UNIVERSAL SERVICE IN THE DIGITAL AGE: THE COMMERCIALIZATION AND GEOGRAPHY OF US INTERNET ACCESS

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ABSTRACT

Many analysts anticipate a need to redefine universal service to account for Internet-related services and other combinations of communication and computing. This concern motivates a study of the geographic spread of the commercial Internet Service Provider (ISP) market, the leading suppliers of Internet access in the United States. The paper argues that two business models presently vie to diffuse commercially-oriented Internet-access across the US. One business model emphasizes a standardized national service, the other a customized local service. The paper then characterizes the location of over 14,000 access points, local phone numbers offered by commercial ISPs in the spring of 1997. Markets differ widely in their structure, from competitive to unserved. Just under three quarters of the US population has easy access to commercial Internet service providers, while approximately fifteen percent of the US population has costly access. Urban/rural coverage must be understood in the context of the different strategies of national/local providers.

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I. Motivation

Governments frequently revisit the principles of universal service, making it an enduring issue in communications policy. In past eras this goal motivated policies which extended the national telephone network into rural areas and into low-income areas. In the last few decades the same concerns motivated policies which eliminated large disparities in the rate of adoption of digital communication technology within the public-switched telephone network. More recently, and in a continuation of this trend, many analysts have begun to anticipate a need to redefine universal service to account for Internet-related services and other combinations of communication and computing.[1]

Previous experience in telecommunications divides this issue into two questions. First, policy must define the minimal level of acceptable service for all users. Second, policy must determine how governments can influence private providers to meet new policy goals for dispersion. This is a familiar exercise in the regulated local telephone industry, yet potentially deceptive when applied to Internet related services. It overlooks unprecedented features of the new (and mostly unregulated) Internet industry. The primary purpose of this study is analyze these new features.

This study focuses on understanding the geographic spread of the commercial Internet Service Provider (ISP) market, the leading suppliers of Internet access in the United States. In the absence of dramatic changes in government policy[2], market-based transactions with ISPs will be the dominant form for delivery of on-line access for medium and small users The ISP industry has grown rapidly in the United States in the last few years, eclipsing the university-supported publicly-subsidized network which spawned it. The preeminence of commercial

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[1] For example: "The traditional concept of universal service must be redefined to encompass a concept more in line with the information superhighway of the future." US Advisory Council on the National Information Infrastructure [1996], p. 31.

[2] For example, as of this writing, the Federal Communications Commission does not charge access fees to ISPs, but is considering a number of proposals to do so. See the discussion and request for comment at www.fcc.gov. For a summary of this and related debates, as well as an argument in favor of imposing access fees, see e.g., Werbach, 1997, Garcia and Gorenflo, 1997, or Sidek and Spulber, 1997.

development is now widely recognized.[3] The most optimistic estimates project that total US receipts for these firms in 1997 will reach somewhere between 3 and 5 billion dollars (Maloff, 1997). While this is a paltry sum compared to the revenues for basic telephone service, it is impressive for an emerging industry whose growth began a few years earlier.

This piece of the commercial Internet market warrants policy interest for a variety of related reasons. First, commercial ISPs do not operate under any explicit universal service mandate, though there is considerable political interest in this goal. No research has yet examined how (or whether) commercial firms contribute to this goal. Second, since ISPs partially use the public-switch network, good policy for this network should understand the commercial forces in the ISP market. Third, many frontier information technology applications in electronic commerce, such as "extranets" and "intranets," deliberately build off the Internet. To the extent that these applications play a more significant role in business, then provision of adequate Internet infrastructure plays a significant role in regional economic development. Finally, this analysis of the commercialization and geographic scope of the ISP industry will influence many other facets of the burgeoning literature on information infrastructure policy.[4]

The first half of this paper develops a framework for research about the geographic diffusion of commercially-oriented Internet-related technology markets. The framework shows how commercial forces influence the availability of Internet access. As such, there is no reason to anticipate ISPs to provide universal access. ISPs' choices of where to locate has much to do with the pricing behavior of firms, the value-added services available to users and quality of service. Two predominant business models vie to be the mechanism that diffuses commercially-oriented Internet-access across the US. One relies on a firm structure providing a national service, the other relies on a local firm providing local services. A third business model, of a regional

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[3] As the Information Infrastructure Task Force (1993, p. 6) stated "The foregoing discussion of the transforming potential of the NII should not obscure a fundamental fact -- the private sector is already developing and deploying such an infrastructure today."

[4] A complete bibliography is impossible. For some examples of some recent studies, see US advisory council on the National Information Infrastructure Advisory Council [1995], National Academy of Engineering [1995], NTIA [1995], the Information Infrastructure Task Force [1993, 1994], Drake [1995], Kalil [1995], Kahin [1991], Gillett [1994], Kahin and Keller [1996], National Research Council [1996], Teske [1995], Compaine[1997], Mueller [1997], Moss and Townsend [1996], Werbach [1997], and McKnight and Bailey [1997].

supplier, is much less common.

The conclusions from the first half of the paper will be familiar to regular readers of commercial trade press for the ISP industry.[5] For such readers, this framework may look like a translation of the commercial press into the language of equal access policy. The analysis focuses on characterizing commercial behavior and strategic choices of many heterogeneous firms. This takes the analysis far from the familiar debates about universal service in local telephone service.

The second half of the paper addresses related empirical issues: Do all regions of the country receive similar access to Internet services provided by commercial firms? How do the different strategic goals of national and local ISPs influence the density of access in different areas? Does the privately financed Internet favor access in some regions over others? To answer these questions the paper characterizes the location of over 14,000 dial-up access points offered by commercial ISPs in the spring of 1997. This is the first study to ever make such a survey. As such, this new evidence is suggestive about the economic forces at work.

Spring of 1997 was a good time for such a survey. The industry's structure, while not completely stable, had reached a point where it was not radically changing every month. Most important firms had been in the ISP market for a few years, making it possible to document their strategies, behavior and commercial achievement. The key findings of the empirical work are as follows:

- The US commercial ISP market is comprised of thousands of small geographically dispersed local markets for Internet access. There is no single structure that characterizes the ISP market across the country, nor should we expect this heterogeneity to disappear. These markets differ widely in their structure, from competitive to unserved.

- Just under three quarters of the US population had easy access to commercial Internet service providers, including virtually all major urban areas and some rural areas. Approximately fifteen percent of the US population lived on the margin between easy access and none, in inadequately competitive markets. The future structure of these markets depends on ease of entry

[5] For systematic surveys of the on-line industry and attempts to analyze its commercial potential, see, e.g., Meeker and Dupuy [1996], Hoovers [1997], Juliussen and Juliussen [1996] or Maloff [1997]. Also see *Inter@ctive* Magazine or *Boardwatch* Magazine, 1997 or Kridel, et al [1997].

for local and national ISPs. The remainder of the US population had access to ISPs in neighboring areas. There are understandable economic reasons for this outcome.

- Issues regarding urban/rural coverage depend on the different strategies of national/local providers. Virtually every national vendor provides access in the major urban areas, where access is plentiful. This is consistent with many analysts' views that Internet access is becoming a commodity business. On the other hand, access in remote rural areas depends mostly on the decisions of independent ISPs who have no national affiliation.

This paper does not advocate any particular policy for the ISP industry, nor does it discuss in depth the merits or drawbacks of any particular policy proposal for universal access. Its primary purpose is to understand and characterize the economic factors underlying the diffusion of commercial Internet access. This analysis, its framework, and its new data should shed light on many different aspects of the universal access debate. Not surprisingly, this new shift in focus raises as many new questions as it answers. As such, the study attempts to be more provocative and suggestive than definitive.

II. The strategy and organization of the ISP business

Since this analyses focuses on commercial events and strategies, it must be put in the context of time and place: For purposes of this paper we analyze the ISP industry after the development of browsers and therefore focus attention on firms who provide dial-up service which enables a user to employ a browser. We implement this cutoff because browser development occurred at about the same time as the final implementation of policies by the NSF to commercialize the Internet (Meeker and Dupuy,1996).

Second, this discussion focuses on firms which provide these services in the United States as of spring1997. It makes no distinction between firms who began as on-line information providers (i.e., America On-Line, Compuserve), computer companies (e.g., IBM, Microsoft), telecommunications carriers (e.g., MCI, AT&T), or entrepreneurial ventures (e.g., UUNet, Pasadena Networks, Netcom or thousands of small ISPs). As long as their ultimate focus is commercial Internet access either as a backbone or a downstream provider they will all be characterized as ISPs. The origins of these ISPs are only interesting if they help us understand

why different commercialization strategies succeed or why specific firms pursue particular geographic territories.

Third, the study only focuses on the availability of cheap Internet access in different geographic areas, not its adoption by users. It is well known that the US population is far from universal adoption of Internet services at home. No survey shows greater than 15% adoption of Internet access at US households, and no survey shows PC adoption exceeding 40% of households (Kridel, 1997, Maloff, 1997, Compaine and Wienraub, 1997). That said, these surveys all beg the question about access -- in other words, whether all households have access to Internet service at the same low cost. All consumers have access to the Internet at some price. The key question for most consumers is whether or not they can "cheaply" access the Internet. For many users "cheap" is synonymous with a local telephone call to an ISP. This open issue motivates this study, which is the first analysis and survey of the geographic spread of access to commercial ISPs.

A. Access and location

There is a growing market for direct access through the use of competitive access providers, but this service is primarily focused on large-scale business use within big cities. There is also a market for 800 dial-up access, which, because of its expense for heavy usage, is targeted at traveling business users who have occasional high-value on-line needs away from home (Maloff, 1997, Barrett, 1997c, *Boardwatch*, 1997). ISPs targeting users with modest needs, which describes most residential users and small businesses in the United States, require the user to make phone calls to a local switch. The cost of this phone call depends on (mostly state) regulations defining the local calling area and (both state and federal) regulations defining the costs of long-distance calling.

Most universal access issues concern the adoption rates of medium and small users, since these are the users on the margin between no-access and a few low-cost alternatives. The vast majority of these users and their providers rely on the public switch network. The presence of ISPs within a local call area, therefore, determines a user's access to cheap Internet service. Similarly, the number of local ISPs determines the density of supply of low-cost access to Internet services within a small geographic region. Thus, the geographic spread of ISPs determines the cost of Internet access for most of the US population.

Commercial Internet entry is determined by local supply and demand conditions. Both the availability of advanced technology as well as the economic surroundings determines the level of access within a region. For example, advanced back-bone technology, by itself, cannot cause growth in downstream services such as Internet access. Factors influencing the supply of ISPs could be the presence of entrepreneurs with engineering skills, institutions devoted to higher education, state regulation of local telephone service and long distance phone rates.[6] Important factors influencing demand in local areas could be the presence of a highly educated population or a population with high income, information-intensive industries, financial hubs and other factors associated with population density. At present, it is unclear as to which of these factors are more important, making it difficult to summarize all ISP strategies.

A few years ago, as recently as 1994, only a few enterprises offered national dial-up networks (*Boardwatch*, 1997), mostly targeting the major urban areas. At this time it was possible to run a small ISP on a shoe-string in either an urban or rural area. These small, mostly entrepreneurial, businesses tried to cover expenses and expand by investing profits back in the business. In contrast, today there are dozens of well-known national networks and scores of less-known national providers. There are also many local providers of Internet access who serve as the links between end-users and the Internet back-bone, and local shoe-string operations seem less common. This transition in industry structure, which some observers characterize as a maturation, also provides another reason why it is difficult to summarize all successful strategies.

B. The building blocks of ISP strategy

As a technical matter there is no mystery to starting and operating an dial-up ISP. A bare-bones independent ISP requires a modem farm, one or more servers to handle registering and other traffic functions, and a connection to the Internet backbone.[7] As an economic matter, starting and operating a node for a dial-up ISP involves many strategic considerations. Higher quality components cost more money, and may not be necessary for some customers. High speed

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[6] Telephone prices varies state by state, depending on the costs of intra-LATA and inter-LATA phone service and other access charges for enhanced services. By and large, state-level regulation of telephone prices will influence the distance covered by local ISP phone numbers.

[7] For example, see the description in Kalakota and Whinston, 1996, or the accumulated discussion on www.amazing.com/internet/faq.txt.

connections to the backbone are expensive,.as are fast modems to cover peak-load traffic. These facilities need to be monitored, either remotely as part of a national network or cooperative arrangement, or in person by an employee or ISP owner/operator. Additional services, such as web-hosting, are also quite costly as they must be properly assembled, maintained and marketed. Providing added value may be essential for retaining or attracting a customer base. All these decisions influence the quality of the service the customers' experiences, ultimately influencing the revenues and profitability of the business (Maloff, 1997).

It is possible to identify the building blocks of strategies pursued by ISPs. Below I define each of these and argue that equilibrium considerations result in the success of only a few combinations -- either a national network with uniform services provided at each location, or a local network with services that are customized for the local area. In both cases, few firms are providing only Internet access by itself. The most successful firms are those who combine high quality Internet service with other complementary services valued by the user. For clarity this framework presents an oversimplification of reality, and skims over the managerial difficulties of running an ISP. The building blocks for most ISPs fall into five categories: scale of service at a node, quality of connection at a node, value-added services offered in conjunction with dial-up service, geographic scope of the enterprise, and price point.

- **Scale of service at a node:** It is a relatively standard technical matter for any dial-up node (or "point-of-presence," often abbreviated as POP) to attach multiple modems to a phone number, moving phone calls across modems as they arrive. The scale of this modem farm is a key strategic choice for a POP, as it determines the ability to handle peak traffic (Leida, 1997, Lambert, 1997, Kalakota and Whinston, 1996)). Larger capacity is obviously more costly to set-up and maintain, but it also allows the ISP to aggregate information packets for high-bandwidth backbone transmission. This allows an ISP to defray the fixed costs of high-speed backbone connections to the Internet at the POP (Boardwatch, 1997). The ability to connect is an important dimension of the consumer's evaluation of the quality of an ISP, so inadequate scale may adversely influence consumer choice. That said, it appears that consumers with different technical orientations have varying tolerances for the inability to access on demand. Some consumers are willing to trade-off price and other features for guaranteed access on demand.

As of this writing there is no widely-acknowledged optimal scale for a modem farm on the basis of costs alone. There was some discussion last spring in the trade press and on the ISP bulletin boards[8] claiming that an isolated ISP must have close to two hundred paying customers who use a POP to justify the costs of investing and maintaining a high-speed backbone connection (with some variance depending on the type of user and the timing of their usage during peak hours). This rule of thumb implies that there is a minimum efficient scale to a running a high-quality POP (Stark, 1997), but it also implies that the minimum efficient scale for a low-quality POP (if it is economically viable) is much lower than 200 regularly paying customers. If the only viable model for running an ISP also involves offering complementary services, then these high-quality investments may be the only way to stay in business, pushing out shoe-string operations and motivating providers to achieve a minimum efficient scale.

- **Quality of connection at the POP:** An ISP node may differ in the speed of its modems (i.e., 28k, 56k, or ISDN), in the rate at which it transfers information packets to back-bone connections, in its susceptibility to interruption and break-down, and in its performance during peak usage times. These features depend both on hardware and software investments, as well as on operator attention to performance in real time. ISPs can make many different types of investment in faster back-bone connections, software protocols for handling priorities during peak usage, back-up procedures at the POP, and other frontier technology. As with the considerations of scale, higher quality investments influence the experience of consumers and the ISP's costs (Leida, 1997, Lambert, 1997, Kalokota and Whinston, 1996). As with the scale choice, some consumers desire these quality features and some do not.

Once again, the appropriate choice depends on the targeted consumer body. Standard industry belief is that the majority of users in the early 1990s were willing to tolerate low quality connections and occasional connection failures in exchange for low prices or some other desirable feature, while technical users would not tolerate as much. It is also standard industry belief that this tolerance will disappear as business-oriented users employ their ISPs for mission-critical applications or home-users employ their ISPs for applications where time-delay critically affects performance (e.g., on-line games or Internet telephony). Current industry surveys still demonstrate

[8] See, for example, the extensive discussion on www.amazing.com/internet/faq.txt.

much heterogeneity in the underlying capital and equipment structures of ISPs, indicative of experimentation in these investments and organizations (e.g., see Maloff, 1997 or *Boardwatch*, 1997).

- **Value-added services in conjunction with ISP service:** Most ISPs offer other services in addition to their dial-up service. While some "pure-ISPs" still exist as of this writing (i.e., they only provide Internet access), it is a widely stated belief within the industry that competitive forces are bidding revenues below the costs of establishing and operating a network that only provides access. Thus, most ISPs today must offer some additional services not only as an strategic move to have an additional revenue source, but as a matter of survival. The engineering cost simulations in Leida (1997) support this industry belief; in these simulations at no scale can a "pure" high-quality ISP cover its costs.

The additional services are typically complementary to their Internet access business. These value-added services run the gamut. Some ISPs offer "web-hosting", rent email accounts, provide free chat rooms, maintain servers with free software targeted to unique user needs, compile lists of interesting web sites, provide customer advice on demand, etc. (The Economist, 1997b). Many ISPs aggregate "content" for its subscribers, such as America On-line with its proprietary on-line offerings or Physicians-On-line with its targeted content. Sometimes it is a service to local users and sometimes it is part of a general strategy to target a specific types of user. Some of these services command fees and some do not. Sometimes the fees are bundled with other expenses.

Once again, there has been much experimentation in the business model, as this choice seems to be an important source of differentiation for ISPs. National and local firms certainly pursue different combinations and even two different local firms may survive with different strategies, particularly if these target different types of users. At first the differences between national companies depended on the initial core-competencies of the companies involved. For example, IBM geared its offerings to traditional computer users and AOL tried to gain revenues by exposing it large user-base to advertising. The lines have significantly blurred over time, as firms imitated the business model of their rivals.

- **Geographic scope of the enterprise:** Some ISP nodes are run by independent operators

who only offer service in one area. This local focus may be a temporary phenomenon for a firm if it harbors ambitions to expand (e.g., see Barrett, 1997a). It may also be part of a strategic choice to focus service on a local level (Stark, 1997). In this case an ISP's identification with a small region is an important part of the company's strategy for high quality service (e.g., "the personal touch") or part of an owner-operated company's attempt to target local users with particular services (e.g., the local PC store runs an ISP in the back office for customers so these users return to the retail outlet).

In contrast, some POPs are run by national firms where the ubiquity of their network is an important dimension of their strategy (Maloff, 1997, Bernier, 1997b). This allows the enterprise to accommodate traveling users who want to check email from their hotels in any major city. Also, national presence may allow a network provider to accommodate businesses with divisions in multiple locations. These businesses may employ the ISP for part of the network services which the business prefers to out-source. Finally, national presence may be part of a marketing strategy to assume a large enough revenue base to defray activities with large fixed costs. For example, several providers gather and redistribute content to all its customers.

National geographic scope is costly to achieve, if a firm defines "national" as having many POPs within the distance of a local phone call to some substantial part of the US population. It was clearly cheapest, though not costless, for companies with existing infrastructure to become national ISPs. That said, this is not the only origin of national firms. Many other national ISPs began from a regional base and expanded, developing brand names from scratch. Commercial surveys indicate that scores of firms have achieved something close to national coverage, but no firm has offered access to a local phone call in every single region of the US (Boardwatch, 1997).

It is worth nothing that there are also examples of firms with regional scope (e.g., west coast, northeastern corridor, etc), which combine facets of both the local and national strategies (Barrett, 1997a, Lambert, 1997). Some of these firms intend to become national firms, but have not yet achieved this, preferring to grow in a systematic manner (Barrett, 1997a).

- **Pricing**: The predominate form of pricing today in the US for (only) dial-up access is monthly charges with no usage fee (Maloff, 1997, *Boardwatch*, 1997, Barrett, 1997b). This was true prior to the much-publicized decision by America On-line to add Internet access to its

standard service and to eliminate its usage fee, and remains true today (The Economist, 1997a). That said, while the majority of ISPs conform to the industry norm of twenty dollars a month, there is still a great deal of variety in pricing levels. These levels may reflect observable or unobservable quality in service. Many users seem to expect the twenty dollar a month service to consist of high-quality access and some additional services. Several firms have attempted to provide $10 access for basic connections, but these firms tend to be underfunded for up-grades and possibly even operating expenses when there is insufficient demand. This low price strategy might also work if it is a loss-leader for further revenue streams (e.g., the ISP makes its subscribers view ads from other companies), but no predominant model for a loss-leader strategy has yet emerged.

Pricing may also vary according to consumer options. Faster access speeds may command higher prices. Different priority for peak-usage treatment can sometimes command different prices. Some ISPs also offer non-linear contracts, such as lower access fees and higher per-minute charges. Not surprisingly, combining ISP dial-in with other value-added services may also change the standard pricing contract. It is also the case that some 800 dial-up services include usage charges on top of their connection charges, but this is only an option with the national ISPs.

C. The geographic scope of local and national firms

As noted, the geographic reach and coverage of an ISP is one of several important dimensions of firm strategy. These choices involve many trade-offs between the costs of providing service, the core competence of the firm, and the revenues generated by those decisions. Geographic coverage is determined in conjunction with choices for value-added services, scale, performance and price. Thus, it is not surprising that local and national ISPs make different choices about the types of areas to cover and about their plans for expansion. They make different choices for sound commercial reasons.

The key issue for policy makers is as follows: will commercial ISPs naturally provide wide geographic scope of their own accord, in pursuit of profitability? If firms differ in their geographic choice (which is easily observable), are those choices also coincident with quality of service, pricing and value-added services (which are not so easily observable)? If firms choose not to provide service to a locality, does this signal that it is quite costly to enter that region or does it

signal that there are few residences in the region who wish to subscribe to an ISP?

The answer to these policy questions depend on an unresolved debate among ISPs about the appropriate business strategy for delivery of services. Can a local firm provide a "local" touch, stave off imitation and keep customers? Can a national firm amortize development costs against a larger customer base and spread to more parts of the US? The commercial industry will provide geographic scope not as an end in itself, but as part of a general strategy to target a particular type of customer. Here we discuss the survival of local and national ISPs and the implications of this competition for the geographic scope of the industry.

- **Surviving and thriving as a local ISP**: In1994 it was possible to survive in an isolated market by providing low quality service with few value-added services. In competitive markets (dense urban areas) this strategy could only succeed if the ISP charged low prices or targeted a specialized under-served user body (e.g., remote office buildings, direct access to apartment buildings). In thin (principally rural) markets the absence of competition did not discipline the pricing as much, nor did ISPs lose customers very often to other firms (Bernier, 1997a). At the same time many local ISPs also thought they could thrive with high-quality service and higher-prices or with many value-added services.[9] This strategy targets users with particular needs or backgrounds, particularly in dense urban areas.

Today many trade publications predict that the low-quality dial-up service cannot survive except in rural areas or isolated markets. The high-quality ISP can still thrive if it targets users who do not want AOL's brand of service or AT&T's lack of "hand-holding", but doing so may be expensive (i.e., a T-1 connection to backbone), necessitating a minimum scale of service (Stark, 1997). Because the underlying engineering capabilities have diffused so widely, the local firm must provide a service that includes features which will not be imitated by "fast-second" entry from a national firm. For example, many features of Internet commerce, such as web-page design, have quickly become standardized, giving advantages to low cost national designer, but local firms may be able to reflect local needs. There is much speculation that if a local industry is to survive, local services must go beyond "friendly" service, and must include site visitation or user-instruction or exceptional technical support.

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[9] For related information on this topic see the accumulated discussion www.amazing.com/internet/faq.txt.

• **Surviving and thriving as a national ISP**: In the early 1990s it was possible to characterize the strategies of the few dozen national ISPs. Some national ISPs initially pursued this market as an extension of their core-competence in a related area, such as computing or traditional long-distance telecommunications (Maloff, 1997, Wilson, 1997, Bernier, 1997b, The Economist, 1997b). For example, since AT&T already had the infrastructure, it entered the ISP market after it set up the appropriate POPs. Others companies, usually those who began their growth as entrepreneurial ventures and expanded (e.g., Netcom, Pasadena Networks), worked at developing their brand-awareness (Barrett, 1997a). Others worked primarily at being back-bone providers, leaving the marketing of downstream access primarily to others. Still others developed their network to complement their computing expertise.

Today the market is much harder to characterize. Some national ISPs clearly target business users, providing them with value-added services (e.g., electronic commerce by IBM). Others focus on residential customers and focus on a different set of value-added services (e.g., appropriate chat rooms by AOL or an array of easy-to-use bulletin boards). Still others seem to do a bit of everything, targeting both business and residential use. Low and high prices survive in this market, depending on the value-added services offered in conjunction with dial-up service and other factors associated with degrees of product differentiation. That said, offering a high prices for *only* dial-up service does not appear to be a viable strategy in such a competitive national market. Some publications also predict that AOL's proprietary brand of service will become less enticing over time as high quality ISPs and AOL become more similar, but this is a matter for future speculation (e.g., see the Economist, 1997b).

• **Implication: Only a few business models are possible:** While it is not yet clear what minimum density will lead to sufficient support for a local provider of commercial Internet access, economies of scale at the POP should prevent entry in many remote low-density areas. At best, these economies of scale, combined with economies of scope between ISP service and any value-added service, may lead to local provision of Internet access by firms who accept a loss on Internet access in exchange for some other strategic benefit or revenue source. In low-density areas, the only viable local option is either a low quality provider or a high-quality provider who

provides service for the sake of community interest or other financial interest.[10] In low density areas, the only viable option for a national provider is a network POP with remote monitoring (and perhaps, lower quality equipment), which is the lowest cost alternative for a national provider. These types of motives may lead to quality differences between rural and urban POPs. It is unclear how far this will go towards providing high-quality ISP service to most remote small towns in the US.

In urban areas, two business models appear viable, high-quality -- potentially branded and differentiated -- national providers or high-quality local providers with a customized "local component." In competitive markets, such as is found in high-density urban areas, either of these business models use the Internet access as loss-leaders for other services. That said, since the appropriate business form for these companies is still undetermined, predictions are hard to make.

- **Implication: The geographic scope of coverage.** It is in the interest of most national providers to provide service in any moderately large city in the US in which there is appreciable commercial activity. One should therefore expect that commercial forces will lead firms to cover most major areas of the US. In addition, one should expect local ISPs to target many of the niche markets in urban areas that the national ISPs fail to address, especially those users requiring a "local" component or a customized technical service. Local firms however may be more dependent on various local characteristics such as labor markets, the quality of existing infrastructure, educational institutions and the initiative of stake-holders in the community. National firms potentially bring with them the same capabilities in all localities and may be able to use remote monitoring capabilities. These difference will determine whether national firms have a cost advantage in low-density areas and small towns. Thus, until the business model of the ISP business is firmly established, it will remain unclear whether local or national firms will dominate the access business in any area.

It is not in a national or local ISP's interest to provide dial-up service to every small town or less-dense area in the US. Economies of scale at the POP preclude it. Relatedly, no national firm has announced a strategy to accept losses at a POP in an isolated area for the sake of

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[10] See Garcia and Gorenflo [1997].

ubiquity. So the lack of service in remote areas appears to be an equilibrium result. It will only change as the underlying economic fundamentals change, either as costs at the POP decline, as complementary services become more lucrative, and so on. At best, national firms offer their traveling users moderately expensive 1-800 service in remote areas. In addition, many firms offer geographically isolated enterprises the possibility of direct connections for high-volume use (instead of dial-up). This predominantly leaves remote residential users and small business as the set of users who pay extra for commercial access to an ISP.

III. Empirical Research Questions

To summarize, expansion of the Internet by ISPs is driven by the pursuit of commercial opportunities. This framework predicts that most urban areas will have abundant Internet access from commercial firms and some remote areas might not. Between these two predictions lies a very large set of possibilities that can only be measured with careful empirical observation. This motivates a few researchable propositions and empirical issues. These issues will be the focus of the empirical work below.

- **Urban/rural differences in coverage**: Are ISPs in urban/rural areas predominantly local or national? What is the relevant threshold population level required to induce entry? How big does a city have to be to induce three ISPs to enter on average? Do most rural areas have ISPs within the local calling area?

- **The competitiveness of urban/rural areas:** Does every major city have a competitive ISP market? What percentage of the US population does not have access to a competitive ISP market? What percentage of ISPs locate in competitive areas? Do high-tech centers of the US have the most access to ISPs?

- **Structure and strategy of national/local firms:** Are there observable differences in the geographic scope of national and local ISPs? Do the national firms concentrate on urban areas?

IV. Data

In order to track the geographic spread of ISPs, I compiled a list of telephone numbers for dial-up access and their location. I then computed the geographic distribution of the POPs across

the US. I explain these data and methods below.

a. Data sources

The best way to compile a list of ISPs by location is to go to the information-sources used by most potential ISP consumers. While there is no single "Yellow Pages" for ISPs, there are a few different profit and non-profit enterprises which track ISPs in the US. In March of 1997 the author surveyed every compilation of ISPs on the Internet. While there are many compilations, most of them are small. The majority focus on a small region or type of user, and are not useful for a study of the whole country. Of the remainder only a few are comprehensive, systematic, and regularly up-date their lists in response to entry and exit. This study's data combines a count of the ISP dial-in list from March of 1997 in *thedirectory* and a count of the backbone dial-in list for March/April of *Boardwatch* magazine.[11]

This choice was made for several reasons. First, *thedirectory* requests that its ISPs list the location of its dial-in phone number. Though not all of the ISPs comply with this request, most do so, making it much easier to determine an ISP's location in a general sense (e.g., at the county level). Second, *thedirectory* and *Boardwatch* both claim to maintain comprehensive lists and these claims seem to be consistent with observation. Both continue to list more companies than any other list and overlap substantially. That said, *thedirectory* consistently lists more ISPs than *Boardwatch.* On close inspection, it appears that this is so because *thedirectory* has more extensive coverage of small ISPs.[12] Third, while *thedirectory* shows the location of most ISPs, *Boardwatch* only does so for backbone providers. In sum, *thedirectory* ISP list contains a more comprehensive survey of the locations of POPS maintained by all ISPs except the national backbone providers, for which *Boardwatch* contains a superior survey of locations.

For many of the tables below, the key question will be the following: "How many suppliers have POPs in a county?" While answering this question we came across a few ambiguous situations which we resolved as follows: When the location of dial-in phone number

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[11] Current versions of these lists may be examined at www.thedirectory.org and www.boardwatch.com. This includes POPs found in the ISP section of *thedirectory* and excludes POPs found in bulletin boards. This also includes POPs for ISPs listed in the *Boardwatch* backbone section.

[12] We were unable to find any cases of small ISPs who continued to be listed, but were out of business.

was in doubt, the area code and prefix of the dial-in POP was compared to publicly available Bellcore lists of the locations of local switches with these area-codes and prefixes. If this failed to locate the POP, which only happened for small ISPs, then the voice dial-in number for the ISP was used instead. When a city is part of two counties and Bellcore did not resolve the ambiguity, the phone number was counted as part of the county in which the city has the greatest share of its land.[13] When a location and area-code were inconsistent, the observation was included under that city's name if it represented an uncovered part of the US (roughly three dozen phone numbers). Otherwise, it was not included in the final data set (approximately one hundred phone numbers).

On final count, *thedirectory* contained 12,038 phone numbers and *boardwatch* backbone list 3,192. Of the latter group, 2,648 did not overlap with numbers from *thedirectory*. The merged set contained 14,686 phone numbers which serve as dial-in POPs. Applying the above procedures and principles resulted in a total of 11,978 unique firm/county presences (because many firms do maintain multiple POPs in the same county) for 3,531 ISPs.

How comprehensively does this measure the location of ISPs? Both *thedirectory* and *Boardwatch* claim to be the most comprehensive lists of commercial ISP POPs, a claim for which I have been able to find small counterexamples in both cases. That said, neither source seems to be far from realizing their claim and neither seems to have a geographic bias in their coverage. The combination of both lists captures every major commercial firm in the industry and appear to contain most small firms. Both lists attempt to be a source for consumers who are searching for a commercial ISP, even ISPs in remote areas.

The key issue is whether this procedure makes the data in this study sensitive to sampling error which correlates with geography. On the whole I think not, though the above procedures may have imparted some small biases to a few counties, which we describe below. Overall, there appears to be no strong evidence of any error in the coverage of small commercial ISPs. In addition, there appears to be a strong positive correlation in the geographic coverage of national firms because most of them locate predominantly in urban areas. Thus, even if these two lists failed to completely describe the coverage of many national firms, it is unlikely that the qualitative

[13] Special thanks goes to Tom Downes for help in resolving many of these issues.

conclusions below would change much if these firms were added.[14]

That said, the above procedures may show less ISP entry in counties that border on dense urban counties. There is a tendency for new growing suburbs or recent suburban developments to use the telephone exchange of existing cities, which may be just over the county border. Unless the ISP specifically names this new suburb in the bordering county as a targeted area, then our procedures will not count the ISP's presence in that new suburb. In general this bias will only arise in special circumstances, as it clearly cannot arise once the suburb has achieved any appreciable size. A similar and related bias arises when a county's boundary's and a city's boundaries are roughly equivalent (e.g., Baltimore City), even when the neighboring county contains part of the suburbs of the city. In this situation, many ISPs will claim to be located within the city's boundary even though residences will recognize that the ISP is located on the city boundary and their coverage may be more extensive than this declaration would indicate.

In the best case scenario, the compilation in this study will give an accurate account of all commercial ISP coverage in the US, particularly of those companies who advertise through standard channels. In the worse case scenario, counting the locations of the POPs listed in both directories will give an indication of how the ISP market looks to a consumer who does a small amount of searching. The compilation in this study probably lies between the worst and best cases, both of which are acceptable for a study of the spread of ISPs across the nation.

B. Definitions

What type of ISPs are on these lists and does their selection have any implications for the scope and coverage of this study? Both *thedirectory* and *Boardwatch* try to distinguish between "bulletin boards" and ISPs, where the former may consistent of a server and modems, but the latter provides WWW access, FTP and email.[15] Thus, the scope of this study is appropriately limited to firms providing commercial Internet access, and excludes firms whose primary business is providing down-loadable text or software without Internet access. It also excludes firms who

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[14] Indeed, we tested this proposition on the data in the study. Even if a dozen national providers were left out of the sample, the basic qualitative conclusions would not change.

[15] Extensive double-checking verified that *thedirectory* and *Boardwatch* were careful about the distinction between an ISP and a bulletin board. .None of these were ISPs and they were appropriately not classified as an ISP.

only provide direct access and have not established any dial-up capabilities.

Second, both lists concentrate on the for-profit commercial sector. For example, both eschew listing university enterprises that effectively act as ISPs for students and faculty. This is less worrisome than it seems, since commercial ISPs also gravitate towards the same locations as universities. This co-existence results from the failure of some universities to provide high-speed ISP service for technical users, so commercial providers jump in with ISDN and similar services. It also arises because former university students stay in the local area and often desire continued access to the Internet. This study's procedure, therefore, will likely pick up the presence of ISP access at remotely situated educational institutions unless the amount of traffic outside the university is too small to induce commercial entry. For example, the county of Champaign, IL. contains the University of Illinois (i.e., the origin of NCSA Mosaic) and the cities of Champaign and Urbana (combined population of approximately 100,000) and several other much small towns. The county does not border on any other urban area, and the county is considered an urban county by the broadest definition provided by the US Census. In the spring of 1997 it contained 29 ISPs, one of the highest per capita ISP ratios in the country. Clearly, the university's presence explains this outcome.

Thedirectory does, however, list some free-nets. Their inclusion appears to depend on whether the free-net notifies *thedirectory* of their existence and seeks users in the general population. A similar remark can be made for state-sponsored networks, local cooperatives, and quasi-public networks that are part of a state's educational or library system, though my own perusal of the data did not find any local ISPs with "public library" in the title. In general, this study's procedures will identify the commercialized sector of Internet access, but may under-represent some non-profit access alternatives, especially those that do not advertise in the standard online forums.

In all tables below, "national" ISPs are defined as firms who maintain POPs in more than 25 states. This is more stringent than the definition for national provider found in *Boardwatch* (in which the definition of "national" is any provider in more than 25 area codes)."Local" firms are present in three or fewer counties. The remainder are considered "regional" ISPs.

The tables below provide a broad description of county features. Population numbers

come from 1996 census estimates. We label a county as urban when the census gives it an "MSA" designation, which is the broadest indicator of an urban settlement in the region (about a quarter of the counties in the US). While this is certainly an approximation, this will be sufficient for purposes of this study. Further research will need to refine the precise relationship between ISP entry and different types of urbanization.

Finally, for all tables below, the data pertain to all states in the US except Alaska.[16] These data also include the District of Columbia, which is treated as another "county." Throughout this study county definitions correspond to standard US Census county definitions.[17] This results in a total of 3115 counties. While slicing US geography in this way has certain well-known drawbacks – principally, county boundaries are political boundaries and do not directly correspond with meaningful economic market boundaries – these drawbacks are overwhelmed by the benefits of using US Census information. This permits us to provide a succinct summary of the geographic features of the entire US ISP market and we will try to account for some of these drawbacks below.

C. Maps

Figure 1 illustrates the density of location of ISPs across the US at the county level. Black areas are counties with more than three providers. Gray areas have between one and three. White areas have none. The picture illustrates the uneven geographic coverage of the US ISP industry last spring. While ISPs tend to locate in all the major population centers, there is more to it than one map can illustrate. Below we analyze the basic features of ISP coverage.

V. The geographic scope of ISPs in Spring 1997

The summary of these counts can be found in Tables 1 through 8. The discussion below is organized under three headings, following the questions listed in section III. The first section discusses urban/rural differences in market entry. The second discusses differences in market structure across the country. The third analyzes firm strategies for providing access. The last

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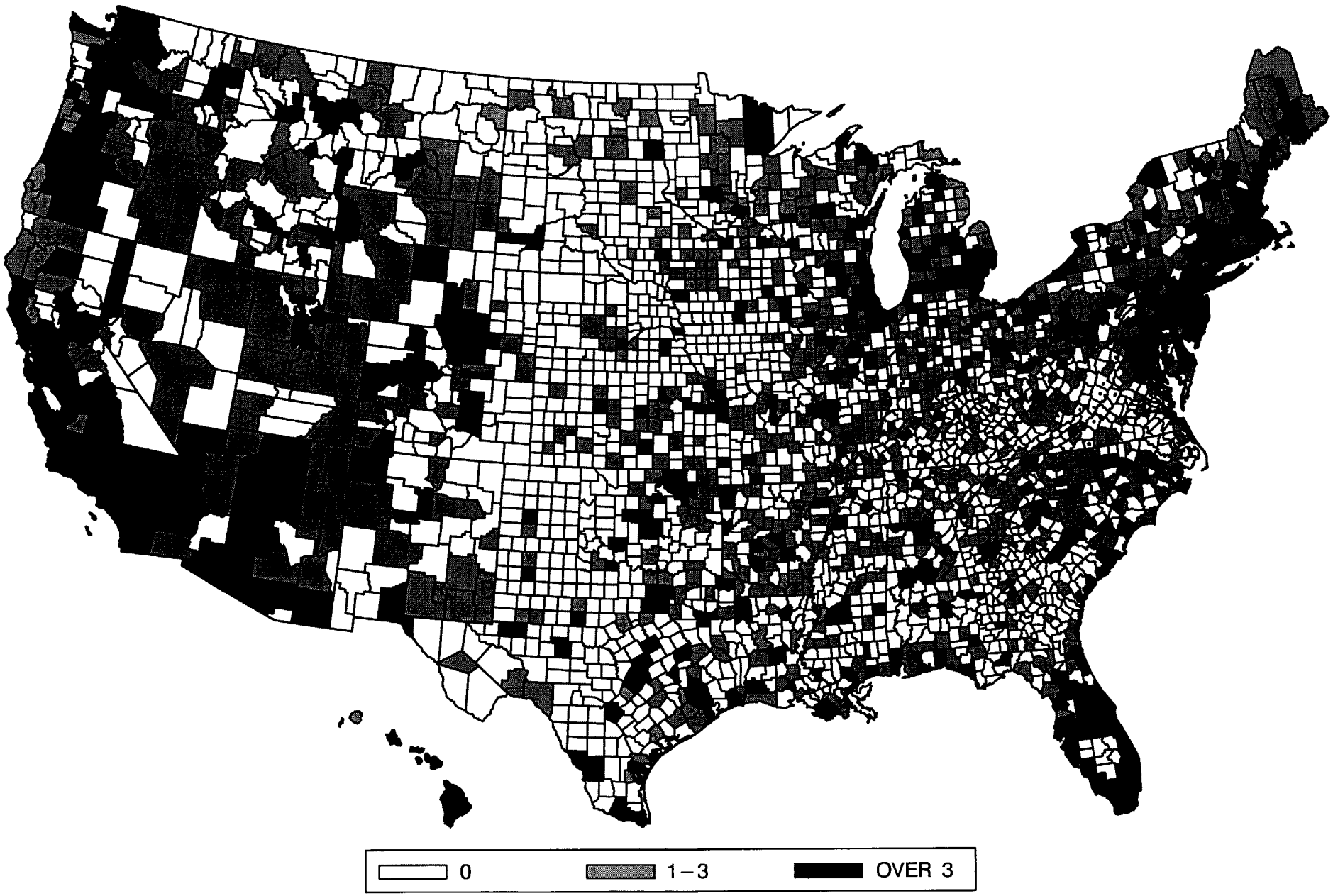
[16] Alaska is excluded because its geography and related statistics are so unusual.

[17] Thus, for example, the New York City is five census counties. The paper also follows census standards in Virginia, where some cities are "counties" within counties.

Distribution of ISPs
March 1997



section discusses some of the immediate implications of this analysis to the universal access debate.

A. Urban/rural differences

Table 1 is organized by counties in the continental US. It shows the number of counties with zero, one, two, etc., number of ISPs. It then shows the percentage of the US population that lives in those counties, as well as a cumulative percentage. Finally, it shows the percentage of urban counties with a particular number of suppliers.

Of the 3115 counties, 1742 do not contain a single POP supported by any ISP. 521 have only one and 181 have two. Not surprisingly, these counties tend to be small in population. Collectively, however, they amount to a substantial fraction of US population. Roughly a quarter of the US population lives in counties with three or fewer ISPs. As further evidence that low (high) entry is predominantly a rural (urban) phenomenon, there is an inverse relationship between the percentage of counties that are rural and the number of suppliers who enter.

At first blush, the results in Table 1 yield provocative ramifications in regards to state of the ISP market. It shows that commercial forces have caused the diffusion of Internet access to a substantial part of the US population. By historical standards for new technologies, this is remarkable for such a young commercial industry. It has grown extraordinarily rapidly, putting it in the same category as the most pivotal technical diffusions in the twentieth century, such as electricity, phones, automobiles, televisions and so on.

However, high density access is not available everywhere. In particular, it is well known that in differentiated markets one supplier usually does not provide an adequate variety of services at low enough prices. For purposes of this paper, we use a conservative definition of "competitive." On the assumption that "more than three suppliers makes a market competitive,"(e.g., Bresnahan and Reiss, 1991) Table 1 suggests that in the spring of 1997 approximately a quarter of the US population (over 60 million people) lived in counties with an inadequately competitive supply of commercial Internet access. Of this subset of the population, approximately half had no ISP at all in their region.

This is a hasty conclusion, and, as shown below, too pessimistic. A proper interpretation of Table 1 requires caution. The table does not provide a summary of the percentage of US

population that has easy access to commercial ISPs. For example, it understates the true level of access because it does not account for the US population living in counties with very few suppliers that, nonetheless, border on competitive markets. Similarly, it overstates access in counties in which the suppliers are predominantly in one area, while some part of the population resides in other far-away areas of the county. And, as noted elsewhere, it has nothing to say about the capacity or quality of the ISPs in an area. This precaution warns us not to treat these as precise numbers, but as approximations to understanding access.

Table 2 elaborates on Table 1 and addresses some of these issues. It shows the relationship between the presence of ISPs and some basic features of these counties, principally population and population density. The key observation is that, to a first order, population levels are a good predictor of the number of suppliers in a county, but density is not. While there is variance around the relationship between population and the presence of ISPs, the trend in average population size is almost monotonic.. That is, disregarding a few dozen very large counties, the ratio of suppliers to population tends to be relatively the same across counties of small, medium and large populations. Population density per square kilometer also seems to corresponds to more suppliers, but the relationship is not particularly monotonic and may be an artifact of the relation between the size of a county's population and its density.

Studies of entry have focused on "entry thresholds," the incremental population change necessary to induce another entrant (Bresnahan and Reiss, 1991). In this spirit, the table suggests that on average 20,000 additional people induce another ISP to enter. This relationship appears to hold for all counties except those with the largest populations, providing further evidence that economies of scale at the POP determine entry in a region.

Figure 2 illustrates this finding with a scatter plot and simple regression for all 3115 counties. As population size increases, so too does the average number of suppliers. The variance around the mean tendency indicates that the relationship is not solely a function of population levels.[18] Identifying the determinants of this relationship will be the focus on future analysis.

[18] The regression line is for descriptive purposes only and does not control for many obvious properties of the error structure. For example, there is truncation bias in outcomes and the endogenous variable is count-data. The line in figure 2 follows the equation PROVIDERS=-045+.057POPULATION.

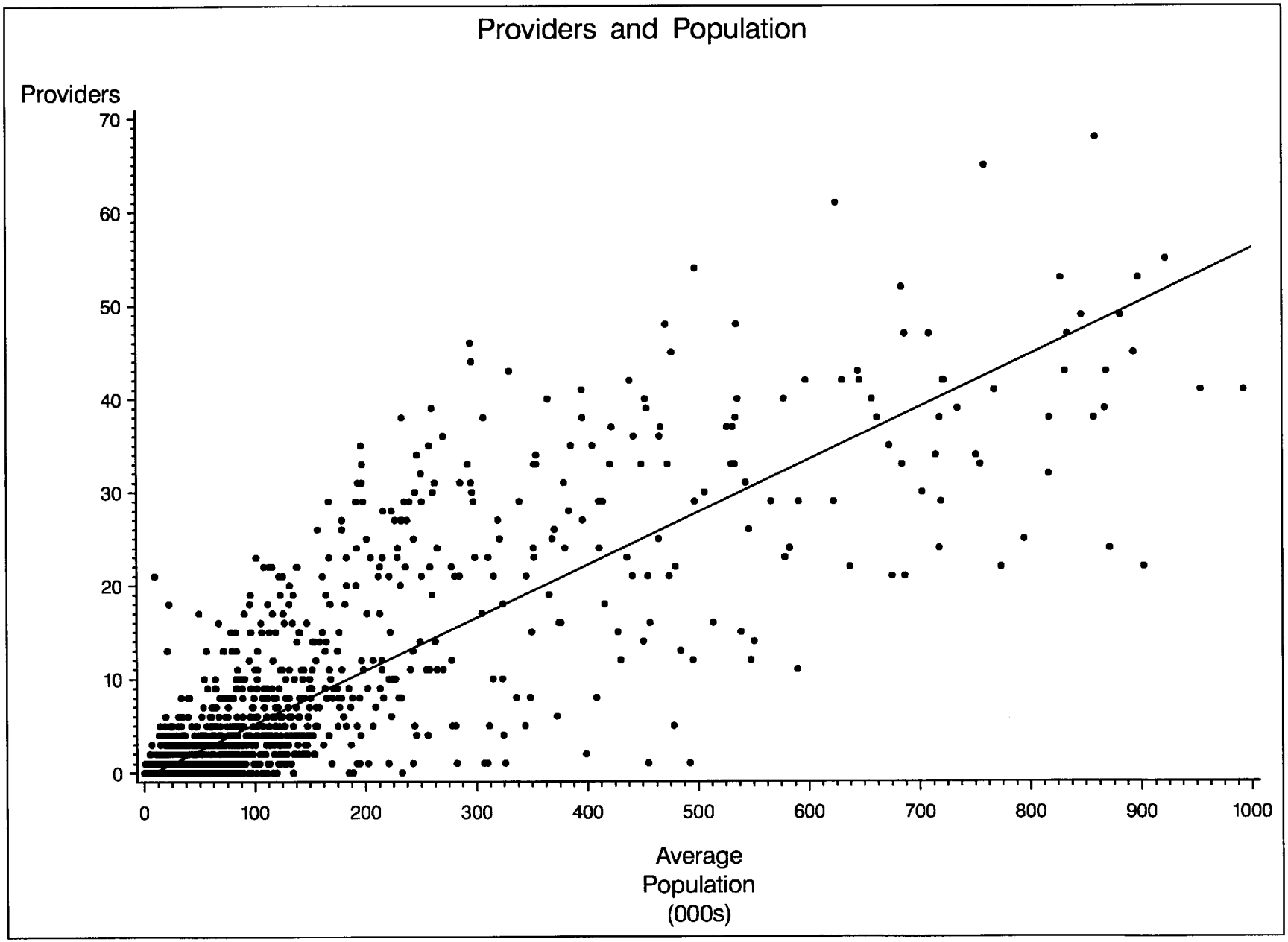

Providers and Population
Providers
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
800
900
1000
Average
Population
(000s)

Table 3 explores the difference between urban and rural areas, shedding light on the relationship of density to entry. It breaks the counties into those in urban and those in rural areas, then computes the same statistical averages and variances as in Table 2. The most striking feature is that population thresholds differ between urban and rural areas. In rural areas, both population levels and population density predict the level of entry into small counties (those under five suppliers). For larger rural counties, there seems to be almost no relationship between either population or density and the degree of entry. In contrast, in urban areas population levels coincide with ISP entry, but density does not. The relationship between urban population and entry is virtually monotonic.[19] In addition, the entry thresholds appear to be quite different between urban and rural counties, with the urban counties having higher thresholds. These differences between population levels at each level of entry in urban/rural areas is strong evidence that the entry relationship differs between areas with different population densities.

Finally, Table 3 shows that 204 counties in urban areas do not have any ISP, 97 have only one and 40 only two. This does seem to be partly a function of population levels. For example, the population that induces almost three suppliers in a rural market is the average population for the urban counties with none. Yet, this also leads to speculation that some of these small urban counties border on larger areas with adequate supply of ISPs.

Figure 3, a map that highlights urban counties, lends evidence to this speculation. It shows the urban counties that do and do not have ISPs present. Figure 3 shows conclusively that every single urban county without any ISPs is located next to an urban county with ISP entry. Detailed examination of the data, not shown in the figure, found that in almost every case, there is extensive ISP entry next door. Some of this reflects the actual patterns of entry and some of it may be an artifact of the measurement procedures used, as noted above. Thus, it is unlikely that any but a few urban area contain insufficient Internet access.[20] Reading Table 3, this means that as many

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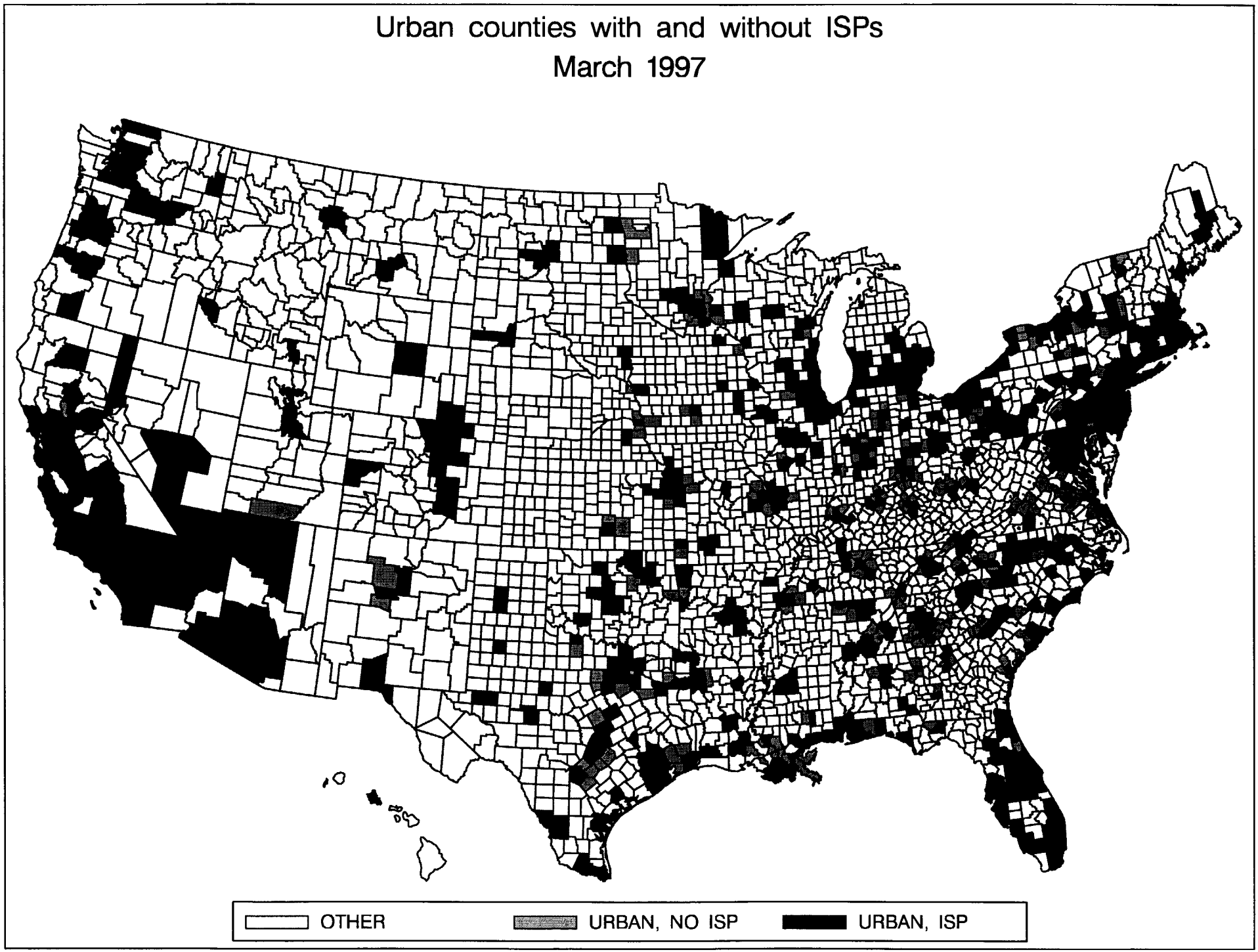
[19] The exceptions actually prove the rule. Three breaks in the monotonicity, at 2, 6 and 11 suppliers, occurred in the counties for the Bronx, Brooklyn and Queens. Here the neighborhood effects from Manhattan are especially important.

[20] Neighboring effects, however, are not likely to be the only explanation in rural areas. If the neighboring effects explained the counties with small number of entrants, then there should be no relationship between the size of counties and the number of entrants. Yet, in rural areas there is a strong relationship.


Urban counties with and without ISPs
March 1997
OTHER
URBAN, NO ISP
URBAN, ISP

as 20 million people (of the 60 million with inadequate access in Table 1) may actually have adequate Internet access nearby.[21] Thus, Figure 3 leads to an important modification of the conclusion from Table 1: the population with inadequate access is approximately 40 million, or about 15 percent of the US population.

It is not possible to definitely conclude that economies of scale at the POP solely determines the relationship between number of suppliers and population levels. It is theoretically possible that different geographic features of these areas may stand in for the level of demand (which interacts with the economies of scale at the POP and therefore determines level of entry). Different geographic features may also be standing in for unobserved intensity of demand that systematically differ across counties of different population size (e.g., users in small towns are less intensive users and, therefore, less profitable to serve). There is insufficient evidence to test these hypotheses. To do so would require careful measurement of the determinants of demand (e.g., see Kridel et al, 1997).

B. The competitiveness of urban/rural areas:

Table 4 presents the structure of ISP entry in small markets. It divides markets by the number of entrants and then classifies them into those in which all suppliers are either local, regional or national. The striking feature of this table is that many small markets are entirely supplied by local ISPs. In the 521 counties with only one supplier, 44% of those are local ISPs, 4.2% are national ISPs, and just over half are regional ISPs. In 181 counties with two suppliers, 27% of those counties have only local ISPs, 17.7% are only regional and 3.9% have only national ISPs. In the 97 counties with three supplies, 14.4% are only local, 13.4% are only regional and 8.2% are only national. It is only for 574 counties with four or more suppliers that Internet access is offered by a variety of different types of firms. The fact that national and local ISPs treat urban and rural areas differently is further evidence that firm strategies differ.

The other columns show the population who live in the counties with only one type of supplier. Just over 16 million people live in counties with only one local ISP. Over 10 million live in counties with only regional suppliers. Close to 3 million live in counties with only national

[21] This was calculated by adding the total populations in urban counties with zero, one and two suppliers. This results in over 22 million people.

providers. These results are consistent with the view that small areas or rural areas are first being developed by local and regional ISPs and only occasionally by national ISPs.

Two different interpretations are consistent with the pattern in Table 4. If one believes that national ISPs offer higher quality access than local ISPs then the economies of scale required to maintain high quality POPs will preclude national entry in small markets. On the other hand, if one considers local or regional ISPs to be better than national ISPs at tailoring their services to the unique needs of their area, then national ISPs will acknowledge their disadvantage and often choose not to enter. Notice too that this second view requires there to be something unique or idiosyncratic about the tailoring of services to small markets. Otherwise, national firms could easily imitate the strategies pursued by local or regional firms in small markets.

The differences between the smallest and largest counties motivates Table 5, which asks a similar question as Table 4, but only for large urban areas. Table 5 examines the fifty counties with the greatest number of ISPs. It further classifies the counts by ISPs with local, regional and national affiliations, which then identifies the source of entry in large markets. The table shows that areas with the largest number of suppliers are those with the largest number of local suppliers. The reason is as follows: National suppliers are present in almost all the urban areas, and in all but a few counties there are not many regional suppliers. Hence, the total number of suppliers in a large urban area is largely a function of local entry.

These observations make one cautious about inferring much from the rank in Table 5. If the number of local suppliers is simply a function of the size of population, then it is not surprising that the counties with larger populations rank higher.

The first half of this papers leads to speculation that regional ISPs are simply one of the growing stages from local to national firms. This leads to the question: If most regional ISPs begin as local, then where did they start? In a close inspection of the data, it appears that only a few areas are the spawning grounds for most regional ISPs. Counties which have an unusually large number of regional ISPs include San Mateo, Santa Clara CA, San Fransisco, Marin, Alameda and Contra Costa, CA (SF Bay Area and Silicon Valley), New York and proximate New Jersey counties, Los Angeles and Orange CA (Southern California), Cook and Dupage IL (Chicago and western suburbs), Montgomerey, Bucks, Chester, and Philadelphia PA (Philadelphia

and its suburbs), Wayne, Washtenaw, Macomb and Oakland MI (Detroit area), and the counties in the Washington D.C./Baltimore corridor. Part of this is due to the higher carrying capacity of the larger urban areas, which support a larger number of ISPs including regional ISPs. Arguably, the Boston area, the Research Triangle of North Carolina, and the Seattle region of Washington also support a large fraction of regional suppliers.[22] It is interesting that no other large region of the country serves as a major spawning ground for regional ISPs.

Since population levels in a county are an important determinant of entry, table 6 takes the same fifty counties as in table 5 and further ranks them by the total and local ISPs per capita. This table shows that per capita presence is not easy to predict. The top ten counties are associated with Washtenaw County MI (Ann Arbor), Albany NY, Mercer NJ (Princeton), Denver CO, NewCastle County in DE (Wilmington), San Francisco CA, Multnomah OR (Portland), Orleans County LA (New Orleans), Davidson TN (Nashville) and Orange FL (Orlando). These ten counties do not have anything obvious in common. Again, this cautions about reading too much into the precise numbers of ISPs in urban areas.

Tables 5 and 6 show that the San Francisco Bay Area does better (in terms of number of suppliers and suppliers per capita) than just about any other large metropolitan area, consistent with its reputation as the most wired area in the country[23].

These discussions highlight the complexity of market structure. It is important to account for many relevant factors, such as nearby universities, the surrounding region, neighboring counties and so on. It is not surprising that no single explanation or simple factor will explain cross-county differences in entry patterns and competitiveness. The ISP industry has matured, prices have declined, and the technology underlying it has diffused widely. No area will look

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[22] Middlesex County, MA has 5 regional suppliers present (out of 53 ISPs total), Suffolk, MA has 6 (out of 43), Durham County, NC has 3 (out of 33), Wake, NC has 3 (out of 38), King County, WA has 8 (out of 88) and Thurston, WA has 3 (out of 31), Snohomish WA has 4 (of 36).

[23] Five of eight Bay Area counties are listed in the top fifty by size, which is partly an artifact of their large geographic and population size. These counties are Santa Clara, San Mateo, San Francisco, and the east Bay counties of Alameda and Contra Costa. The three other counties not listed are the north Bay counties of Marin, Napa and Sonoma. Marin County also does quite well in per-capita ISPs, though the total number is not large. As a point of comparison, Seattle (King) is twenty-fifth, and Boston suburbs (Suffolk, Middlesex) are fifteenth and thirty-sixth. Minneapolis is nineteenth. In data not shown, neither Austin, TX, nor the Research Triangle in NC, seem excessively wired.

exactly like any other area and no urban region could possibly sustain a substantial lead in access over any other urban region.

C. Structure and strategy of national/local firms:

Tables 7 and 8 examine the geographic strategies of different types of ISPs. These tables show how firm strategy interacts with geography. Table 7 divides the entire list of firms by the number of counties in which they are present. The table shows that 2980 ISPs are present in only one county, 246 ISPs in two counties, 89 in three, and over 70 ISPs are in more than 10 counties. This is a remarkable market structure. Several dozen national firms are present in hundreds of locations, providing access to many users, while the majority of firms are not.

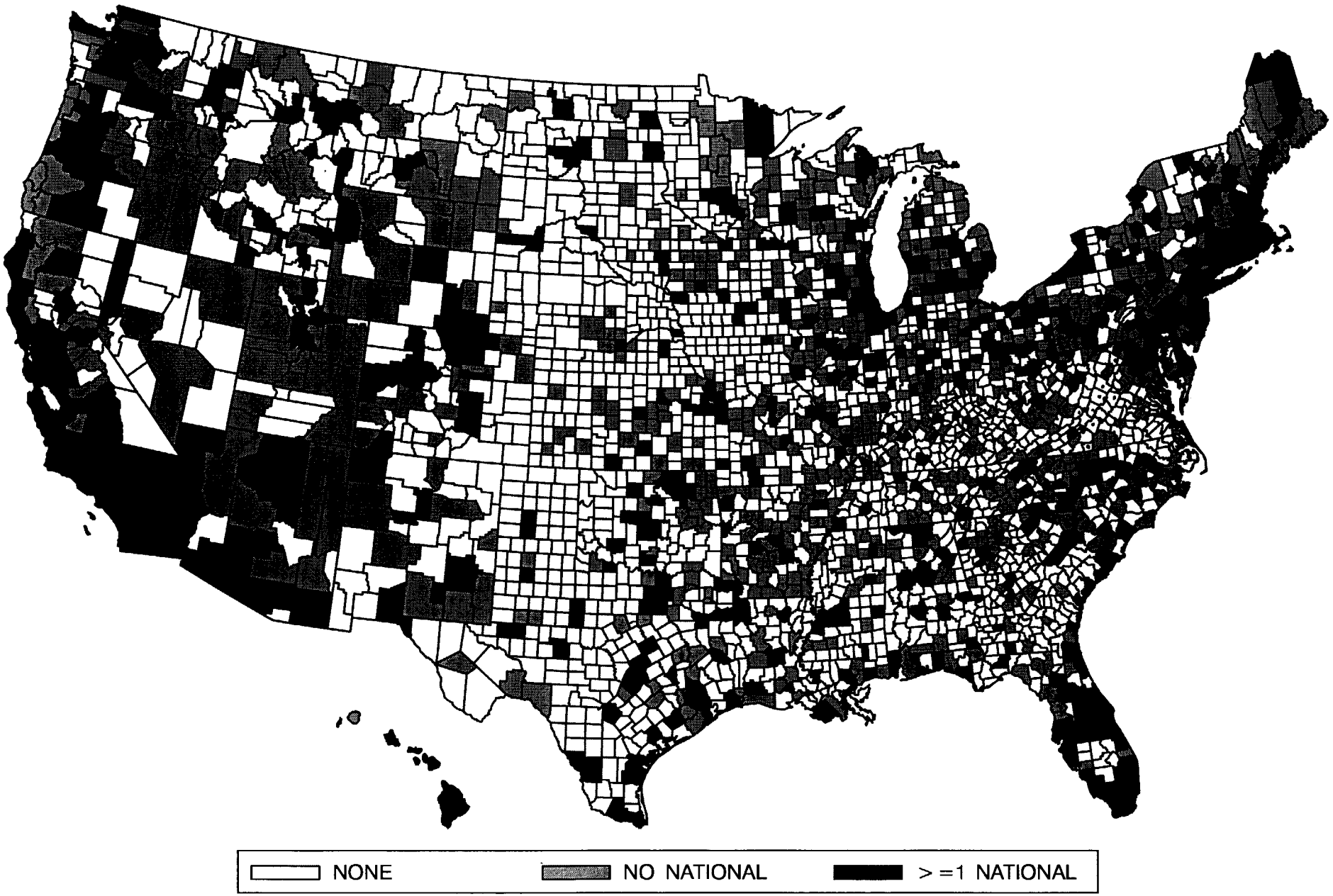
From this simple fact follows a few important implications: First, counting the number of firms in the entire country provides a deceptive view of the access industry. The majority of POPs are associated with national firms, not local ISPs. Next, the decisions and strategies of a few dozen national firms influence the experience of the majority of users in the United States. That said, worries about excessive concentration in this industry seem misplaced. No single national firm (or small cabal of them) has much control over the distribution of access in the US at this downstream level.

The previous tables highlight different national/local structures in urban/rural markets. Table 7 distinguishes between ISPs who specialize in either urban or rural areas. All things equal, most ISPs have a foot in an urban county. Indeed, most local ISPs find themselves in thick competitive urban markets, which gives them a very different experience from the local ISPs in thin rural markets. That said, the greater the geographic spread of the ISP the more likely it will be in a mix of urban and rural counties. Very few local ISPs specialize in only rural counties. This is consistent with the view that ISPs who grow in geographic scope tend to go into neighboring geographic counties with different characteristics. Even if they began in an urban county, they expand to provide service in a rural areas, and visa versa.

Figure 4 is a map which illustrates these points. It shows all the counties with at least one national provider and compares it to any county with none. Counties which are black have at least one national provider and counties which are gray have only local or regional providers. The major urban areas (i.e., the areas with the most ISP entry) are those counties where most national

Location of national firms

March 1997



firms have entered. The areas with the least entry, predominantly rural counties, are those where no national firm has entered. Indeed, Figure 1 and Figure 4 look very similar for this reason.

Table 8 examines the entry strategies of the firms in the largest number of counties. It displays the number of counties in which these firms have local POPs and the percent of the population covered by these POPs. It is not surprising that the largest ISPs in the US tend to predominantly be in urban counties. It is somewhat surprising that this widespread presence, even for a firm as large as IBM, only puts it within reach of a local phone call from just over half of the US population.[24]

Several factors are notable. First, most of these large vendors cover urban areas. For many of these firms, all but a few POPs are in urban counties. Second, only four firms in this data break from this pattern and specialize in non-urban areas (i.e., Info Avenue, The Portage, Voyager and Alliance). None of them was large enough in the spring of 1997 to cover many of the rural counties in the US.

Third, since national firms prefer urban areas they often target the same regions. Virtually all of them are in the same top fifty US cities, the rest of their coverage varies substantially. As a result, three quarter of the population living in urban areas have access to very competitive service from a variety of national firms. Fourth, some of the national ISPs, such as IBM concentrate on business, not residential users. These firms have no reason to provide extensive networks comprised of many POPs when they also provide direct access lines to businesses.

Table 8 illustrates one important reason why most of the national firms do not expand beyond several hundred counties. Many national firms provide access to just under a third of the US population by having presence in approximately 100 counties (and this does not count neighborhood effects). As we move from medium to large firms, their networks begin to cover larger portions of the US population. However, adding an additional 100 counties only increases coverage by (approximately) 15 percent of the population. To achieve a similar growth requires

[24] It is not surprising that firms such as this also offer more than dial-in service, including 800 service and direct access to high volume users in remote location.

adding another 200 counties.[25] This pattern is consistent with the most basic economic feature of expansion into national distribution channels: there is diminishing additional population associated with each additional expansion in the number of POPs. This is simply a function of the settlement in the US – most people live cities which are spread out over hundreds of counties.

In the absence of some decreasing cost technology (e.g., some sort of coordination economies) or some increasing returns in the demand-side (e.g., national brands), these basic economics limit the geographic expansion of the national ISP networks. Since national firms also face economies of scale at the POP -- even at a remotely monitored POP -- and constant costs to the addition of POPs, it follows that they too find it unprofitable to be ubiquitous. It will not be beneficial for any national firm to expand its network POPs in increasingly remote areas, bringing in fewer additional customers with each additional expansion. It is better for IBM, for example, to offer potential customers in remote locations 800 service or direct access lines.

Tables 7 and 8, together with the previous tables, is consistent with the earlier taxonomy between national/local firms. It suggests urban/rural differences may be key features of national/local firm strategies. However, it also suggests that it may be appropriate to expand the view of ISP's market structure. As a first-order approximation to understanding strategy and structure, firms in the ISP access industry could be classified into five categories:

- *1. Urban/national*: National firms who predominantly specialize in urban areas and secondarily serve rural areas. This is the vast majority of national firms.
- *2. Urban/local*: Local firms who predominantly specialize in urban areas. This is a substantial majority of local firms.
- *3. Rural/local*: Local firms who predominantly specialize in rural areas. While not the majority of local firms, these still number in the hundreds.
- *4. Rural/national*: National firms who predominantly specialize in rural areas and secondarily in urban areas. This is a handful of firms
- *5. Regional*: Firms whose base is either rural or urban, but whose geographic territory is expanding well beyond that base. This is a couple dozen firms.

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[25] In the "best case" scenario, going from 102 to 196 provides 16.6% more population. From 196 to 395 brings in 18.9% more population.

This taxonomy is consistent with the framework in the first half of the paper. Firms differ in their strategy, in their location and the degree of competitiveness of the markets they enter, but they largely choose the same types of organizational forms in euqilibrium. Most firms will be either high-quality national ISPs or high quality local ISPS, firms in categories 1 and 2. The equilibrium analysis correctly suggested that categories 3, 4 and 5 would not represent the experience of the majority of firms. If the equilibrium analysis is correct, these latter three categories will become even less common over time. In particular, category 5, regional ISPs, may become temporarily important and then diminish in number as many local firms expand beyond their initial geographic reach.

D. Implications for geographic scope of commercialized access

These tables raise as many questions are they answer. Indeed, their main point is to motivate the policy community to grapple with many hard questions.

Three findings should shape further policy discussions of the commercialization of the Internet. First, these tables suggest that there is a minimum threshold of population needed to support entry of an ISP POP. It also seems possible that local and national POPs face different thresholds. Second, urban and rural areas experience different market structures. It appears that marginal rural areas are mostly covered, if at all, by local or regional ISPs and somewhat by national ISPs. In urban areas, virtually all markets contain a mix of local and national ISPs. Third, local and national firms appear to pursue different entry strategies, which translates into different geographic scope for local and national firms in the industry. Below the discussion develops a few additional implications of these facts.

- **The scale of ISPs and scope of geographic coverage:** The different population thresholds for local and national POPs are consistent with three theories. First, local POPs in rural areas may enter with lower quality than national POPs. That is, entering with low quality equipment lowers a local POP's costs. Alternatively, local POPs in rural areas may be entering with different value-added services than national POPs in urban areas. That is, local POPs in rural areas may not be deriving much profit from their ISP service, but make up for these losses with other complementary services which are tailored to rural areas. A third view[26] is that many rural

[26] See, in particular, Garcia [1996] and Garcia and Gorenflo [1997].

ISPs provide service as part of their activity as a rural cooperatives or other quasi-public institution supporting local growth. In this view it is not profit motives that are the key driver of entry in rural areas, but rather community and public service. This different motive would account for the willingness of rural ISPs to enter areas that profit-oriented national ISPs avoid.

My own speculation is that the first and third views are the most likely. There are many examples of low-quality rural ISPs and rural ISPs opening with quasi-public motives. The second view only makes sense if the value-added services offered by a local POP have a strong "local component"; otherwise, a national firm could imitate it and profitably expand into rural areas. Though this is plausible, I have yet to hear of many examples.

It is my conjecture that these three views will set the agenda for the universal access debate into the next century. If there are strong economies of scale at the POP, it will limit entry of ISPs in rural and remote areas. If ISPs become essential for local growth, quasi-public local institutions will try to subsidize local ISPs to overcome these scale economies. If the local component of an ISP's service becomes an essential element of its offerings, then national firms may never find it commercially profitable to move to remote areas. If high quality service is expensive to offer, then remotely situated firms may find it difficult to afford. And, of course, all of this could change if scale economies weaken or if the costs between high and low quality narrow enough so that ISP product lines become similar in rural and urban areas.

- **Market structure and issues at the top of policy agenda:** The finding about the different market structures in urban and rural areas, as well as the findings about the different behaviors of national and local firms, shape any debate about the commercialization of Internet access. It appears that, as of the Spring of 1997, there were differences in the costs of access between urban and rural areas.

Second, these facts particularly influence any debate about subsidies and taxation of the ISP industry.[27] All future policy debates should be cognizant that changes in policy will affect urban and rural areas differently. For example, altering access charges for ISPs will elicit different responses depending on whether the area is predominantly served by local or national companies.

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[27] For example, contrast the very different proposals in Sidek and Spulber [1998] and in Garcia and Gorenflo [1997]. The former call for an end to implicit subsidies and the latter comes close to calling for subsidies for rural ISP service.

Relatedly, taxing ISPs, which many states are already doing or proposing to do, will produce similar differences in urban/rural communities.

Proposals for subsidizing ISPs also bring forth some difficult questions. If private firms stay out of rural areas they do so for sound economic reasons. Only compelling social benefits justify ignoring these reasons. If, as some critics charge[28], ISPs are already receiving a large implicit subsidy by not paying for access, then the implied social expenses of extending ISPs further will be increasingly large. Are the social benefits worth those expenses?

Finally, a related and still unsettled question concerns the unobserved strategies of the five types of firms. Do value-added services, pricing and quality also differ by geography? If so, is this problematic for policies of universal access? Do rural/local and urban/local firms differ substantially in quality? If so could any government body do anything about it? Will rural markets be served only by rural/local or regional firms, and never have access to the features found in urban/local or urban/national firms? If some types of commercial firms locate in certain places but not others in a complex pursuit of cost/benefit trade-offs of operating their business, could a government change this through subsidies and other mandates? These are the types of questions that ISP policy needs to address if it will make headway on the universal service debate in Internet technologies.

- **Future Consolidation:** It is common in the business trade press to predict consolidation of ownership of the ISP industry. On one level, this study suggests that this belief has no economic basis. Multiple firms survive in this industry and some appear to have a strong local component, which would suggest little scope for national consolidation of all firms. On the other hand, many firms have national networks and are trying strategies in which national branding plays a large role. If those national brand names begin to take on value, either because they stand in for higher quality, more reliability, or some other difference in service that cannot be imitated by a local firm, then consolidation will occur, driving out local ISPs who cannot mimic national brands.

There appears to be much room for consolidation within this industry. There are scores of national providers and thousands of local ISPs. The ISP access market could experience hundreds

[28] See, for example, Sidek and Spulber [1997].

of mergers in ISPs and not come close to violating any potential antitrust statute. Nor would many potential consolidations of ISP firms excessively concentrate access in too few hands.[29] That said, there is an important local component to the industry, as of spring 1997. Consolidations that do not concentrate market share at the national level may concentrate access in a local market.

Consolidation will not influence access in rural areas if local ISPs continue to be the predominant provider of access in remote regions. However, if national and local ISPs begin to diverge in quality over time, and if the industry does not remain as fragmented as it is today, the concentration of the industry could influence the universal access debate.

VI. Conclusions

The commercial Internet access industry has an important geographic component which correlates with features of market structure, quality of service, pricing and competitiveness. As a result, most of the important issues in the universal access debate also have some important geographic component. The links between geographic coverage and market structure arise because an ISP, whether it is national or local, simultaneously chooses several important dimensions of firm strategy, including the geographic coverage of the firm. These choices involve many trade-offs between the costs of providing a service, the core competence of the firm, and the revenues generated by those decisions.

As of spring 1997, there were economies of scale at the POP and these limited the spread of ISP service to all parts of the country. Related strategic decisions induced variance in market structure in different regions of the country. This resulted in most of the population facing competitive supply of Internet access, while the remainder faced less ideal conditions in marginal urban areas or rural areas.

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[29] Two caveats apply to this observation. First, as has been noted by other authors (e.g., see McKnight and Bailey, 1997 and several articles therein, such as Srinagesh, 1997) there are potential bottlenecks in many facets of the backbone of the network and in the infrastructure used to coordinate the whole network. Concentrated ownership of these bottlenecks could have consequences for market power in this industry. The statement in the text only pertains to the downstream industry. Second, these numbers only speak to concentration in POPs, not market share in use. By some estimates the AOL/Compuserve merger gives one firm somewhere between 40% and 50% of the residential access market (Maloff, 1997). If these shares were to increase significantly, it is an open issue whether the low concentration in alternative POPs is sufficient to discipline AOL's pricing in the future. That said, the degree of competition in the ISP industry was sufficient to motivate AOL to lower prices in the past (The Economist, 1997a), so this has not yet been an issue.

These structural and strategic differences should be central issues in policy discussions of universal access to advanced communications and computing technology. Many issues will remain unresolved until future research on access analyzes the precise determinants of firm entry and expansion strategies. How important is the presence of a wealthy or educated population? How important is the presence of advanced telecommunications infrastructure or a major educational institution? The answers to these questions are the key to understanding different patterns in different regions. Thus, these are the key to many future policy issues.

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Table 1. Entry of ISPs: Number of Providers/County

Number of providers in county	*Number of counties*	*Population Percentage*	*Cumulative Population Percentage*	*Percent counties urban*
0	1742	12.8	100	11.7
1	521	7.7	87.2	18.6
2	181	4	79.4	22.1
3	97	2.4	75.4	36.1
4	74	2.5	72.9	43.2
5	58	2.5	70.5	62.1
6	36	2.3	68	55.6
7	21	1	65.7	81
8	36	2.1	64.7	80.6
9	22	1	62.6	72.7
10	20	1.1	61.6	85
11 or more	307	60.5	60.5	97.7

Table 2. Population & Density by Number of Providers/County

Number of providers in county	*Number of counties*	*Average Population*	*Stdev Population*	*Average Density*	*Stdev Density*	*Percent urban*
0	1742	19,511.21	19,419.85	0.02	0.07	11.7
1	521	39,310.46	47,100.12	0.04	0.09	18.6
2	181	59,153.46	95,070.30	0.11	0.84	22.1
3	97	66,301.95	36,191.57	0.05	0.07	36.1
4	74	88,308.05	58,172.91	0.08	0.14	43.2
5	58	113,464.52	87,467.98	0.13	0.35	62.1
6	36	168,798.81	366,144.79	0.49	2.11	55.6
7	21	120,158.86	43,171.77	0.08	0.04	81
8	36	154,200.08	85,660.16	0.19	0.35	80.6
9	22	124,639.41	46,669.03	0.08	0.07	72.7
10	20	144,040.70	79,299.35	0.12	0.09	85
11-15	65	204,906.78	136,917.90	0.25	0.61	90.8
16-20	35	249,200.37	324,780.84	0.39	1.17	97.1
21-25	57	354,740.09	226,790.90	0.35	0.56	100
26-30	34	342,842.26	161,507.28	0.34	0.45	100
31-35	29	422,489.59	190,912.43	0.4	0.72	100
36-40	25	556,496.60	245,464.87	0.34	0.21	100
41-45	20	749,649.70	302,655.86	0.61	0.91	100
46 or more	42	1,550,098.67	1,484,900.78	1.39	3.26	100

Table 3. Urban/Rural Differences in Population & Density by Number of Providers/County

Number of providers in county	*Number of counties*	*Average Population*	*Stdev Population*	*Average Density*	*Stdev Density*	*Urban or rural?*
0	1538	15,889.35	13,385.14	0.01	0.03	Rural
1	424	28,525.57	19,848.13	0.03	0.08	Rural
2	141	41,122.49	23,987.32	0.02	0.02	Rural
3	62	53,274.35	26,813.31	0.04	0.07	Rural
4	42	62,006.95	38,736.83	0.05	0.11	Rural
5	22	57,255.95	24,763.50	0.03	0.02	Rural
6	16	83,488.38	45,077.77	0.03	0.02	Rural
7	4	69,706.50	19,832.59	0.03	0.04	Rural
8	7	78,721.57	24,465.94	0.05	0.03	Rural
9	6	93,512.50	40,945.62	0.09	0.11	Rural
10	3	67,987.67	16,009.22	0.04	0.02	Rural
11-15	6	87,478.33	20,388.92	0.06	0.02	Rural
16-20	1	96,152.00	.	0.08	.	Rural
0	204	46,817.14	32,081.46	0.08	0.18	Urban
1	97	86,452.64	86,725.78	0.08	0.1	Urban
2	40	122,712.65	185,286.90	0.43	1.76	Urban
3	35	89,379.40	39,379.39	0.07	0.07	Urban
4	32	122,828.25	61,782.71	0.11	0.17	Urban
5	36	147,814.19	94,298.28	0.18	0.43	Urban
6	20	237,047.15	484,066.52	0.86	2.8	Urban
7	17	132,030.00	38,339.41	0.09	0.04	Urban
8	29	172,419.03	85,298.15	0.23	0.38	Urban
9	16	136,312.00	44,243.23	0.07	0.06	Urban
10	17	157,461.82	78,482.65	0.13	0.09	Urban
11-15	59	216,848.66	138,124.61	0.27	0.63	Urban
16-20	34	253,701.79	328,554.93	0.4	1.18	Urban
21-25	57	354,740.09	226,790.90	0.35	0.56	Urban
26-30	34	342,842.26	161,507.28	0.34	0.45	Urban
31-35	29	422,489.59	190,912.43	0.4	0.72	Urban
36-40	25	556,496.60	245,464.87	0.34	0.21	Urban
41-45	20	749,649.70	302,655.86	0.61	0.91	Urban
46 or more	42	1,550,098.67	1,484,900.78	1.39	3.26	Urban

Table 4. Type and Density of ISPs: Number of Providers/County							
Number of providers in county	*Number of counties*	*Percentage only Local*	*Population only Local*	*Percent only Regional*	*Population only Regional*	*Percent only National*	*Population only National*
0	1742	.	.	.	.	.	.
1	521	44	10,814,960	51.8	8,423,338	4.2	1,242,450
2	181	27.1	3,149,833	17.7	1,264,266	3.9	429,575
3	97	14.4	1,022,096	13.4	608,101	8.2	431,554
4	74	4.1	448,976	4.1	415,859	4.1	160,214
5	58	3.4	492,191	0	0	1.7	46,410
6	36	5.6	312,317	0	0	2.8	83,593
7	21	0	0	0	0	4.8	118,600
8	36	0	0	0	0	0	0
9	22	0	0	0	0	0	0
10	20	0	0	0	0	5	315,015
11	307	0	0	0	0	0	0
Total			16,240,373		10,711,564		2,827,411

Table 5. ISP type and size for largest 50 Counties

Rank by Total Providers	*County*	*Local Providers*	*Regional Providers*	*National Providers*	*Total Providers*
1	LOSANGELES,CA	113	13	33	159
2	SANTACLARA,CA	63	19	32	114
3	NEWYORK,NY	59	12	32	103
4	ORANGE,CA	59	12	30	101
5	COOK,IL	45	14	33	93
6	KING,WA	48	8	32	88
7	ALAMEDA,CA	39	19	26	84
8	HARRIS,TX	49	3	32	84
9	SANDIEGO,CA	35	9	30	74
10	SANFRANCISCO,CA	24	19	31	74
11	DADE,FL	34	6	32	72
12	MARICOPA,AZ	32	5	32	69
13	DALLAS,TX	34	3	31	68
14	DUPAGE,IL	32	11	24	68
15	ORANGE,FL	29	6	30	65
16	HENNEPIN,MN	33	2	29	64
17	WAYNE,MI	19	13	32	64
18	MULTNOMAH,OR	27	5	29	61
19	ALLEGHENY,PA	17	9	33	59
20	MILWAUKEE,WI	22	4	29	55
21	PHILADELPHIA,PA	10	13	32	55
22	DENVER,CO	19	4	31	54
23	SACRAMENTO,CA	22	4	28	54
24	HILLSBOROUGH,FL	16	7	30	53
25	MIDDLESEX,MA	17	5	31	53
26	SALTLAKE,UT	17	5	31	53
27	TRAVIS,TX	22	3	27	52
28	BROWARD,FL	24	4	23	51
29	BERGEN,NJ	16	8	25	49
30	CONTRACOSTA,CA	12	14	23	49
31	CUYAHOGA,OH	12	4	33	49
32	FRANKLIN,OH	17	2	30	49
33	DAVIDSON,TN	11	5	31	48
34	NASSAU,NY	17	5	26	48
35	NEWCASTLE,DE	16	2	30	48
36	FAIRFIELD,CT	12	5	30	47
37	MONTGOMERY,PA	15	14	18	47
38	OAKLAND,MI	20	8	19	47
39	SANMATEO,CA	13	15	19	47

40	SANBERNARDINO,CA	17	5	24	46
41	TARRANT,TX	18	0	28	46
42	WASHTENAW,MI	13	9	24	46
43	CLARK,NV	11	3	31	45
44	ORLEANS,LA	16	0	29	45
45	WESTCHESTER,NY	12	4	29	45
46	ALBANY,NY	10	3	31	44
47	HARTFORD,CT	11	7	25	43
48	MERCER,NJ	8	5	30	43
49	PINELLAS,FL	12	5	26	43
50	SUFFOLK,MA	9	6	28	43

Table 6. ISP Density for largest 50 Counties

Rank by Total Providers	*County*	*Rank by Density Total Providers*	*Total Providers*	*Density Total Providers*	*Local Providers*	*Density Local Providers*
1	LOSANGELES,CA	50	159	1.74	113	1.24
2	SANTACLARA,CA	13	114	7.13	63	3.94
3	NEWYORK,NY	15	103	6.72	59	3.85
4	ORANGE,CA	35	101	3.83	59	2.24
5	COOK,IL	49	93	1.82	45	0.88
6	KING,WA	26	88	5.43	48	2.96
7	ALAMEDA,CA	19	84	6.32	39	2.94
8	HARRIS,TX	47	84	2.69	49	1.57
9	SANDIEGO,CA	46	74	2.79	35	1.32
10	SANFRANCISCO,CA	6	74	10.06	24	3.26
11	DADE,FL	42	72	3.47	34	1.64
12	MARICOPA,AZ	48	69	2.64	32	1.23
13	DALLAS,TX	43	68	3.4	34	1.7
14	DUPAGE,IL	11	68	7.91	32	3.72
15	ORANGE,FL	10	65	8.56	29	3.82
16	HENNEPIN,MN	20	64	6.04	33	3.12
17	WAYNE,MI	44	64	3.14	19	0.93
18	MULTNOMAH,OR	7	61	9.76	27	4.32
19	ALLEGHENY,PA	32	59	4.55	17	1.31
20	MILWAUKEE,WI	21	55	5.96	22	2.39
21	PHILADELPHIA,PA	37	55	3.72	10	0.68
22	DENVER,CO	4	54	10.85	19	3.82
23	SACRAMENTO,CA	31	54	4.83	22	1.97
24	HILLSBOROUGH,FL	22	53	5.91	16	1.78
25	MIDDLESEX,MA	36	53	3.75	17	1.2
26	SALTLAKE,UT	18	53	6.4	17	2.05
27	TRAVIS,TX	12	52	7.6	22	3.22
28	BROWARD,FL	39	51	3.55	24	1.67
29	BERGEN,NJ	23	49	5.79	16	1.89
30	CONTRACOSTA,CA	25	49	5.56	12	1.36
31	CUYAHOGA,OH	41	49	3.5	12	0.86
32	FRANKLIN,OH	30	49	4.83	17	1.68
33	DAVIDSON,TN	9	48	8.97	11	2.06
34	NASSAU,NY	38	48	3.68	17	1.3
35	NEWCASTLE,DE	5	48	10.18	16	3.39
36	FAIRFIELD,CT	24	47	5.64	12	1.44
37	MONTGOMERY,PA	17	47	6.63	15	2.12
38	OAKLAND,MI	34	47	4.04	20	1.72

39	SANMATEO,CA	14	47	6.84	13	1.89
40	SANBERNARDINO,CA	45	46	2.88	17	1.06
41	TARRANT,TX	40	46	3.52	18	1.38
42	WASHTENAW,MI	1	46	15.59	13	4.4
43	CLARK,NV	33	45	4.29	11	1.05
44	ORLEANS,LA	8	45	9.44	16	3.36
45	WESTCHESTER,NY	28	45	5.04	12	1.34
46	ALBANY,NY	2	44	14.86	10	3.38
47	HARTFORD,CT	27	43	5.17	11	1.32
48	MERCER,NJ	3	43	13.02	8	2.42
49	PINELLAS,FL	29	43	4.95	12	1.38
50	SUFFOLK,MA	16	43	6.67	9	1.4

Table 7. Coverage and ISP Spread

Number of counties covered by provider	*Number of providers*	*Percent with only urban counties*	*Percent with rural counties only*
11 or more	70	17.1	0
10	1	0	0
9	10	30	10
8	13	30.8	15.4
7	14	71.4	0
6	22	40.9	0
5	40	67.5	5
4	46	50	10.9
3	89	67.4	9
2	246	75.2	7.7
1	2980	85.2	14.8

Table 8. Top 40 ISPs by number of Counties

Rank by Total Counties	Provider	Total counties	Percent counties urban	Percent US Population in total counties
1	IBM GLOBAL NETWORK	394	84.8	56.6
2	AMERICA ONLINE	388	82.7	57.6
3	COMPUSERVE	346	87.3	57.2
4	SPRYNET	317	87.4	53.8
5	INFORMATION ACCESS TECHNOLOGIE	309	87.7	53.2
6	INTERNETMCI	290	97.6	52.9
7	PASADENA NETWORKS	278	93.2	53.6
8	THEONRAMP GROUP, INC.	270	93.3	52.7
9	GLOBAL NETWORK NAVIGATOR, INC.	268	93.3	53.5
10	CWIX	241	95.9	46.8
11	UUNET TECHNOLOGIES, INC. / ALT	240	96.3	51.3
12	DISCOVERY COMMUNICATIONS	224	96.4	49.6
13	GTE INTERNET SOLUTIONS	223	96.4	47.6
14	HLC INTERNET	221	97.7	49.4
15	AGIS	196	89.3	37.7
16	SPRINT INTERNET PASSPORT	195	97.4	45.8
17	AT&T WORLDNET SERVICE	183	100	44.4
18	PSI	178	95.5	40.4
19	UNITED STATES BLACK ON-LINE	175	99.4	43.5
20	CONCENTRIC INTERNET SERVICES	168	99.4	44.4
21	WILTEL INTERNET SERVICES	165	99.4	42.9
22	NETCOM ON-LINE COMMUNICATION S	164	99.4	44.4
23	POWERNET	148	98.6	39.1
24	NEW VISIONS, INC.	146	98.6	40
25	BBN PLANET CORP.	134	99.3	36.5
26	WHOLE EARTH 'LECTRONIC LINK	109	100	34.9
27	EARTHLINK NETWORK, INC.	103	100	33.5
28	ANS COMMUNICATIONS (D)	102	96.1	31.1
29	GRIDNET INTERNATIONAL	93	100	33.6
30	PERFORMANCE SYSTEMS INTERNATIO	93	100	30
31	ACTIVELINK INTERNET SOLUTIONS	85	97.6	22
32	GOODNET	60	100	24
33	INFO AVENUE	58	36.2	1.8
34	PRIMENET	48	91.7	22.1
35	PORTAGE, THE	42	50	3.1
36	VOYAGER INFORMATION XCHANGE	42	47.6	3.1
37	AECNET	41	97.6	20.8
38	INFINET	41	92.7	10.8
39	ALLIANCE NETWORK, INC.	38	57.9	3.1
40	CRL NETWORK SERVICES	38	100	19.5