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To cite this article: Mitchell L. Moss & Anthony Townsend (1997) Tracking the net: Using domain names to measure the growth of the internet in U.S. cities, *Journal of Urban Technology*, 4:3, 47-60, DOI: [10.1080/10630739708724566](https://doi.org/10.1080/10630739708724566)

To link to this article: <https://doi.org/10.1080/10630739708724566>



Published online: 02 May 2007.



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Tracking the Net: Using Domain Names to Measure the Growth of the Internet in U.S. Cities

Mitchell L. Moss and Anthony Townsend

TO understand the effects of the new communications systems and the growth of the Internet, it is necessary to develop new empirical techniques that link information activity to geographic areas. The domain name system, the Internet's addressing scheme, provides a wealth of geographic information on Internet activity since each Internet address is registered to a specific organization and street address. The InterNIC domain name database, the primary clearinghouse for domain name registrations in the United States, provides the basis for the statistics cited in this report. Our observations indicate that cities are driving, rather than simply participating in, information-based phenomena such as the expansion of the Internet. As this research demonstrates, new telecommunications technologies are reinforcing business activity in many, though not all, cities in the United States.

Mapping the Internet and Domain Names

The Internet has emerged as the fastest growing and most versatile telecommunications medium since the invention of the telephone. Yet there is scant empirical research investigating the extent to which different cities, regions, and industry sectors are participating in this

on-line community. The obstacles involved in coupling cyberspace's virtual world to urban centers are substantial. It is difficult to determine Internet growth precisely, since there is disagreement on the appropriate criteria for measurement. In this report we propose new criteria for measuring this growth, using Internet *domain name* density and growth figures gleaned from an analysis of the InterNIC database. Using these criteria, this study then analyzes the distribution of Internet activity in the United States, especially the region served by the recently merged telecommunications companies Bell Atlantic and NYNEX (now called Bell Atlantic). We then "telescope" our emphasis from the Northeast, to New York City, to Manhattan. For this study, all U.S. city domain counts for January 1997 are courtesy of Imperative! of Pittsburgh, Pennsylvania. Older, city-level domain data comes from announcements by Internet Info of Falls Church, Virginia.

Imperative! Inc.

Internet Info July 1994

In order to understand the significance of domain names, it is important to understand that every system on the Internet has a unique numerical address, for example *128.122.253.80*. Because these numerical addresses would be quite difficult for most people to remember and use on a daily basis, the domain name system allows us to create and use intuitive names to address Internet systems. It does this by associating, or "mapping," an alphanumeric name, such as *www.nyu.edu*, to these purely numerical addresses.

In general, a domain name represents a single organizational entity present on the Internet (e.g., a corporation, university, or non-profit agency). Simply put, a domain name represents a naming authority—the ability and right to assign names under a certain hierarchy. For example, the *nyu.edu* domain encompasses all Internet activities at New York University and allows the organization that controls the *nyu.edu* domain to give its Internet-connected systems such names as *www.nyu.edu* or *mailserve.is.nyu.edu*. No other entity can map a domain name that ends with *nyu.edu* to the numerical address of an Internet-connected system.

In the United States, nearly all domain registration services from January 1993 through mid-1997 were provided by the InterNIC, a joint project of AT&T, General Atomics, and Network Solutions, Inc., supported by the National Science Foundation. As a result, for the period in question, there exists a centralized, professionally administered database of domain names that includes both the sponsor organizations and the addresses of those organizations. The completeness and geographical specificity of the domain name data set makes it a highly attractive preliminary tool for measuring Internet activity. Our primary measures have been of numbers of domains,

domain density (the number of registered domains per 1,000 inhabitants of a city), and the growth of domain registration.

Currently, approximately 85 percent of domain registrations are commercial domains that use the abbreviation "com." They have been the main engine of Internet growth during the last three years. The trends and patterns identified by this study are driven primarily by business location rather than the location of other types of Internet-connected organizations.

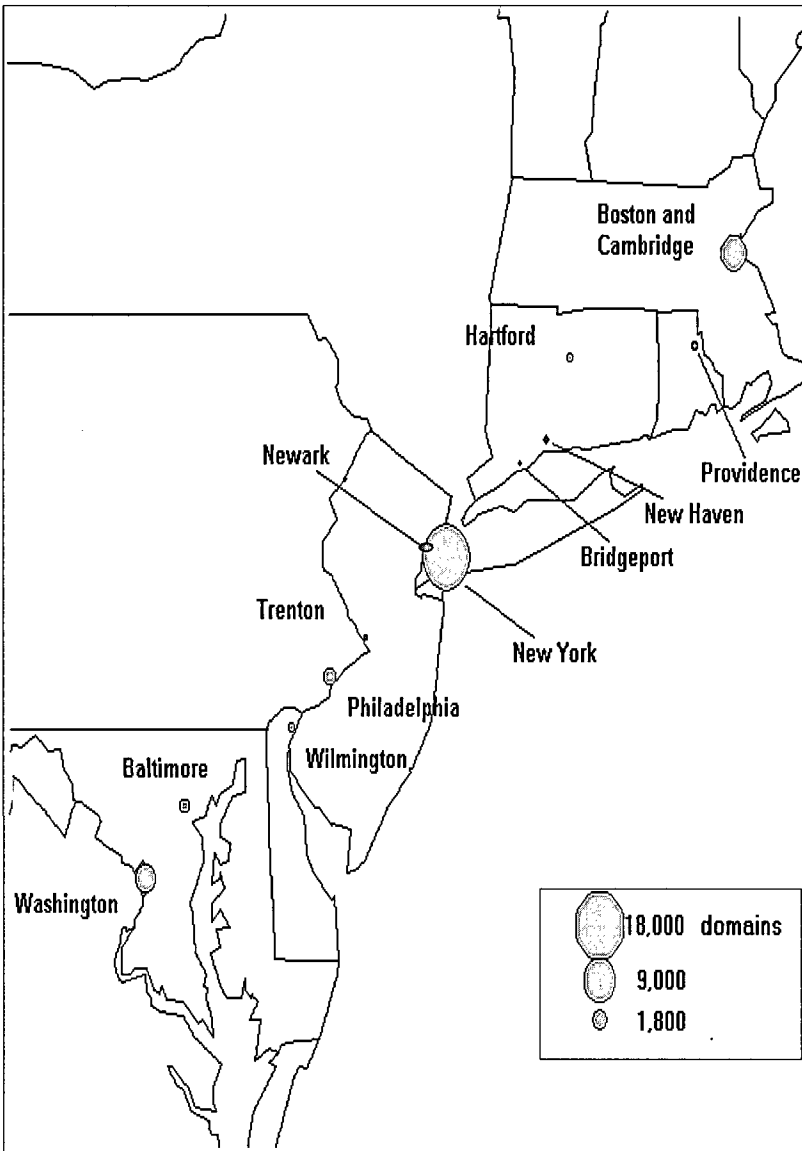
The Northeast Corridor and the Bell Atlantic Region

The cities of the Bell Atlantic region, from Maine to West Virginia, are among the largest and most densely "wired" in the United States. In addition to New York City, significant centers of Internet activity can be found in Boston, Washington, Wilmington, Stamford, and Hartford. Outside the Boston-New York-Washington axis, Pittsburgh is the only city in this region with a notable Internet presence. The magnitude and density of domains in these cities are shown in Figures 1 and 2. Within the Boston-Washington corridor, 13 major cities contain nearly one-third (29.7 percent) of the domains in the entire region.

In comparison to the rest of the nation, the cities of the Bell Atlantic region rank highly in both the absolute number and the density of domains. Figure 3 shows the 20 most networked cities in the United States. These were selected from a group of 85 of the largest cities across the country. Each of these 20 cities has at least 1,000 registered domains and twice the national average domain density. Washington is deceptively under represented by the domain count, as the entire Internet operation of the federal government is confined to a limited number of domain names, yet it represents an enormous Internet presence. It is also important to note that the borough of Manhattan is treated independently of New York City, since it has a disproportionate share of the domains in New York City.

In terms of domain density, Boston and Washington represent a second tier beneath Manhattan. Hartford and Wilmington form a third tier. In the latter two cities, insurance and financial service industries drive the local economies; thus, the large number of domains is presumably due to a labor force well-trained in computer use. Philadelphia and Baltimore both have a relatively small number of domains despite their large populations, with lower densities than the national average. Newark and Bridgeport, two economically distressed cities, are each at one-third of the national domain-density level and very low in absolute domain numbers.

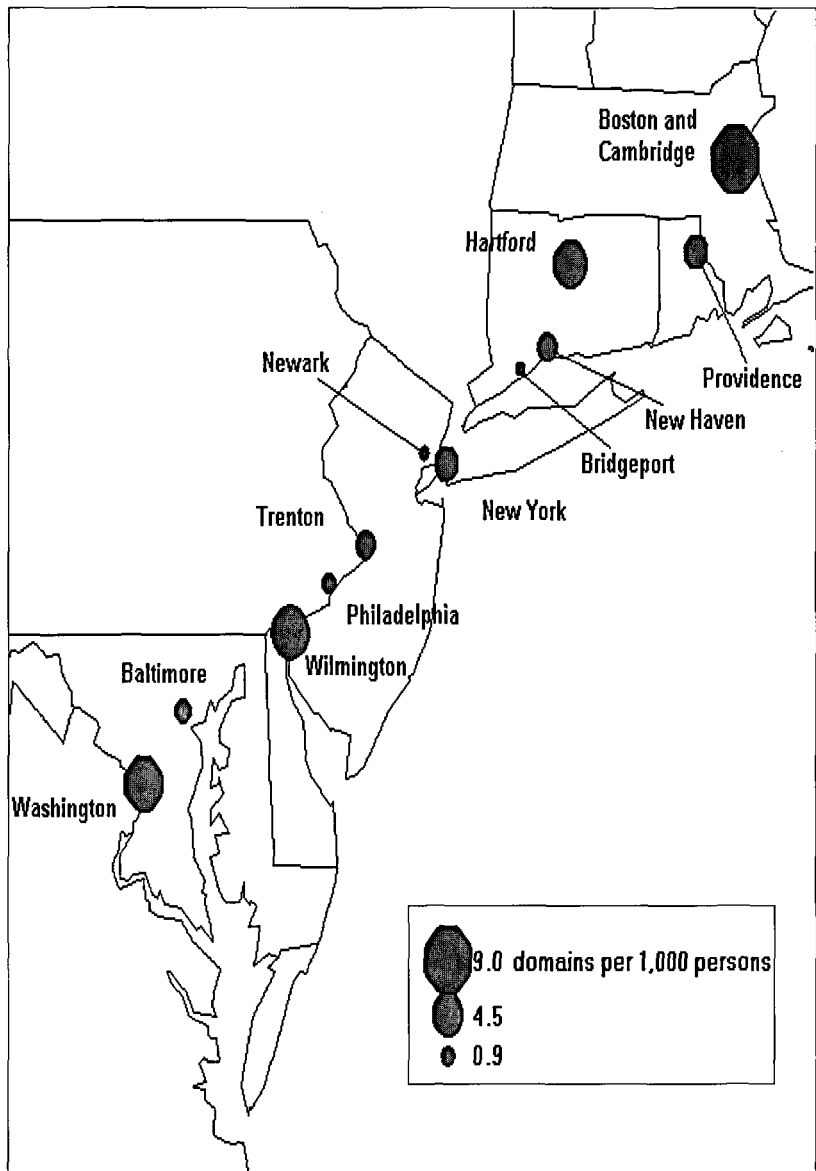
FIGURE 1
Domains in the Cities of the U.S. Northeast Corridor*
January 1997



* These cities represent:
 7.9 percent of all domains and 4.5 percent of the population of the United States.
 29.7 percent of all domains and 17.6 percent of the population of the Bell Atlantic region.

Source: *Imperative! Inc.*

FIGURE 2
Domain Density in the Cities of the Northeast Corridor*
January 1997



* The average domain density among the cities depicted on this map is 2.67 per 1,000 persons, compared to a nationwide average of 1.61.

The highest density shown is in the combined area of Boston-Cambridge, at 8.85—the lowest in Bridgeport, at 0.53.

Source: Imperative! Inc.

New York City and the Internet

New York City has the largest Internet presence of any city in the United States, and in all likelihood, the entire world. With 17,579 registered domains, New York City accounts for 4.2 percent of the U.S. total. The next largest concentration, in San Francisco, is less than half the size of New York City's, at 7,518 domains. Though it has a higher number of actual domains, New York City as a whole has a lower domain density than San Francisco, because of the latter's much smaller population. However, the Manhattan central business district has a domain density comparable to that of San Francisco.

New York City also leads other major financial centers around the world in Internet adoption. While there is no published study that has yet analyzed the Internet at the city level in Europe, national data for Singapore and Hong Kong show much lower levels of utilization. According to the January 1997 Netwizards Domain Survey, Hong Kong had 3,775 domains and Singapore 2,250, resulting in densities 10 to 20 times lower than the most networked American cities.

Netwizards, Inc.

FIGURE 3
The Top 20 Most Networked U.S. Cities*

<i>City</i>	<i>Domains</i>	<i>Domain Density</i>	<i>Population</i>
Manhattan, NY	15,139	9.9	1,533,774
San Francisco, CA	7,518	10.2	734,676
Seattle, WA	4,080	7.8	520,947
Dallas, TX	3,988	3.9	1,022,830
Boston, MA	3,981	7.3	547,725
San Jose, CA	3,863	4.7	816,884
Phoenix, AZ	3,760	3.6	1,048,949
Washington, DC	3,522	6.2	567,094
Austin, TX	3,306	6.4	514,013
Atlanta, GA	3,115	7.9	396,052
Miami, FL	2,827	7.6	373,024
Minneapolis, MN	2,764	7.8	354,590
Portland, OR	2,354	5.2	450,777
Denver, CO	2,186	4.4	493,559
Fort Lauderdale, FL	1,888	11.6	162,842
Cincinnati, OH	1,711	4.8	358,170
Pittsburgh, PA	1,651	4.6	358,883
Salt Lake City, UT	1,450	8.4	171,849
Sacramento, CA	1,228	3.3	373,964
Las Vegas, NV	1,204	3.7	327,878

* These cities constitute just 4.3 percent of the U.S. population but 17.1 percent of its domains.

Source: Imperative! Inc.

Internet Activity in New York City and Manhattan

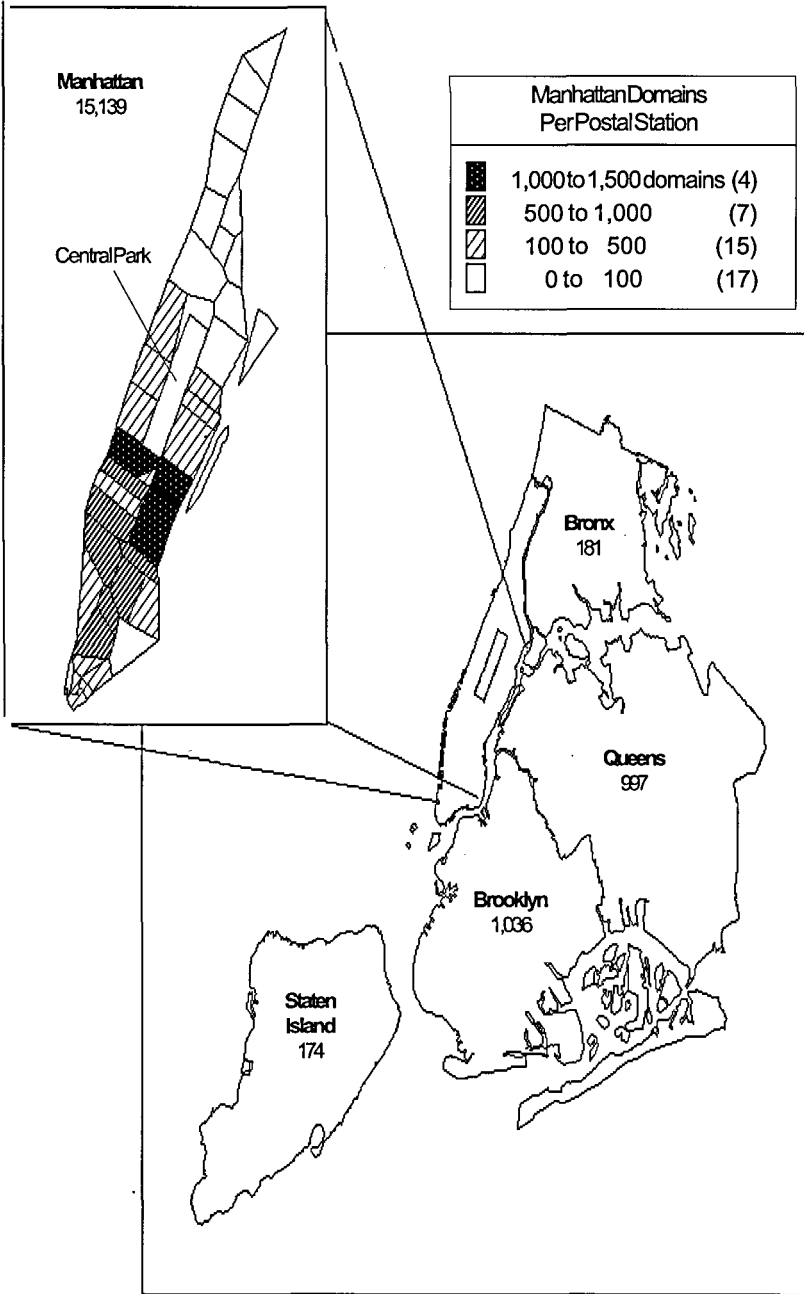
The borough of Manhattan dominates New York City's Internet activity. Since the introduction of the World Wide Web in 1993, the number of domains per capita in New York City has grown nearly 10 times more quickly than the nation as a whole. Among the outer boroughs, Brooklyn has the largest number of domains, with 1,036. Queens is the second largest at 997, with the Bronx at 181 and Staten Island at 174. The boroughs of Brooklyn, Queens, and Staten Island have less than a third of the national average of domains, while the Bronx has only one-tenth. Figure 4 is a map showing the distribution of domains among the five boroughs of New York City with a detail of Manhattan divided by postal codes.

Within Manhattan, the geographic location of domain registrations is almost exclusively in the central business district south of Central Park. Several postal codes within the district each hold as many Internet-ready companies as cities such as Indianapolis, Orlando, or Las Vegas. Figure 5 lists the top 10 postal stations by number of domains, along with other U.S. cities with similar domain statistics.

Figure 6 illustrates the number of Internet domains located in the top 10 cities in the United States. New York City has more than twice as many domains as the closest contender, San Francisco. Considered alone, Manhattan has a comparably high density to San Francisco's, as was shown in Figure 3. The only other city with a similarly high density is Fort Lauderdale, but as a center of domains, it is less than 15 percent of Manhattan's size. The high domain density in Fort Lauderdale is most likely due to a practice known as "domain grabbing." The practice occurs when speculators register intuitive or trademarked names with the hope of selling the rights to these names sometime in the future. That the number of websites linked to the city on popular website directories such as Yahoo! falls short of what one would expect, given the domain count, is another indication that Fort Lauderdale's domain dominance is more apparent than real. The evidence indicates that a substantial number of the city's domains are not actively used.

Even considering that Manhattan is a far larger center for employment than for population, it is still a distinctly dense center of Internet activity. Manhattan's 2,447,946 jobs in 1994 correspond to a domain density of 6.18 domains per 1,000 employees, four times the national average. Comparably, San Francisco's 479,155 jobs in 1994 resulted in a density of 15.7 domains per 1,000 employees. However, a higher proportion of city employment in large corporations will deflate domain counts; conversely, cities with a predominance of

FIGURE 4
Internet Domains in New York City
January 1997



Internet Info 1996

small companies will have higher counts because each firm will possess its own domain. It is possible that Manhattan's Internet use figures as reported here may be conservative, since more than half of New York City's employment is from firms with over 100 employees.

Figure 7 shows the commercial domain density in Manhattan and the United States during the period December 1993 to January 1997. Measured against the nation during this time, Manhattan has experienced phenomenal growth in domain density. However, the statistics for April 1996-January 1997 suggest that growth in Manhattan may be leveling off. During this period, commercial domains in Manhattan grew 25 percent, from 10,822 to 13,521, while the nation's domain as a whole grew 34 percent, from 278,300 to 373,000. This trend will likely continue, as the rest of the United States catches up with its leading cities. Still, it is important to note that Manhattan has established itself as a dominant force in the early stages of Internet development and commerce.

FIGURE 5
Top Ten Postal Stations in Manhattan by Domains

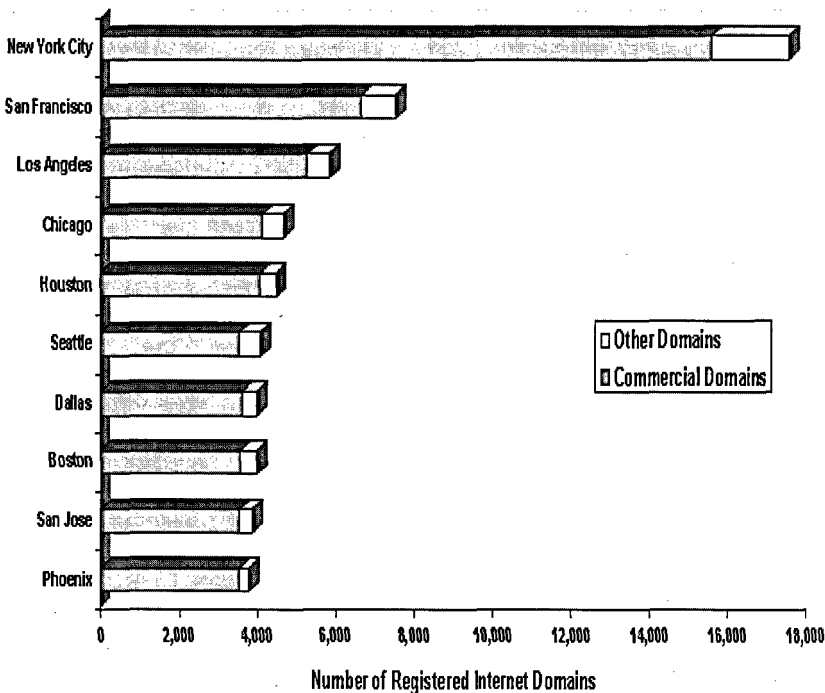
<i>Code</i>	<i>Station</i>	<i>Domains</i>	<i>Comparable City</i>
10019	Radio City	1,111	Colorado Springs
10017	Grand Central	1,068	Orlando
10022	F.D. Roosevelt	1,036	Tucson
10016	Murray Hill	1,003	Tampa
10010	Madison Square	847	Raleigh
10036	Times Square	761	Madison
10012	Prince	760	Madison
10003	Cooper	751	Madison
10011	Old Chelsea	692	Memphis or Tulsa
10001	James A. Farley	679	Charlotte

Source: Imperative! Inc.

Internet Growth and U.S. Cities

The rapid initial growth of domain density in Manhattan is part of a larger phenomenon occurring in many cities in the United States. Figure 8 compares domain density growth between 1994 and 1997 among the 15 cities with the most domains in the United States and between these cities and the rest of the country. Manhattan and San Francisco clearly led the nation in the accumulation of domains,

FIGURE 6
Top Ten U.S. Cities by Internet Domains
January 1997



Source: Imperative! Inc.

followed closely by Atlanta, Miami, Seattle, Boston and Austin. We can conclude that companies using the Internet are far more densely concentrated in these central cities than in outlying areas.

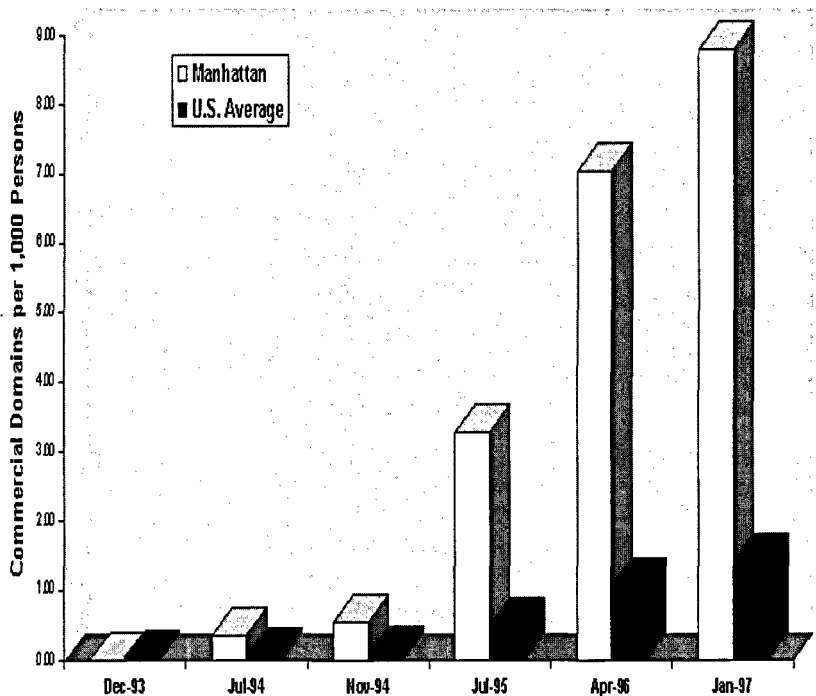
None of these 15 cities grew more slowly than the nation as a whole, and together they absorbed one-fifth of all domain registrations during this period. As a result, they now contain 19.7 percent of all commercial domains in the United States, up from 12.6 percent in April 1994. The highly disproportionate share of growth in these cities demonstrates that Internet growth is not weakening the role of information-intensive cities. In fact, the activities of information-producing cities have been driving the growth of the Internet in the last three years.

Methodological Limits and Constraints

While this study uses Internet domain names as the basic unit of analysis, it is important to recognize the inherent limits to this approach. First, this measurement process does not take into account

an organization's size, or the amount of information that flows through it. *Microsoft.com*'s Internet presence certainly ought to weigh more than *villagetaylor.com*, a small establishment located in SoHo in Manhattan. Also, the geographic data contained in the InterNIC database does not always correspond to the true physical location of each domain's computers or users, but rather to the location of administrative or MIS headquarters. While this fact is increasingly of concern—as geographically dispersed “network corporations” continue to centralize command and control operations—very large corporations may not necessarily register their domain name from their headquarters. In addition, companies are increasingly registering multiple domain names—often those of the company's products, or multiple variations upon the company's name.

FIGURE 7
Domain Density:
Manhattan and the United States
1993 to 1997*



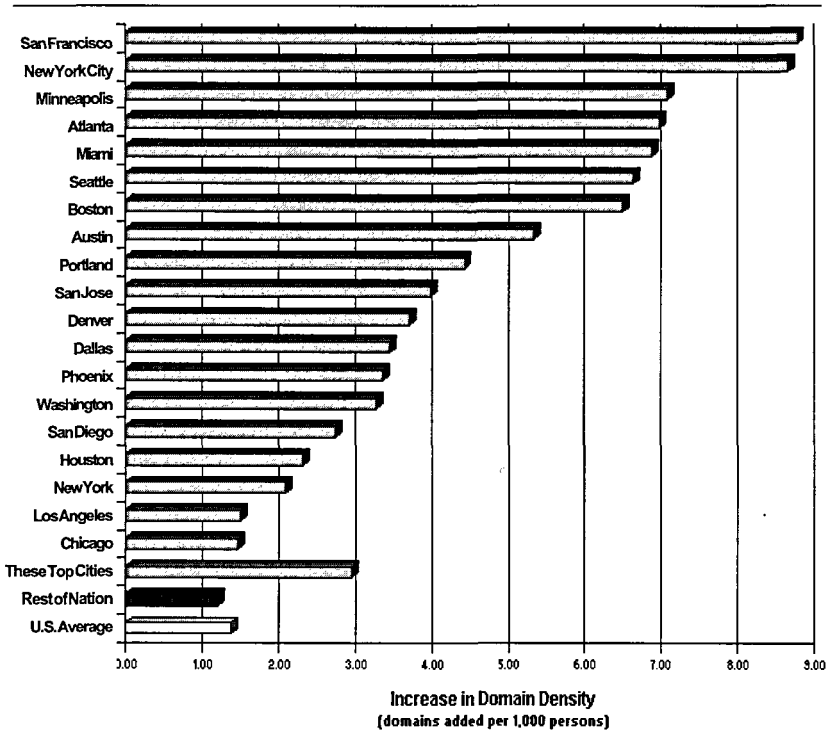
* Includes commercial domains only (.com). July 1995 figures are estimates.

Source: Domain counts provided by Internet Info of Falls Church, VA via the INTERNET-MARKETING listserv archive at <www.popco.com>. 1997 figures from Imperative! Inc.

Most importantly, though, the domain measurement does not convey accurate information about the demand for information provided over the Internet. In future research, we intend to address where Internet users are located. The data indicates that Internet domains are disproportionately concentrated in cities: Are Internet information-consumers also heavily located there? More research is necessary to allow us to determine if the Internet is reinforcing conventional flows of information, fashion, and entertainment *out* of cities, or if it is facilitating new communications *between* or *within* cities. In short, we need to obtain a more comprehensive understanding of the Internet than domain registration, or any other currently available measure, provides.

Despite the limitations of domain registration as a measure, it should be noted that the findings of this study, drawing upon domain counts and growth trends, were within reasonable expectations based on the history of national cyber-culture developments. San Francisco, Austin, Seattle—and, more recently, Manhattan—are major centers for rapid, enormous growth in advanced uses of new information and communications technologies.

FIGURE 8
Domain Density Growth in the 15 Top U.S. Internet Cities
April 1994 to January 1997



Conclusions

This study demonstrates the need for a new approach to the study of cities and communications. The development of new communications systems has allowed those cities that are centers for information-based industries to extend their markets and geographic range via the Internet. Contrary to the prevailing wisdom—that technology threatens urban life—this study suggests that many North American city-based organizations are using telecommunications creatively and aggressively. Consequently, these organizations may be driving the growth of the Internet. Manhattan is a center of urban Internet activity and growth that leads nearly every part of the world for which data is available in both size and density of domain registrations. For the island of Manhattan, the hub of New York's financial, cultural, and media industries, the Internet has emerged as a powerful link to the rest of the globe, a link that rivals the bridges and tunnels that were originally built to connect New York City to the rest of the nation and world.

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