The Internet: Where Does Florida Stand?[1]

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Technology is now among the factors that make a place competitive. State-of-the-art economic development no longer focuses on "chasing" high technology companies, but has given way to building knowledge, networks, and collaboration. Newer, "fourth wave" of policies that have emerged since the mid-1990s now comprise a mix of public-sector policies to integrate local economies into global markets, develop local human capital resources, and increase use of telecommunications as a development tool (Clarke and Gaile 1998).

The argument that a "new economy" has developed is compelling. The Internet has changed how people, firms, and governments go about their daily routines. Yet the existence of a "digital divide" between haves and have-nots is also disturbing. In a series of reports, the US Department of Commerce has documented that the poor and those in rural areas are far more likely to be unconnected to the new economy (NTIA 2000a).[2] A "new geography" also is emerging, with some places taking better advantage of the new economic and technological situation than others (Kotkin 2000). The paper investigates briefly where Florida stands in the Internet economy, primarily using data for 2000. This is followed by a look at some statewide indicators. A third section examines in detail the connections to Florida metropolitan areas on the Internet's "backbone" networks. A fourth discusses interconnection and the two South Florida Internet Exchange (IX) points. The last section looks at several other rankings of Florida's metro areas related to the Internet.

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Statewide Picture

State-level comparisons of "new economy" indicators by the Progressive Policy Institute show that Florida, the 4th-largest state in population, ranks 20th in the US in overall "new economy" indicators (Atkinson et al. 1999). The state ranks better, 12th, in "digital economy" indicators. These include digital government (6th), commercial Internet domain names (12th), technology in schools (21st), and online population (27th). Overall, then, the picture is mixed, and shows Florida well behind several other states. What might lie behind the failure of Florida to surge to the lead in the Internet economy?

In part, Florida's economy is still highly dependent on tourism, retirees, and agriculture, rather than on the high-tech firms of the Internet economy. The Governor's Internet Task Force (itFlorida.com) has a directory of IT firms in the state on the Web site (www.itflorida.com). The number of firms included in the state's four regions (after deleting double listings within a region) are: South, 28; Central, 20; North, 4; Northwest, 8. This directory includes many large companies and firms based outside Florida, such as Microsoft and Novell, as well as listing some firms, such as KPMG LLP, in all four regions and Andersen Consulting (recently renamed Accenture) in three regions. Correcting for multiple listings, the directory includes a mere 54 IT firms in Florida, although because of multiple listings of some firms the total number reaches 60. An active trade group, InternetCoast.com, has coalesced to contradict this image and to capitalize on the advantages of South Florida. A slick web site includes news stories back to mid-1999, and links to nine newspapers and other publications in South Florida. The group's self-description connects with the legacy started when the IBM PC division was established in Boca Raton in the early 1980s:

> The InternetCoast is made up of a collection of Internet companies and organizations operating in Southeast Florida. It is an Internet cluster of businesses, organizations and educational facilities that is now reaching "critical mass" – in the same way that other U.S. technology clusters like Silicon Valley have grown in the past.
>
> Like the Internet itself, the InternetCoast is a grassroots movement being fueled by a natural progression of events in

> Southeast Florida, the original birthplace of the IBM PC (www.internetcoast.com)

The InternetCoast's Research Committee report a year ago shows 5,806 businesses in the three-county region, which would mean "establishments" as derived from the Dun & Bradstreet data base used (InternetCoast.com 2000). By comparison, the organization's directory of firms on its Web site (January 28, 2001) includes 988 firms. Both numbers are impressive evidence of "critical mass" in Internet and information technology companies.

The Geography of Internet Backbones

This section provides a picture of the status of Florida metropolitan areas in their connectivity on Internet backbone networks. The Internet "is a composite of tens of thousands of individually owned and operated networks that are interconnected, providing the user with the illusion that they are a single network" (NRC 2001, p. 3). Backbone networks, known as "autonomous systems," are the core of the Internet and are essential for all but the most local of interactions. Although there is no consensus as to which networks are backbones, the following applies:

> A backbone is a set of paths that (LAN) local area networks connect to for long-distance connection. A backbone employs the highest-speed transmission paths in the network. A backbone can span a large geographic area. The connection points are known as network nodes or telecommunication data switching exchanges (DSEs) (NTIA 2000b).

The original Internet network was hardly more than a back-of-the-envelope sketch of connections among four university nodes in California and Utah (Abbate 1999). As computing and communications technology converged, private networks grew to serve corporate clients. It is the new telecommunications carriers, as well as older telecom firms, whose individual networks make up the present Internet. The competitive environment means that universal service has been replaced by "cherry-picking" and opportunistic behavior by the various backbone networks and other firms as they attempt to tap the demand in the world's largest cities (Graham 1999).

A large number of firms provide long-haul transmission, dominated by WorldCom, Sprint, and Cable & Wireless, which together account for perhaps 55% of the Internet market (TeleGeography 2000: 57). These firms and their competitors have invested heavily to install new fiber optic cables and in new technologies that provide greater bandwidth capacity. Data traffic demands high-speed (high-bandwidth) links to transmit video (especially) at normal speeds.[3] Indeed, it is the digitization of several products, such as music and video, that accounts for much of the growth of data traffic. Exactly how much traffic is not known; Coffman and Odlyzko (2001) suggest that we simply do not have comprehensive data on flows, yet best estimates confirm that traffic is probably doubling each year. Anticipating this future traffic, a great deal of new fiber-optic capacity is being installed throughout the US, much of it "dark" fiber – fiber-optic cable which has not yet been "lit" by the optoelectronic equipment that facilitates transmission of data. Indeed, several firms in the electricity, pipeline, and railroad sectors install such fiber along their rights-of-way. In Florida, such firms include FPLFiberNet and GRUNet among utilities, Williams and Enron among pipeline companies, and EPIK (a subsidiary of Florida East Coast Industries) among railroads.

Technological change also has permitted massive increases in bandwidth, the speed at which data can be transmitted through the cable. Enormous investment in Internet backbone capacity has *also* occurred between 1998 and 2000 in the US. In early 1998, only two of 38 national backbones offered bandwidth at OC-48 (2488 Mbps or 2.488 Gbps). By mid-2000, fully 17 of 41 backbone networks (41%) had installed capacity at bandwidths of 2488 Mbps or faster. Such bandwidths easily overwhelm networks of the slower capacity: a single OC-48 cable has the same bandwidth as 55 of the older DS-3 capacity. The current standard is OC-192, which moves data at speeds of nearly 10 gigabits per second, and work is underway to implement OC-768 in the near future.

At the national scale, Moss and Townsend (2000) compared the intermetropolitan Internet backbone capacity in the USA in 1997 and 1999. The 1997 data included 29 networks; there were 39 by the Spring of 1999. They found that a "core group of seven metropolitan areas (San Francisco/San Jose, Washington DC, Chicago, New York, Dallas, Los Angeles, and Atlanta) had maintained their dominance as the central nodes of the Internet in the United

States" (Moss and Townsend 2000: 41). They also found that a group of metro areas in the central part of the country had become "hubs for new, large network links" (ibid.). Third, they found that the principal global cities in the country – New York, Chicago, and Los Angeles – were relatively weak in backbone links. Similarly, Boston and Seattle, well-known for their technology-based firms, ranked below Atlanta and Dallas – largely because of the geographically central locations of the latter.

Using data from the annual *Boardwatch Directory of Internet Service Providers*, as Moss and Townsend's research did, and supplemented by maps on the Webs sites of many of those networks whose maps had greater detail, data were compiled for all links of 41 networks in mid-2000. Nationwide, the leading group of seven metro areas from Moss and Townsend's work remains intact.

Table 1 shows the total bandwidth that connects Florida metropolitan areas on Internet backbones. If a city is included on a backbone map, its bandwidth and the cities with which it is linked were recorded. Orlando emerges as the leading city, followed closely by Miami-Fort Lauderdale.[4] Perhaps more surprising is the standing of Tallahassee and rural Lake City. These cities are major hubs on several high-bandwidth networks as they extend south to other cities in Florida.

Table 2 confirms the concentration of bandwidth in Tallahassee and Lake City, but also in Orlando, Naples, and Jacksonville – all of which have more bandwidth per 1000 population than the average of all US metropolitan areas. However, Tampa-St. Petersburg and Miami-Fort Lauderdale are below average, as are most metro areas in the state. This situation is relatively significant, since 23 metro areas in the country have more bandwidth than the US metro average, including Salt Lake City (68.7 Mbps/1000 population) and Kansas City (50.8), but also, in the South: Atlanta (38.7), Dallas (37.4), Birmingham (28.9), Austin (28.7), New Orleans (25.1), and Charlotte (25.0).

Table 3 provides a historical perspective, comparing the results in Gorman's (1998) study of Internet backbones with those of this study, which used a similar methodology. Orlando is the only large Florida city that has risen in its national ranking between the two years. The relatively small bandwidth numbers for 1998 reflect the fact that few backbone networks provided even 155 Mbps (OC-3) at the time; 45 Mbps (DS-3) was more common.

Table 1
Florida Cities Linked by Internet Backbones, 2000

Metropolitan Area	Total Backbone Bandwidth (Mbps)	National Rank
Orlando	45,528	20
Miami-Fort Lauderdale	42,138	22
Tampa-St. Petersburg-Clearwater	30,310	30
Jacksonville	23,952	37
Tallahassee	17,684	44
Lake City*	10,331	63
West Palm Beach-Boca Raton	6,111	78
Daytona Beach	5,466	87
Melbourne-Titusville-Palm Bay	5,466	87
Naples	5,244	98
Pensacola	5,155	103
Fort Pierce-Port St. Lucie	4,976	110
Gainesville	356	126
Ocala	311	130
Sarasota-Bradenton	134	140
Fort Myers-Cape Coral	89	143
Fort Walton Beach	89	144

* Lake City, although not a metro area, is a listed hub on several national backbone networks.

Source: Compiled from data in *Boardwatch Magazine's Directory of Internet Service Providers* , 12th edition, 2000, and company Web sites.

Table 4 illuminates further what makes up total backbone bandwidth for any city: the number of backbone networks that pass through it and include it as a hub and, more importantly, the number of high-bandwidth links. Although only third among Florida cities in the number of backbone networks, Orlando ranks first in total bandwidth largely because 10 of those networks link the city with high-bandwidth links – 2.488 Mbps of higher. Indeed, Table 4 demonstrates that the number of high-bandwidth links largely determines the ranking with respect to total bandwidth. A great deal of new, even high-bandwidth capacity is being installed in Florida, some of it lit since the data were gathered in mid-2000. Much of this bandwidth has been installed by ***so-called*** "carriers'

Table 2
Backbone Bandwidth per 1000 Population in Florida Cities and Metro Areas, 2000

Metropolitan Area	Total Backbone Bandwidth/ 1000 Population
Lake City*	192.3
Tallahassee	68.0
Orlando	29.7
Naples	25.3
Jacksonville	22.7
US metro average	**18.4**
Fort Pierce-Port St. Lucie	16.6
Tampa-St. Petersburg-Clearwater	13.3
Pensacola	12.8
Melbourne-Titusville-Palm Bay	11.6
Daytona Beach	11.5
Miami-Fort Lauderdale	11.4
West Palm Beach	5.8
Gainesville	1.8
Ocala	1.3
Fort Walton Beach	0.5
Sarasota-Bradenton	0.2
Fort Myers-Cape Coral	0.2

* Lake City, although not a metro area, is a listed hub on several national backbone networks.

Source: Compiled from data in *Boardwatch Magazine's Directory of Internet Service Providers*, 12th edition, 2000, and company Web sites.

carriers," such as EPIK, Enron, and Williams, which lease their bandwidth to other firms, rather than by backbone network providers. Additional research – and greater data availability on the part of providers in Florida – is needed to determine the comprehensive status of Internet connectivity in the state.

To provide a national perspective on the data reported in Table 4, both Chicago and New York have over 50 links of 2.488 Mbps or more connecting them to other cities, and Dallas-Forth Worth, San Francisco, and Washington have over 40 such links. Indeed, these five metro areas, as well as Kansas City and Salt Lake City, have a larger number of high-bandwidth (2.488 Mbps) links than the

Table 3
Shifts among Florida Cities in Internet Backbone Links, 1998-2000

	2000		1998	
Metro Area	Total Backbone Bandwidth (Mbps)	National Rank	Total Backbone Bandwidth (Mbps)	National Rank
Orlando	45,528	20	990	24
Miami-Fort Lauderdale	42,138	22	1,575	19
Tampa-St. Petersburg	30,310	30	810	26
Jacksonville	23,952	37	855	25

Source: Data for 2000 compiled from data in *Boardwatch Magazine's Directory of Internet Service Providers* , 12th edition, 2000, and company Web sites; data for 1998 from Gorman (1998).

number of networks linking them, indicating both a high degree of redundancy and a high level of recent investment.

Data traffic between pairs of cities or metro areas travels along specific routes, much like segments of the Interstate highway system. In general, the routes in the US with the highest concentrations of backbone networks and of high-bandwidth links are located outside Florida. The top three inter-city links in the US are Washington-New York (55,059 Mbps), Los Angeles-San Francisco (44,636 Mbps), and Boston-New York (44,281). The Miami-Orlando route, with 15,709 Mbps, is the 21st-largest link in the US Internet, and the Orlando-Atlanta route ranks 31st nationally in total backbone bandwidth.

Network redundancy is a high priority for firms that rely on the Internet. Having alternative networks assures an Internet Service Provider (ISP), for example, that its links to the Internet are not severed if one network is temporarily "down." Large firms, such as banks, also utilize redundant paths to the Internet for similar reasons. Table 5 shows that multiple, redundant backbone networks are available primarily in the four major metro areas. Miami, Tampa, and Orlando are all linked to 12 or more cities, and by an average of about three links to each. Miami is the best-linked metro area in the state, with an average of 3.9 links per city. However, the high-bandwidth connections that pass through Fort

Table 4
Internet Backbones Links and Broadband Links to Florida Cities, 2000

Metro Area	Total Backbone Bandwidth (Mbps)	Number of Backbone Networks (out of 41)	Number of Backbone Links of OC-48 (2.488 Mbps) or greater
Orlando	45,528	19	10
Miami-Fort Lauderdale	42,138	26	9
Tampa-St. Petersburg	30,310	20	7
Jacksonville	23,952	14	5
Tallahassee	17,684	4	5
Lake City	10,331	3	4
West Palm Beach-Boca Raton	6,111	6	2
Daytona Beach	5,466	4	2
Melbourne	5,466	4	2
Naples	5,244	4	2
Pensacola	5,155	3	2
Fort Pierce	4,976	2	2
Gainesville	356	1	0
Ocala	311	1	0
Sarasota-Bradenton	134	1	0

Source: Compiled from data in *Boardwatch Magazine's Directory of Internet Service Providers* , 12th edition, 2000, and company Web sites.

Pierce, Tallahassee, and Lake City provide those three cities with the highest average levels of bandwidth per link – all at gigabit per second speeds. Among the major metro areas in Florida, Orlando again is the best linked, with 892.7 Mbps per link to other cities.

The standing of Florida's cities on Internet backbones largely reflects network geography. As a peninsula, Florida is not on the way to anywhere, except perhaps the Latin American market. Bandwidth to Latin America is very small in comparison to that connecting the US to Europe and to Asia (TeleGeography 2000). If Internet use in Latin America grows significantly, Florida's bandwidth will increase as hubs in Florida become intermediate stops to Central and South America. This is the goal of the NAP of the Americas, which aims to become the Internet equivalent of Miami

Table 5
Florida Cities Linked by Internet Backbones, 2000: Details of Links

Metro Area	Number of Cities Linked	Number of Links	Average Number of Links per City	Average Bandwidth per Link
Orlando	15	51	3.4	892.7
Miami-Fort Lauderdale	15	58	3.9	726.5
Tampa-St. Petersburg	12	43	3.6	704.9
Jacksonville	12	35	2.9	684.3
Tallahassee	7	11	1.6	1607.7
Lake City	5	10	2.0	1033.1
West Palm Beach	7	14	2.0	436.5
Daytona Beach	4	8	2.0	683.2
Melbourne	4	8	2.0	683.2
Naples	4	8	2.0	655.6
Pensacola	3	6	2.0	859.2
Fort Pierce	2	2	1.0	2,488.0
Gainesville	3	3	1.0	118.6
Ocala	2	2	1.0	155.5
Sarasota	3	3	1.0	44.7
Fort Myers	2	2	1.0	44.7
Fort Walton Beach	2	2	1.0	44.7

Source: Compiled from data in *Boardwatch Magazine's Directory of Internet Service Providers* , 12th edition, 2000, and company Web sites.

International Airport, which serves as a hub for the entire Latin American region.

Urban areas located in the central region of the USA, such as Dallas-Fort Worth, that serve as intermediate hubs in the transcontinental routes, are the best connected with high-bandwidth links. Florida cities are not alone in this geographical impact. Well below-average bandwidth/population ratios also are seen in the largest eastern cities: Boston, Philadelphia, and New York; in the western cities of Phoenix and San Diego; and in the manufacturing-belt cities of Detroit and Pittsburgh. In Florida, Orlando, as an intermediate hub connecting both Tampa and Miami, and the crossroads for east coast and west coast routes, is far better connected with bandwidth despite its relatively small size.

The itFlorida *1999 Annual Report to the Legislature* provides a few generalities but no detailed data on backbone connections in the state. It notes that seven networks have high-bandwidth (OC-48 or OC-192) networks in Florida "so that access to redundant fiber should not be a major issue" (p. 94). The report then continues: "The IP networks in Florida are of more concern. Several major IP backbones have limited presence in Florida" – proceeding to cite most of the high-bandwidth networks just listed (itFlorida 2000). In fact, the picture is more uneven, and there is real cause for concern for Miami's standing as an Internet hub if new bandwidth is not installed at a pace that keeps up with the other two dozen major Internet hubs in the US.

Florida Bandwidth Not Accounted for in Backbones

The bandwidth figures reported here do not account for all the bandwidth in the state. Several categories are excluded:

- BellSouth's and Genuity's local networks within Florida, which connect the national backbones to local users in Florida communities
- Internet2 links that connect Florida's universities to the very high-speed Abilene backbone
- Bandwidth that belongs to carriers' carriers, such as national players Enron and Williams and regional providers such as FPLFiberNet and EPIK Communications. These firms primarily lease bandwidth to other firms.
- Local networks, such as Gainesville Regional Utilities' subsidiary GRUCom, which serves as the primary link from the University of Florida to the Internet
- Metropolitan area networks, or MANs, that link sites within metropolitan areas
- Networks still under construction, such as the Florida Fiber Network

All of these categories add considerable, but unknown amounts of, bandwidth to locations within Florida. However, providers of most of these networks make available only scanty data on their networks. Some provide a great deal of detail; others very little. In nearly all cases, these networks function by leasing and trading bandwidth with other, often national carriers whose networks are included in the totals reported in this paper. The advantage of the

Boardwatch data used here is the consistent format, including detail on bandwidth on each network link.

The InternetCoast and Network Access Points

The InternetCoast Research Committee report (2000) highlighted the need for South Florida to establish a network access point (NAP) where interconnection between Internet backbones would be facilitated. This proposal also was highlighted in itFlorida's (2000) report.

In fact, many interconnection or Internet exchange (IX) points now exist around the world, most of which are privately operated and increasingly "carrier-neutral" or facilitating access to many backbone networks. The call for a South Florida NAP was more successful than anticipated, and has resulted in two potentially competing IX points. The NAP of the Americas opened in July 2001 in downtown Miami and BellSouth has built a four-location all-optical Florida Multimedia Internet Exchange (FloridaMIX).

The NAP of the Americas is the more successful of the two, as measured in the number of members (63) and the number of backbone networks (9). The networks that are considered backbones here include: 360networks, AT&T, Broadwing, Cable & Wireless, Enron, Global Crossing, Level3, NetRail, Williams, and XO, as well as several Latin American and European firms. Not all of those are in the analysis above; Enron and Williams are carriers' carriers, wholesaling their bandwidth to others, as do EPIK and other regional firms. The FloridaMIX has 17 participants, among them backbone providers Exodus, NetRail, Qwest, and UUNET, along with Diveo, a firm that is focusing on the Latin American market and that is one of the few companies in both NAPs. It is apparent that US firms were forced to choose with which NAP to be associated, since no network, with the exception of Diveo, is included in both.

If high-bandwidth connections reach Latin America in the next few years, they almost certainly will be connected through one or both of the South Florida IX points. There may well be room for two IX points in the region; Washington and San Francisco have at least three each, in addition to several data centers where private interconnection occurs. Several of the 55 IX points in TeleGeography's current list (www.telegeography.com) are in multiple-IX cities, such as Atlanta, Chicago, New York, San Jose, and Washington. Whether Miami has the demand or the Internet

traffic to support both will soon be known.

In Internet data centers and co-location facilities, which is what the NAP of the Americas also advertises itself as, Florida cities are mid-range in importance at best. Miami and Orlando fall in a third tier of locations for these facilities, behind both the top tier that includes Los Angeles, New York, San Francisco, and Washington and a second tier comprised of Boston, Chicago, Atlanta, Dallas-Fort Worth, and Seattle. Orlando and Miami share this third tier with Philadelphia and Portland. Further research as well as the dynamic growth of the colocation-data center sector suggest that the situation may change, but it is unlikely that either Florida city will rise to the upper tier of Internet hubs. Some firms in the "telecom hotel" or data center-colocation industry are Florida-based, including one of the first, Switch and Data Facilities, based in Tampa, and Terremark Worldwide, the developer of the NAP of the Americas, based in Miami.

Most Wired

A final perspective from which to see where Florida stands in the Internet economy is the occasional compilations of "wired" places. *Yahoo! Internet Life*, for example, compiles an annual list of the 50 "most wired" cities and towns. The rankings are a composite of *five* indicators: (1)home and work net use; (2) domain density; (3) hosts per capita; (4) directory density; and (5) content quality.

A comparison of these rankings for the years 1998, 1999, and 2000 shows that several Florida metro areas have appeared in the US top 50 (Table 6). The Yahoo! rankings mirror closely the results concerning Internet bandwidth data mentioned earlier. Miami has fallen from 10th in 1998 to 28th in 1999 to 35th in 2000. Orlando, not included in 1998's top 50, was 33rd in 1999, and rose to 19th in 2000. Like Miami, Tampa-St. Petersburg has fallen steadily throughout the three years. Jacksonville, in fact, fell out of the rankings in 2000, after falling from 29th in 1998 to 47th in 1999. The emergence of Fort Lauderdale as 42nd in 2000 could, if it were combined with Miami as it is in the Census Bureau's CMSA, enhance the region's standing. West Palm Beach-Boca Raton has appeared, ranked a steady 45th, in both 1999 and 2000.

Detailed data for Yahoo!'s 2000 rankings provide more detail. The only city to crack the top 10 on any criterion is Miami, which ranks 7th in domain density. This is likely due to the fact that the

Table 6
Rankings of Florida Cities in Yahoo!'s "Most Wired" Lists

City (Metro Area)	1998	1999	2000
Miami	10	28	35
Orlando	–	33	19
Fort Lauderdale	–	–	42
West Palm Beach-Boca Raton	–	45	45
Tampa-St. Petersburg-Clearwater	29*	37	49
Jacksonville	29	47	–

* Tampa only

Source: *Yahoo! Internet Life* (1998, 1999, 2000).

Web sites of the Latin American divisions of companies that use Miami as their headquarters for the region are hosted in Miami. Zook (2000) corroborates Miami's status as a domain name hub. He found the Miami-Fort Lauderdale Consolidated Metropolitan Statistical Area (CMSA) ranked 9th in the US in number of commercial (.com) domain names in 1998. The leading metro areas include the big seven of Moss and Townsend's research: New York, San Francisco, Los Angeles, Chicago, Boston, Washington, and Dallas-Fort Worth, as well as Philadelphia. Miami placed ahead of Atlanta, Denver, and Seattle in Zook's study.

An alternative list is internet.com's CyberAtlas, which reports Nielson//Net Ratings' rankings of the top 20 markets. Tampa ranks 13th and Miami 19th among the top 20 markets based on Internet penetration (internet.com 2000). Other Florida cities were not ranked by Nielson//Net Ratings.

Web Design Firms

There is no comprehensive directory of firms in the Internet economy. The Design Survey of 167 Web design firms in the September 1, 2000, issue of *Internet World* provides one snapshot. Six Florida firms appear among the 167 companies that took part in the online survey: of these, 3 were in Boca Raton, 1 in St. Petersburg, 1 in Deerfield Beach, and 1 in Vero Beach. A larger directory is that maintained by *The Industry Standard*, one of the major providers of "intelligence for the Internet economy." A tally of the 838 Web Development firms (the net number after eliminating 17

that were double-listed) in its Company Directory (716 in the US) yielded 33 firms, including a cluster of 10 firms in Miami.[5] The Miami-Fort Lauderdale metro area has 16 of the state's 33 Web development firms, to which one could add the 3 in Boca Raton.

Tracing data paths in the Internet

Traceroutes provide a simple means to identify the routes taken by Internet traffic between two points. A few examples illustrate the actual geography traveled by Internet data – seemingly within the state of Florida:

- A trace from my home in Gainesville to either the University of Miami (www.miami.edu) or Florida International University in Miami (www.fiu.edu) on BellSouth's ADSL service travels to Orlando on UUNET's backbone, then to Atlanta, to travel to Miami – all on UUNET. The same route is taken to a commercial site in Miami: www.NAPoftheAmericas.com.
- A trace to www.fsu.edu in Tallahassee travels via UUNET from Gainesville to Orlando to Atlanta to Jacksonville to Tallahassee.
- A trace to www.usf.edu in Tampa also travels to Orlando and Atlanta on UUNET, changing there to the Sprint backbone to return to Orlando and on to Tampa.
- The route from Gainesville to www.internetcoast.com and www.itFlorida.com, both in Boca Raton, travels from Gainesville to Orlando, to Atlanta, to Washington DC, where it shifts to the Verio backbone, passing back through Atlanta to Boca Raton.

The same paths – to Atlanta or Dallas – are taken by data packets traced from Davie, FL. Redundant networks allow different paths to be taken but, again, circuitous routes are the norm:

- Paths to UF and FSU travel to Atlanta and Jacksonville on their way to Gainesville and Tallahassee.
- A trace from Davie to www.itFlorida.com in nearby Boca Raton travel to Washington, DC, the nearest location where UUNET and Verio interconnect.
- A trace to www.internetcoast.com, also in Boca Raton, traveled on the Level3 network to Dallas, interconnecting with Verio's network, returning to Boca via Houston and New Orleans.

Neither South Florida NAP at present includes Verio, suggesting that these long-distance routes to facilitate interconnection (or peering) will continue.

Conclusion

It remains the case that Florida is, at best, a second-tier state in Internet backbones as well as in other indicators of "wiredness" or digitization. For large businesses, the presence of several, redundant backbones in Florida's large cities is, as the itFlorida report suggests, "not a major issue." However, in general, small businesses are not targeted by the companies that provide connection to those backbones.

In cities with low bandwidth passing through, web development and other bandwidth-intensive businesses are less likely to succeed. It is noteworthy, for example, that Tallahassee appears among Florida's cities as a web development center, corresponding with its commercial backbone bandwidth, while Gainesville does not. Although the University of Florida is a major hub, a GigaPoP, on Internet2, Gainesville businesses cannot take advantage of this network. Indeed, the university makes access to this network available to faculty, staff, and students from their homes. Businesses and others not affiliated with the university do not have this advantage.

Most of Florida may not have the high-bandwidth backbone connections to permit state-of-the-art work on Internet applications. The major metropolitan areas in Florida, not linked with the number of high-bandwidth backbone links of other US cities, are, with the exception of Orlando, falling behind as high-capacity links are installed elsewhere in the country. Orlando and Miami-Fort Lauderdale are certain to remain important hubs on the Internet, Tampa-St. Petersburg and Jacksonville somewhat lesser hubs.

In general, the new information and communication technologies per se do not make local and regional milieus dynamic; rather, more dynamic milieus "are better able to use new technologies to their advantage than are less dynamic ones" (Gilbert and Villeneuve 1999: 115). Florida and its cities must continue to keep up their efforts to compete with other places in a competitive environment that includes investment in Internet backbone networks and data centers as well as traditional forms of investment.

Notes

[1]This research has been supported by the National Science Foundation and by the University of Florida's Center for International Business Education and Research (CIBER).
[2]The Digital Divide Web site (www.digitaldivide.gov) provides a wealth of information and full reports, including the series by the National Telecommunications and Information Administration (NTIA).
[3]Bandwidth is the term commonly used to designate transmission speed, measured in bits per second. A simple "rule of thumb is that good video requires about a thousand times as much bandwidth as speech. A picture is truly worth a thousand words" (Mitchell 1995: 180, note 28). *Broadband* generally refers to transmission speeds above 64kbps, the base normal speed of a voice call. Higher bandwidths generally are made possible by multiplexing the base line.
[4]The convention here, as in most such research, is to use the official Metropolitan Statistical Areas (MSAs) and their combination into Consolidated MSAs (CMSAs) when so defined. For the current definitions, see http://www.census.gov/population/www/estimates/metrodef.html.
[5]Only one Florida firm appears in both lists, illustrating both the ephemeral nature of such directories and the turbulence of the industry.

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