve the mass market.

35. Cable telephony technology works.[21] AT&T has committed to investing billions of dollars over a period of at least several years to bring it into the market. Nevertheless, there are substantial technical, capacity, operational, and/or financial obstacles to competition from cable television companies. For instance, providing telephone services over cable television hybrid fiber coaxial cable ("HFC") networks requires significant upgrades to many cable systems to support two-way communications services as well as significant incremental investment in cable telephony equipment, switching facilities and OSS capabilities. Moreover, there is currently a technical

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[21] See Hatfield Associates, Inc., The Enduring Local Bottleneck II, April 30, 1997, pp. 18-28.

stalemate over which of two fundamental technologies to employ.[22] Eventually, these obstacles are likely to be overcome given AT&T's commitment. However, ILECs will not face widespread competition from cable in the near future.

36. The fairly rapid growth of cable modem services, in which cable companies support two-way broadband digital transmission to and from customers, does not mean that the cable companies are viable competitors for traditional local exchange services. While there are various systems for carrying voice in a broadband data stream, the state of technology is still fairly rudimentary. The systems are simply not yet able to replicate the high quality, reliable, secure, and feature-rich services associated with the Public Switched Telephone Network ("PSTN").

37. Mobile wireless, or broadband point-to-point wireless systems also face substantial technical, capacity, operational, and financial barriers. Existing Commercial Mobile Radio System ("CMRS") providers have been reluctant to address the fixed-location market. The per-minute charges for fixed-location service are not competitive with those available in the mobile market. It is more attractive for these carriers to pursue customers that have never had mobile service, or the high-revenue customers of their competitors, than to compete with the entrenched incumbent local exchange companies ("ILECs").[23]

38. There are also quality, safety, security and reliability issues associated with mobile wireless services. Certain features available on wireline networks, such as extension lines, are not available or are awkward to provide on wireless networks.

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[22] Cable providers must choose between circuit switched, constant bit-rate telephony or IP, packet-switched telephony. The latter is under development, but not yet a commercial reality for local access.

Finally, with current technology, there may not be sufficient allocated spectrum in dense urban areas to economically handle the traffic loads associated with both mobile and wireline traffic.

39. The ability of broadband radio systems (in the 24, 28 and 38 GHz bands) to significantly increase the customer base they serve is limited by the lengthy and resource consuming process of acquiring radio sites, the need for line-of-sight transmission, and technical considerations that require the customers to be close to a radio site. As a result, the focus of broadband wireless operators has turned to providing niche services to small and medium size businesses. Even this deployment has been slow. As discussed further below, due to its advantageous place in the spectrum, Multi-channel Multi-point Distribution Service ("MMDS") may be an exception. Carriers using MMDS may even have an as yet unexploited opportunity to provide residential service.

40. The success of the Internet, described below, is causing interest in broadband technologies. An entirely new class of providers has evolved to provide broadband services over local loops. Companies such as Covad, NorthPoint and Rhythms are already in business. But these companies all rely primarily on unbundled loops obtained from the incumbents to reach their customers. Therefore, they are highly dependent on the ILECs for pricing, provisioning and quality of their services. In Section V we discuss the possible effect of the merger on the deployment of these alternative technologies.

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[23] The absence of "calling party pays" billing arrangements is also an issue because consumers are reluctant to receive what amounts to collect calls.

D. Consolidation and Integration in the Telecommunications Industry

41. In addition to rapid technological change, the telecommunications industry is experiencing significant organizational change. SBC has acquired PacTel, SNET and Ameritech. Bell Atlantic acquired NYNEX, is proposing to acquire GTE, and now is merging its wireless business with Vodafone. AT&T acquired McCaw, TCG, TCI and IBM's international network business. AT&T is also proposing further cable mergers and joint ventures. AT&T and BT have merged their international businesses. While it is difficult to prove that technology is driving consolidation in the industry, it is clear that firms have made the decision to become larger as the industry evolves. Policymakers have already approved several recent mergers between large telecommunications firms.

42. Another major organizational change is on the horizon. At some point the Bell Operating Companies ("BOCs") will be allowed into in-region interLATA long distance markets. These markets will look dramatically different after BOC entry. For example, bundling of local and long distance services, already a growing marketing factor, will only increase after BOCs are able to offer one-stop shopping.[24] Indeed, due to low barriers to entry in the long distance market, the BOCs will be able to provide interLATA long distance service immediately upon receiving 271 authority. The growth and development of the Internet, discussed next, adds to the extent and significance of these technological and organizational changes.

V. Technological Change and the Internet

43. The commercial success and resulting growth of the Internet will have profound effects on all telecommunications markets. We discuss Internet services and

[24] This will be an especially difficult problem for long distance carriers if the BOCs are allowed to enter before local markets become fully and irreversibly open to competition.

technology in Section A and the broadband technologies that Internet demand is stimulating in Section B.

A. Internet Services and Technology

44. The Internet has stimulated the growth of broadband data service, which provides transmission capacity for sending data, video, and imaging information. For example, broadband data service is growing in response to one of the most popular Internet applications, the World Wide Web ("WWW"). The WWW consists of increasingly sophisticated web pages and content-intensive databases, such as video clips and images, which in turn require large data downloads from servers to browsers.

45. Internet technology, in conjunction with the growth of client-server computing to replace the former terminal-host computing paradigm, has also taken root in corporate networks. Legacy computer networks, such as those based on IBM's System Network Architecture, are being supplanted or transformed by web-based communications. Within a single corporation, networks based on Internet technology are referred to as intranets. Multiple corporations, typically trading partners in a supply chain, also band together to create multi-company networks called extranets.

46. Whether considering the public Internet, intranets, or extranets, the key point is that these networks involve the movement of increasingly large amounts of data, which in turn impose the requirement for broadband data transport services. These developments are leading a host of large and small companies to scramble to provide consumers with broadband connectivity.

47. The Internet is also evolving to provide corporate customers with Virtual Private Networks ("VPNs"). VPNs appear to the user to have the attributes and features

of a private local or long distance network without requiring dedicated routers or transmission facilities. In effect, the Internet VPN attempts to replicate the degree of reliability and security that is characteristic of virtual circuits in frame relay and Asynchronous Transfer Mode ("ATM") networks, or for that matter voice circuits in the PSTN, while maintaining the inherently "connectionless" routing provided by IP.[25] Finally, the Internet already supports many services that are substitutes for, or augmentations of, voice service, such as chat rooms, electronic mail, and electronic commerce.[26]

48. As broadband data networks have grown in importance to users, interest is growing in integrating data and voice networks. For example, Winstar and CTC (a Massachusetts-based reseller that is building a data network) are competing for corporate network business in the Northeast by providing a single source for local, long distance, Internet and data traffic.[27] This interest is heightened by the Internet's potential ability to serve as a replacement and enhancement for voice and other services customers otherwise purchased from the PSTN. Specifically, the Internet may develop to support a full range of voice services and features, using what is often referred to as Voice over Internet

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[25] IP routes each packet independently of all other datagrams. Unlike ATM, Frame Relay, or the PSTN, there is no notion of a network "connection" that is maintained for the duration of a communications session between devices attached to the network. This allows the IP protocol to be simple, fast, and able to adapt quickly to changes in the network, such as the loss of a node or link. But it raises concerns about reliability and security on the Internet, concerns that are addressed by the VPN without seriously compromising the desirable attributes of IP.

[26] For instance, a consumer can call an 800 or 888 number and place an order for a product with a salesperson, or can electronically order goods over the Internet, thus the PSTN and Internet provide equivalent functionality for many consumers.

[27] Peter J. Howe, "On Cutting Edge of Convergence CTC, Winstar are Pioneers in Providing One-Connection Telecom Service to Boston Area," Boston Globe Online, November 2, 1999, http://commerce.boston.com/bg-archives.

Protocol ("Internet voice").[28] Integrated networks could produce a number of advantages, such as more efficient utilization (for instance, interspersing low-priority data in lulls between the transmission of higher-priority voice), consolidated management, and innovative applications involving a mixture of voice and data content.

49. At the same time, there are substantial technical obstacles to the full integration of voice and data, related to the quality of the reconstructed voice signal and the effects of transmission delays and lost packets when voice is sent over a packet network. A substantial effort is underway to analyze and resolve these issues, including any protocol development that may be required. We expect resolution of these issues within the next year or two.

50. Resolution of these obstacles would allow the Internet to evolve to play an increasingly important role in the provision of long distance voice services. As time moves on, then, the distinction between the "voice" network and the Internet may increasingly blur. As a corollary, there will be a blurring of distinction between today's long distance carriers and Internet Service Providers ("ISPs").

51. The success of the Internet has also spawned an interest in the provision of value-added applications services by companies who previously provided transport services. These services are being bundled with transport. This is most evident today in the provision of applications by ISPs. ISPs provide protocol conversion services for non-Internet PCs, electronic mail, other Internet applications such as file transfer and remote terminal logon, web site hosting, and in some cases, advanced information services such as stock market quotations and airline ticketing. By doing so, they acquire the

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[28] Technical and implementation problems with this technology make it unlikely that it will be used on a widespread basis in the near term as a replacement for voice services

opportunity to earn revenues from feature-rich applications. Integration into these vertically related services also allows ISPs to differentiate their offerings from those of other transport providers. The provision of applications services is now taking further root in the concept of the Application Service Provider ("ASP").[29] ASPs are beginning to deliver processing-intensive and often bandwidth-intensive applications to their customers over the Internet.

52. The concept of bundling processing-rich applications with transport has not been lost on interexchange carriers ("IXCs"), who are entering the ISP business or otherwise adding various kinds of applications to their arsenal of services. Nor have the BOCs and other incumbent telephone companies missed this development.

53. Thus, the market distinctions between ISPs and IXCs are blurring as 1) IXCs increasingly provide ISP services; 2) ISPs provide voice offerings that compete with IXC long distance services; and 3) Internet, other data services, and perhaps voice offerings are integrated on a single network provided by an IXC/ISP. Furthermore, the onset of sophisticated network-based applications provides additional incentives for the development and expansion of the ISP market.

B. Developments in Broadband Transport Systems

54. The enormous growth and success of the Internet is fueling an interest in new network architectures and technologies that can deliver broadband services to the consumer. Broadband systems are those capable of transmitting at least hundreds of

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provided over the PSTN.

[29] See, e.g., "ASPs Build Momentum," Network World, 5/24/99, p. 26, reporting formation of the ASP Industry Consortium and several new ASP entrants; "ASP Consortium Grows, But Key Players Still Absent from Roll Call," Network World, 6/28/99, p. 11, projecting ten-fold growth in ASP revenues, from $0.2 billion in 1999 to $2.0 billion in 2003.

kilobits per second ("kbps") and perhaps as high as tens of millions of bits per second ("Mbps"); as even more information-intensive network applications appear, the upper end of this range will move even higher. These systems can support a range of voice, data, video, and imaging services. Existing narrowband services can only support voice and low speed data services. Therefore, broadband is often, if loosely, differentiated from narrowband by stating the former supports all forms of telecommunications, whereas the latter supports only voice and low-speed ("modem-speed") data.

55. Fiber optics transmission systems, which are inherently capable of broadband transmission speeds, are being deployed throughout the telecommunications network, including the local exchange. The adoption of the Synchronous Optical Network ("SONET")[30] family of standards promoted the development of broadband services in telecommunications networks. SONET specifies standard line rates, optical interfaces, and signal formats. It is intended to create a transmission environment that encourages the ubiquitous deployment of high-speed fiber optics transmission, while lowering costs and providing a transport infrastructure that helps to simplify the network.

56. The existing voice switches in the PSTN are being supplemented by packet switches and/or Internet routers that carry the Internet and other data/multimedia traffic. Going even further, some IXCs, LECs, and ISPs have announced the intention of migrating their networks to a fast packet network which fully integrates the transport of information associated with all kinds of applications -- voice, data, video, etc.[31] In this scheme, all forms of communication, including voice, appear as a stream of packets from

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[30] The international standards equivalent of SONET is the Synchronous Digital Hierarchy ("SDH").

[31] See, for instance, "The Old Phone System is Facing an Overload, So Sprint Has a Plan," The Wall Street Journal, June 2, 1998, p. 1.

fast packet equipment on end users premises to and all the way through the network to similar equipment at other end user and information provider premises.

57. In the ILEC networks, these infrastructure changes take the following specific forms. First, the "local loops" that connect customer locations to the rest of the network are evolving from voice-oriented narrowband analog transmission to integrated broadband digital transmission. Currently, this takes two forms: SONET-based fiber transmission systems utilized in the feeder portion of the network, and the use of the xDSL family of broadband digital transmission systems in the copper wire portion of the loop. The nature and use of xDSL systems is discussed more fully below. The use of fiber to replace copper loops all the way to the curb or individual premises may become economic in the future.

58. Second, the existing voice switches in the PSTN Central Offices ("COs") to which customers are attached are being supplemented by adjunct packet switches and/or Internet routers that currently carry the Internet and other data/multimedia traffic, and may later be used to offer fully-integrated voice, data, and other traffic. The packet switch is attached to the CO end of the broadband access line, and serves as the entry point for the rest of the packet network. Finally, the capacity of existing fiber optic interoffice networks is being increased, and part or all of the available bandwidth is being used as an aggregate "bit pipe," rather than being organized into voice circuits.

59. We have mentioned the DSL broadband loop technologies above. A number of different members of the DSL family have been, or are being, defined. The most prominent among them are asymmetric DSL ("ADSL") and High-bit-rate DSL ("HDSL"). ADSL, which itself comes in several variants, is thought of as the technology

most applicable to residences and small businesses; HDSL is viewed as a cheaper, quicker way to provide conventional digital "T1" dedicated circuits to the premises of larger businesses.[32]

60. The entire xDSL family is defined to operate over existing copper loops. Special xDSL terminal equipment is attached to each end of the wire loop – one end is at the customer's premises and the other at the CO end of the copper pairs.[33] The high bit rates are attained through the use of sophisticated signal processing capabilities in the xDSL equipment. ADSL permits a customer simultaneously to make a voice call and to send and receive dâta over a single wire pair. It is "asymmetric" because it transmits at a higher speed downstream (from the network to the customer) than upstream (from the customer to the network). The data signals range from hundreds of kbps to as high as eight Mbps, depending on the loop length and the attached electronics. Generally, the first ADSL application has been Internet access, so IP datagrams are transmitted over the ADSL loop and forwarded to an Internet router.

61. The move to broadband prompted by the development of the Internet and the potential to move both voice and data through the same "pipe" signals major changes for both local and long distance carriers. Integrated networks will accelerate the move to integrated services discussed above. Every established carrier will have to respond to these changes. The most successful ones will lead.

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[32] T1 is a well-known transmission speed, involving a transmission speed of 1.544 megabits per second simultaneously in each direction. HDSL requires two wire pairs to achieve the two-way T1 signal. Symmetric DSL, or SDSL, operates over a single pair and can still achieve up to the T1 rate; however, there are more stringent conditions on the loops utilized.

[33] One major variant of ADSL, often called "ADSL G.lite" (or just "ADSL Lite") for its international standards designation, does not require separate equipment at the customer's premises except for a modem card that is plugged into the customer's PC.

VI. The MCI WorldCom-Sprint Merger and the Local Bottleneck

62. The MCI WorldCom-Sprint merger has the potential to accelerate the introduction of competitive local technologies. The major reason for this is that a combined MCI WorldCom-Sprint has an increased incentive and ability to use both narrowband and broadband wireless competitive technologies to compete in the local exchange market.

63. To understand why this is so, it is important first to consider the fact that technological change has a significant endogenous component. Technology development can be directed to specific purposes. Wireless technology has evolved rapidly and engineers understand how to apply it to both fixed narrowband and broadband applications. However, to date, particularly in urban markets, narrowband wireless carriers have been focused on the high revenue mobility market. The next step is to develop fixed wireless technology, invest in it, and bring it to market.

64. AT&T is currently developing fixed wireless technology using narrowband spectrum, but our understanding is that Sprint PCS remains focused on mobile applications.[34] Large ILECs own many of the other narrowband players. In their own territories, these ILECs obviously have a reduced incentive to innovate in ways that will reduce their fixed wireline monopolies.[35] The combined MCI WorldCom-Sprint will have a significant incentive to position narrowband wireless as a fixed substitute.

[34] See AT&T News Release, "AT&T's Breakthrough Wireless Technology New Alternative for Local Service," February 25, 1997. Western Wireless is pursuing this approach in rural areas.

[35] This problem is exacerbated by the fact the FCC has allowed, or is in the process of allowing, mergers among large ILECs, reducing whatever incentives these carriers had to innovate in fixed wireless to serve customers outside their regions.

65. Broadband wireless access is a relatively new technology. The combined MCI WorldCom-Sprint will have greater ability to develop and deploy this technology than either one of them alone. First, having a more or less national MMDS footprint will provide economies of scope in both product development and marketing.[36] The combination of the MCI WorldCom fiber networks and MMDS spectrum with Sprint MMDS spectrum provides an opportunity to put both local and national networks together for customers.[37]

66. Creating national footprints with fragmented local ownership turns out to be a serious problem. The experience of wireless carriers in assembling nationwide roaming agreements is illustrative. Individual wireless carriers have an incentive to hold-out for preferential terms.[38] This is a case where interfirm contracting faces transactions cost obstacles.[39] The combination of the Sprint and MCI WorldCom MMDS spectrum will help to overcome this problem.

67. Second, the merger will allow MCI WorldCom-Sprint to quickly select a single efficient technology and implement a service competitive to other wireless and wireline access models. The existing assets of each company can be leveraged; larger volumes of equipment orders will result in better prices, and a merger prior to rollout of different services by the two firms will result in operating efficiencies. Third, the rollout

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[36] The other broadband wireless players already have a national footprint

[37] The MMDS spectrum that Sprint and MCI have acquired has particular advantages compared to other broadband spectrum. For example, MMDS operates at a lower frequency, which reduces weather issues.

[38] See Lynette Luna, "Roaming Drives Need for Rural Partners," RCR, October 11, 1999, p. 1. ("Rural cellular carriers are reaping generous roaming revenues from nationwide operators. As such, larger players have become willing to pay top dollar to acquire these companies and eliminate the high roaming fees they pay to them.")

[39] See Oliver E. Williamson, Markets and Hierarchies: Analysis and Antitrust Implications (1975).

of a national service requires a great deal of capital. The merged firm will obviously have access to capital.

68. The cable telephony experience provides an analogy. Cable telephony has been discussed as an alternative local distribution technology for many years, but given technical and economic problems, has not been implemented. AT&T is finally making plans to deploy the technology, but not without a great deal of prior consolidation of the fragmented cable industry. In the final analysis, it appears that it took a long distance carrier to move cable telephony from the drawing boards to the development and implementation stage. Within a few years, there may be appreciable diffusion.

69. The merged firm will have the resources to develop and deploy the appropriate mix of the various technology options in order to provide customers with broadband access to the firm's backbone network. The merged firm can exploit fiber rings to provide access for business and multiple dwelling unit residential customers located in and near central business districts. It will be able to use the MMDS broadband spectrum to extend wireless connectivity from nodes on the ring to customers located in areas where it is not economical to extend fiber rings. It will use collocation and xDSL to provide access for residential and small business customers.

70. Adding a potential MCI WorldCom-Sprint wireless local exchange player to the mix both increases the probability that at least one additional technological approach will succeed. Encouraging local entry by MCI WorldCom and Sprint is particularly important given the decision by the FCC to allow large local telephone companies to merge. These mergers reduce the number of potential entrants and

eliminate important regulatory benchmarks.[40] These merged ILECs may enter niche markets in each other's territories (e.g., data or the fiber ring business), but do not have the same incentives as the combined MCI WorldCom-Sprint will have to enter mass markets.

71. In sum, the merger raises the prospect of increasing competition by accelerating innovation. That is, it will create a new firm with the potential to erode the current local telephone bottleneck through investment and innovation in new technologies. However, even with the combined resources of MCI WorldCom and Sprint, policymakèrs must understand that it will take a significant amount of time before local markets become competitive.

VII. Technology and the Horizontal Effects of the Merger

72. The proposed MCI WorldCom-Sprint merger obviously has a significant horizontal component. It brings together the MCI WorldCom and Sprint long distance businesses. Besen and Brenner conclude that the merger is not likely to be anticompetitive. They point out that there are numerous long distance competitors with their own national transmission networks and using numerous distribution channels. If the BOCs comply with their 271 checklist obligations, there will be additional significant players. Moreover, entry barriers into the long distance market are relatively low – proven by, if nothing else, the fact that so many firms have entered and established themselves.

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[40] See Declaration of Kenneth C. Baseman and A. Daniel Kelley, In the Matter of Applications for Consent to the Transfer of control of Licenses and Section 214 Authorizations from Ameritech Corporation to Southwest Bell Telephone, CC Docket No. 98-141, October 15, 1998.

A. Technological Change and Firm Structure

73. Continuing technological change is also a factor to be considered in evaluating the effects of the merger on the long distance market. The Internet has created significant demand for broadband capacity. Many firms are providing broadband access, broadband switching and broadband interoffice capabilities. These developments have two potentially significant effects on the long distance market. First, ISPs have become a new source of the broadly defined communications needs for many consumers. These firms have become, or could readily become, another source of traditional retail long distance services. As discussed above, the availability of broadband networks together with the development of packetized voice technology provides the possibility that ISPs could even vertically integrate into the wholesale long distance business.

74. Technological change does not always have to lead in the direction of deconcentrating markets. Nevertheless, the technological forces for change in the long distance market seem to be pointing toward easier entry and deconcentration. Timothy Bresnahan points out that government policy must be particularly carefully crafted when industries face "epochal change."[41] Given all of the ongoing or imminent changes in technology, the telecommunications business certainly qualifies as one facing epochal change. The government cannot predict how change will evolve, but should be looking for ways to facilitate change, rather than taking steps that may risk reducing dynamic efficiency.[42]

75. Bresnahan also describes the importance of competition coming from horizontal layers in a vertical industry structure. His model applies to the computer

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[41] Bresnahan, *supra.*, note 4.

industry where high concentration at various horizontal levels has not lead to poor performance. The analogy is not exact when applied to telecommunications. The local exchange monopoly has been in place for decades and is not the product of recent technological change. Nevertheless, assuming that local markets can be successfully entered, there is an opportunity to replicate the kind of competition that has kept the computer industry vibrant. In other words, if long distance firms enter local markets with existing or new technology to challenge poor performance by the ILECs, the results will be positive for consumers, even if there is some temporal increased concentration in long distance.

B. Technological Change and Firm Conduct

76. Technological change may also affect market conduct. In periods of rapid technological change, coordination of pricing becomes more difficult. As Hay and Kelley report, " . . . industries with high rates of technological change should not be expected to be found engaging in collusion with the same frequency as industries without rapid change."[43] That is, everything else equal, less coordination for a given concentration level would be expected in markets experiencing rapid technological change.

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[42] Of course, until these changes have the effect of substantially reducing ILEC market power, regulation will be required.

[43] See George A. Hay and Daniel Kelley, "An Empirical Survey of Price Fixing Conspiracies," Journal of Law and Economics, April, 1974, p. 15.

C. Deregulatory Benefits of Effective Local Competition

77. To the extent local competition is accelerated and results in a multi-firm market, deregulation can follow. Deregulation may in turn stimulate further technological change and consumer benefits. As Clifford Winston reports,

> Deregulation should not receive credit for the technological changes that have opened the possibility of intense competition in the communications and energy industries. But deregulation should allow and encourage more rapid application of these innovations, and by providing greater operating freedom and a more competitive environment it should stimulate new innovations.[44]

The possibility of a "virtuous cycle" of innovation begetting competition and deregulation, leading in turn to more innovation, would obviously provide consumers with enormous benefits.

VIII. Conclusion

78. The proposed merger between Sprint and MCI WorldCom is taking place in a world experiencing rapid technological change. The combined firm has a significant incentive and greater ability to bring that technological change to local exchange markets. At the same time, technological change is both reducing entry barriers into long distance and making interfirm coordination more difficult. This reduces the concern that the merger might lead to undesirable concentration in the long distance market.

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[44] Clifford Winston, "U.S. Industry Adjustment to Economic Regulation," Journal of Economic Perspectives (Summer 1998), p. 107.