An economic map of the Internet

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ABSTRACT:

The term "Internet industry" encompasses a broad spectrum of economic activity. A relatively simple action like downloading a web page might involve, among other parties, one or more backbone providers, one or more ISPs, various web hosting companies, application service providers, content delivery networks, content providers, and advertising agencies. Assessing the relationships among the various providers without a guide can be tricky.

This paper presents a framework for studying the Internet industry value chain. Its purpose is to map how dollars flow on the net. The Internet dollar flows map provides a tool and a context for discussing industry economics and policy. For example, where does the consumer's ISP dollar go? Given the cost structures of Internet service, are pure-play ISPs likely to capture enough value to compete with vertically integrated providers? What are the prospects for unaffiliated ISPs providing access over cable television networks, or for CLECs providing access over ILEC facilities? How much of the consumer's access dollar trickles down to the core of the network? Or, working backwards, how might enhanced services in the core of the network (like QoS-guaranteed levels of service) affect access charges?

The economic map of the Internet shows estimates of the current revenues for various industry segments, as well as showing something of the complex structural relationships among the branches. To interpret the map, remember that, just like data, dollars flow into the Internet from the edges. Money enters from consumer and business ISP fees as well as from advertisers and through e-commerce and pay-for-content sites. The ISPs, hosting and e-commerce companies skim off their margins, then pass money to other firms in the value web. Eventually, money makes its way down to the backbone providers at the heart of the Internet.

The paper begins with a discussion of the map. Data gathered from financial reports and dot-com post-mortems provide details on industry revenues and the expenses and capital expenditures required to sustain them. To illustrate how a map of Internet dollar flows could be applied to policy analysis, the paper includes a case studies of the dollar flows through Internet access providers operating over competing technologies.

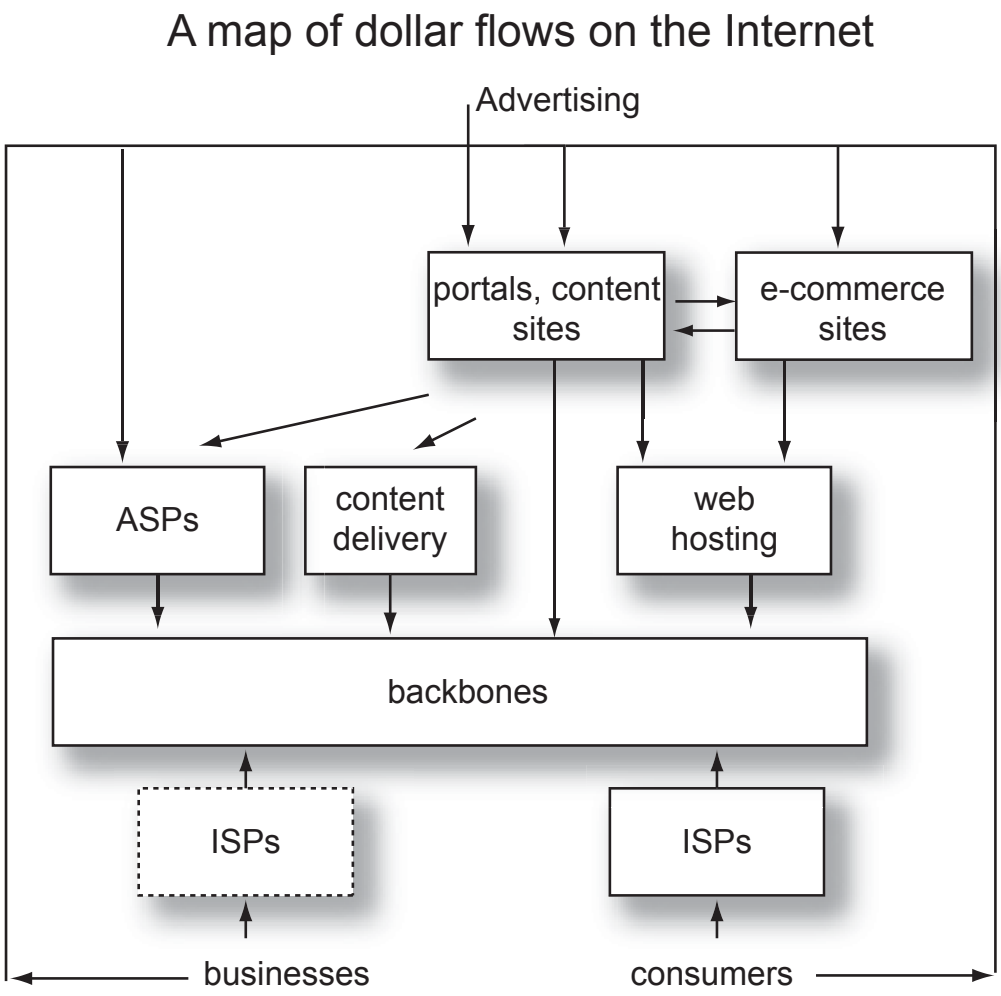
Mapping the Internet

Readers may be familiar with the Internet data path maps produced by Telegeography, Inc. and the Cooperative Association for Internet Data Analysis (CAIDA.) Telegeography's maps (http://www.telegeography.com/) are conventional geographic maps on which are superimposed lines showing backbone connections among various geographic po. Telegeography maps, for example, show how much Internet capacity there is between North America and Europe, or between Australia and North America. CAIDA, at the University of San Diego's Supercomputer Center, focuses on connectivity and geographic location in its maps. (http:// www.caida.org/) CAIDA plots autonomous systems—basically, ISP or organization networks—on a polar plot. The angle to each plotted network is the longitude of the headquarters for the network, as listed in domain registration databases, and the distance from the center of the plot is a measure of the number of number of neighboring networks that accept traffic for that network, a measure of the number of peering arrangements in which the network administrators have entered.

But what if we're interested in how money flows around the Internet? What if we want to follow the money, and find out who pays whom how much for what services? The Internet industry map presented here is not a geographic, "where do the bits flow?" map, but an economic, "where do the dollars flow?" map. The map is limited to the United States, where a large share of Internet traffic flows, and where it is relatively easy to collect information from industry researchers and financial reports.

The Internet economy map is inspired in part by input-output economic models. In input-output models, the output of one sector is considered as one of the inputs to another sector, the outputs of which serve as inputs for other sectors. As the input-output model was originally conceived in the eighteenth century, and developed in the twentieth century, input-output modeling applied to the economy as a whole. In the present application, there will be no attempt yet to capture all of the ways in which Internet economic activity leaks out into other sectors of the economy. Nonetheless, the fundamental concept of treating segments of the economy as elements in value chains does apply to this simple model.

Figure 1. An economic map of the Internet



It is relatively easy to gather information on the size of individual Internet industry segments. Market research firms regularly publish reports that estimate the size of the backbone market, or the ASP market, or other parts of the Internet. Determining the disposition of revenues in any given sector, however, is not easy. Firms tend to treat the mixture of inputs they use as proprietary information. While financial filings may include clues to the portion of revenues spent on various inputs to a service, they are no substitute to have a look at the real books. Some firms are more forthcoming with details about their expenses than others, but there is no reason to believe that companies that

spell out their expenses are representative of a sector. Indeed, some of the most candid reports about a company's expenses can be found in bankruptcy filings, and it would be risky to generalize from the expense structure of bankrupt firms to that of healthy, ongoing companies.

Another question we will address will be the long-term viability of the Internet backbone industry. In particular, we will look at the amount of money that trickles down to the core of the network from economic activity at higher levels.

Measuring the Internet Economy

The Center for Research in Electronic Commerce at the University of Texas produced a series of indicators of the Internet economy through 2001. The CREC reports are available at http://www.internetindicators.com/.

The CREC divided the Internet economy into four "layers":

- Internet infrastructure: including telecommunications companies, Internet backbone providers, Internet service providers (ISPs) and other last-mile access providers, as well as manufactures of CPE.
- Internet applications infrastructure: principally, software required for Internet services, but also consulting and service companies hired to build web sites.
- Internet intermediary: economic activity at the intermediary level includes service provided by auction and aggregation providers—companies that package or provide a forum for economic activity, though they may not be involved in the activity itself.
- Internet commerce: finally, the commerce layer includes companies that are engaged in sales and transactions over the Internet.

Characterizing the CREC categories as layers may be stretching the analogy with network engineering layers, in that both the intermediary and commerce layers may provide top-level 'applications' to consumers. In that sense, they might be considered to be parallel alternatives. Sometimes the intermediary layer is the only layer between the applications infrastructure layer and the consumer. Sometimes another layer intervenes.

According to the CREC, the aggregate size of the Internet economy as of 2001 was $800 billion, up from $525 billion in 1999 and $323 billion in 1998. These numbers are substantially larger than those that we will see below, because the CREC measures include the software and hardware industries on which the Internet industries all rely. In this paper, the software and hardware substrates will not be included in calculations of the money flowing through the Internet services sectors.

So the stack metaphor does not entirely capture the structure of economic relations among higher levels of the Internet industry. Vertical integration in the industry also makes the layering difficult to follow too closely.

Instead, consider the map of services provided on the Internet shown in figure 1. Each of the blocks represents a distinct type of service provided on the Internet. The arrows between the blocks represent dependencies among the services. Ignore, for the moment, the possibility that firms may be active in more than one segment of the Internet industry. In that case, a consumer ISP would rely upon the services of a backbone network operator to provide connectivity to the rest of the Internet.

Three Pillars of Internet Revenue

There are three sources of revenue for Internet service providers that show the most promise for sustaining the development of the sector: user-supported services, advertising revenues, and transactions. To varying degrees, all Internet business models rely on one or more of these three categories of revenues. The expectation by many early adopters of the Internet that all content should be free was a driver of, and a response to, the heavy emphasis on advertising revenue in many early Web site business plans. As we shall see, the early Internet advertising market was not capable of supporting all of the businesses expecting to cover expenses through advertising. The failure of conventional "measured" advertising—that is, advertising sold on a per-view basis, in which larger audiences would fetch proportionally higher advertising fees—does not mean that advertising is not viable as a long run component of Internet business revenues. The early Internet market was dogged by high overhead for the small audiences reached, and the non-linear pricing of most advertising, in which larger audiences attract a higher, per-viewer price than

smaller audiences, meant that the highly fragmented Internet ad market was condemned to very low rates. To make matters worse, advertisers raised questions about the effectiveness of Internet advertising, though, unfairly, the same question is rarely raised about advertising in other media.

User-supported service revenues for the Internet include monthly Internet access fees and fees for services or content delivered over the Internet. For the services and goods categories, user-supported revenues include both subscription and 'pay-per-view' or 'pay-per-download' payments.

Finally, revenues from transactions may accrue to retailers selling on the web or to intermediaries who are compensated for referrals or through affiliate programs. In either case, it is necessary to distinguish between the value of goods and services sold over the Internet and the amount of the proceeds from sales that go to support the Internet infrastructure.

At the conclusion of the paper, we will return to these three categories of revenue to ask what contribution each is currently making to the maintenance of the Internet's core infrastructure. With the help of a few data points from companies engaged in various sectors of the Internet economy, it is possible to generate estimates of the contribution of advertising, subscriptions, and transactions to the Internet backbone.

Advertising expenditures vs. revenues

One theory describing the Internet bubble of the late 1990's claims that the influx of venture capital pumped up the revenues of dot-coms. Investments by venture capitalists into a particular segment of the Internet industry shouldn't affect the revenues of that sector, but since a company may spend its capital on inputs, venture capital may find its way into the revenues of other segments of the industry. (And in some cases, such as advertising, venture capital could conceivably have generated larger than expected revenues through a multiplier effect. Your dot-com might spend $1 of venture capital funds on advertising on my site, then I might buy $0.80 of advertising on your site, then you might buy $0.64 of advertising on my site, and so forth, eventually yielding a total of

$5 advertising spending for 1 dollar of seed money.) As we will see, however, though the volume of venture capital flowing into the Internet sector was substantial, it was probably not large enough to account for more than a small fraction of dot-com revenues.

Judging by the numbers on advertising expenditures versus company revenues, a large number of dot-com businesses expected that they would be able to build brand equity through advertising.[1] Such a strategy explains the profligate spending on such advertising fora as the Super Bowl or NCAA championships.

The following figure illustrates the worst cases from a study of dot-com advertising budgets presented in Ad Age magazine in May, 2001. The chart shows, on a logarithmic scale, the number of dollars spent on sales & marketing by a number of dot-coms in a variety of e-commerce industry segments. Each industry category is shown in a different color. To read the chart, note that the value on the left side of the chart represents the number of dollars spent on sales and marketing per dollar of revenue. Those companies that are above the "1" line were spending more than one dollar on sales and marketing for every dollar of revenue; those below the line were spending (sensibly) less than one dollar on sales and marketing per dollar of sales. By way of comparison, brick and mortar retailers tend to spend in the $.15 to $.40 range on sales and marketing for each dollar of sales. Note that the most spendthrift company here was spending in the neighborhood of $20 on marketing and sales for every dollar of revenue. This is, obviously, not a sustainable strategy. The most egregious spender here, eStamp, not surprisingly, did not last long.

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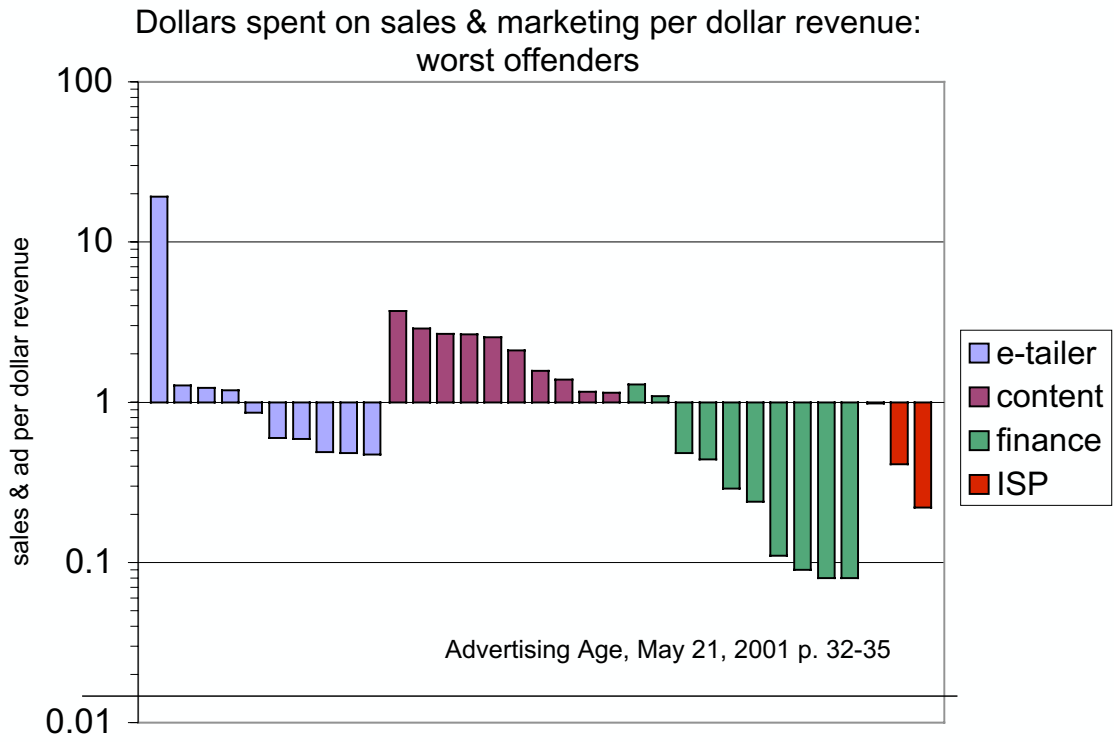
[1] For an argument that advertising cannot build brands, see the recent book by Al and Laura Ries, featuring a run-over Pets.com sock puppet on the cover. Ries and Ries (2002)

Figure 2. Marketing and sales expenditures per dollar of revenue



The Internet venture capital boom

Given the previous review of the size of the various Internet industry segments, it is possible to put the Internet venture capital boom in perspective. Figure 3 illustrates the quarterly volume of venture capital directed to Internet-related companies, and the share of those contributions in the entire venture capital, from 1995 through mid-2002. (Data are from the PriceWaterhouseCoopers MoneyTree report.[2]) On an annual basis, total VC directed at Internet-related businesses is shown in figure 4.

[2] Data from the report is available in PriceWaterhouseCoopers (2002).

Figure 3. Venture capital funding, quarterly, and as percent of total VC funding

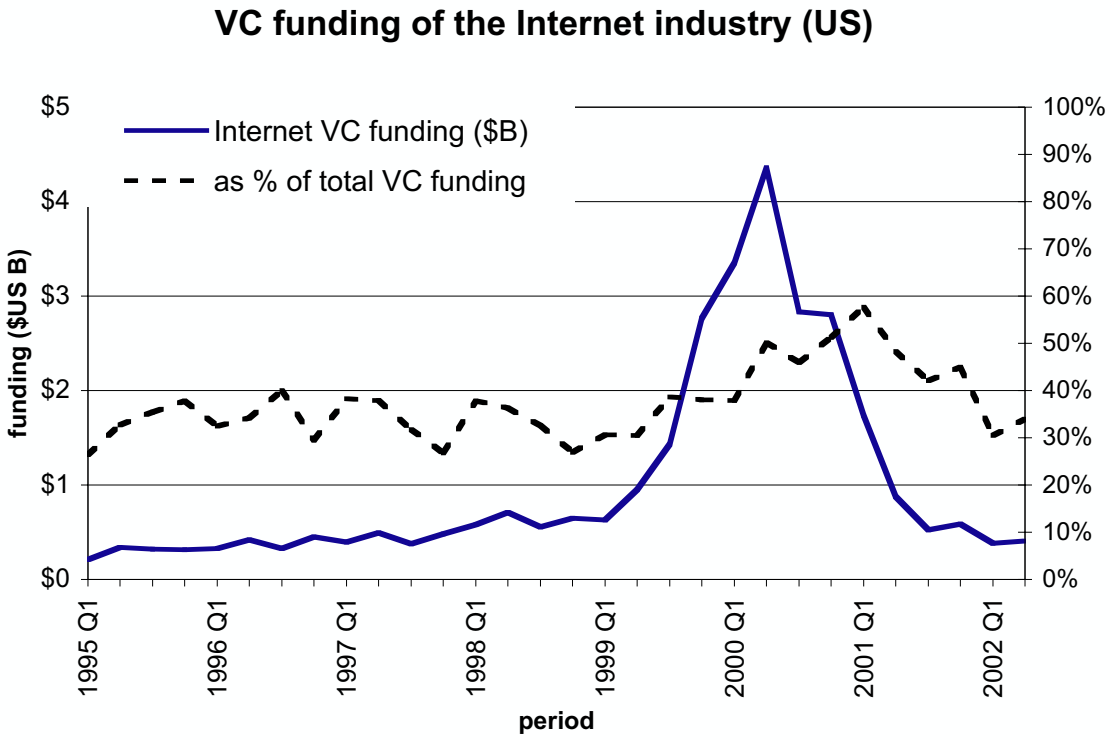
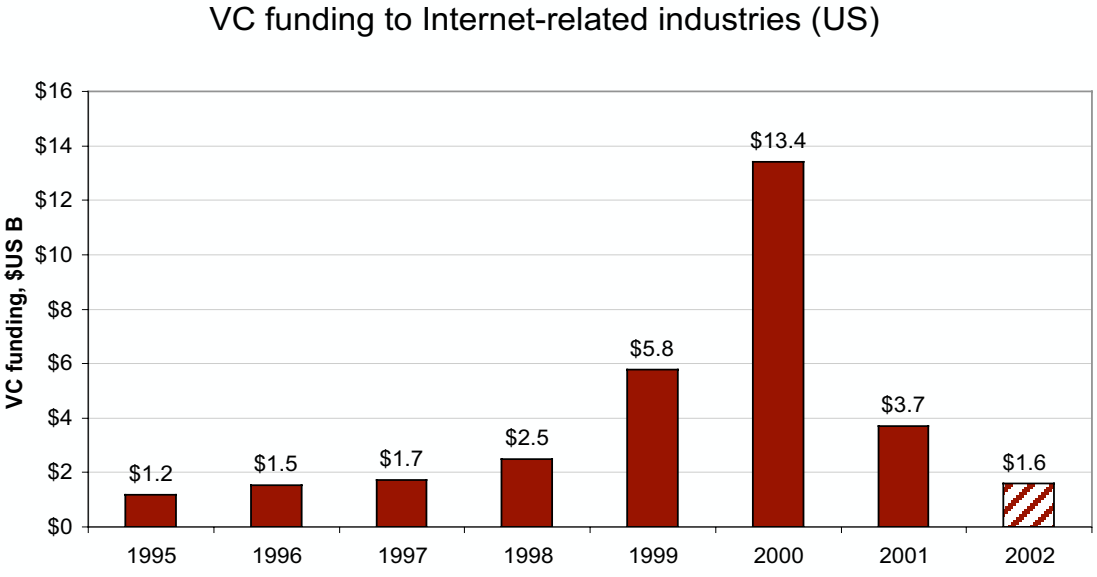


Figure 4. Annual totals, venture capital for Internet-related companies.



According to the figures in the Internet economy map presented above, at its peak, the venture capital balloon was equivalent to roughly 5-10 percent of the industry revenues cataloged. This figure likely overestimates the relative size of the venture capital entering the industry. The venture capital figures include funds invested in hardware and software companies, neither of which is treated in this paper. A more appropriate denominator for measuring the impact of venture capital might be the University of Texas CREC Internet indicator mentioned above, which pegged the Internet economy at $830 billion in 2000, the year when venture capital directed at the Internet economy peaked at $13.4B, or less than 2% of the total size of the Internet economy.

Internet market segments

The following sections describe the market segments depicted on the Internet map. These descriptions include a discussion of the nature and sources of information for the financial data provided.

Content

The market for paid content on the web is growing rapidly, according to the Online Publishers Association. The early Internet culture expectations that anything online must be free have been giving way (among segments of the online population) to a willingness to pay for content. The current online paid-content industry is attracting some $1.6B in revenue. That total comprises about $1B for adult content and some $600M for other types of information.[3]

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[3] On the online adult content industry, see the recent report by the Computer Science and Telecommunications Board Thornburgh and Lin (2002). The discussion on the disputed estimates of the size of the online and off-line adult entertainment businesses provides lessons in data gathering applicable to any empirical exercise. On the more general content industry, see the report by Online Publishers Association (2002). The bulk of the $600M non-adult-oriented online content comprises financial information and paid music downloads.

Portals

Portals were once a raging phenomenon in the dot-com industry, but the failure of consumers to comply with portals' business plans has made the category nearly dead. Portal business plans were built on the expectation that consumers would like a familiar, branded location from which to launch their browsing and online shopping sessions. The problem is that, absent any control over the consumer's Internet access software, there has been very little to tie individuals to portal sites. It is notable that two of the top-ranked portals listed for the industry are AOL and MSN, the number one and number two ISP in the United States, with 34 and 8 million subscribers, respectively. Both AOL and MSN have the ability to lead all but the most motivated and sophisticated subscribers to branded home pages.[4] Given the broad definition of portal, it is somewhat difficult to estimate the size of the portal market. As a rough estimate, I take Yahoo's revenues and assume that they represent approximately one third of the portal market. (This would overestimate the size of the market if Yahoo has a larger market share.) Under these assumptions, the portal market has approximately $2B in revenue.

Advertising

Internet advertising revenues, according to the annual analyses produced by Universal McCann Erickson's Robert Coen, have declined over the last two years. For 2002, Coen is estimating an online advertising market of $5.5B.[5] Deciding whether the similarity in shape between this figure and the chart of venture capital funding is more than coincidental would require more fine-grained financial data than most companies are likely to provide.

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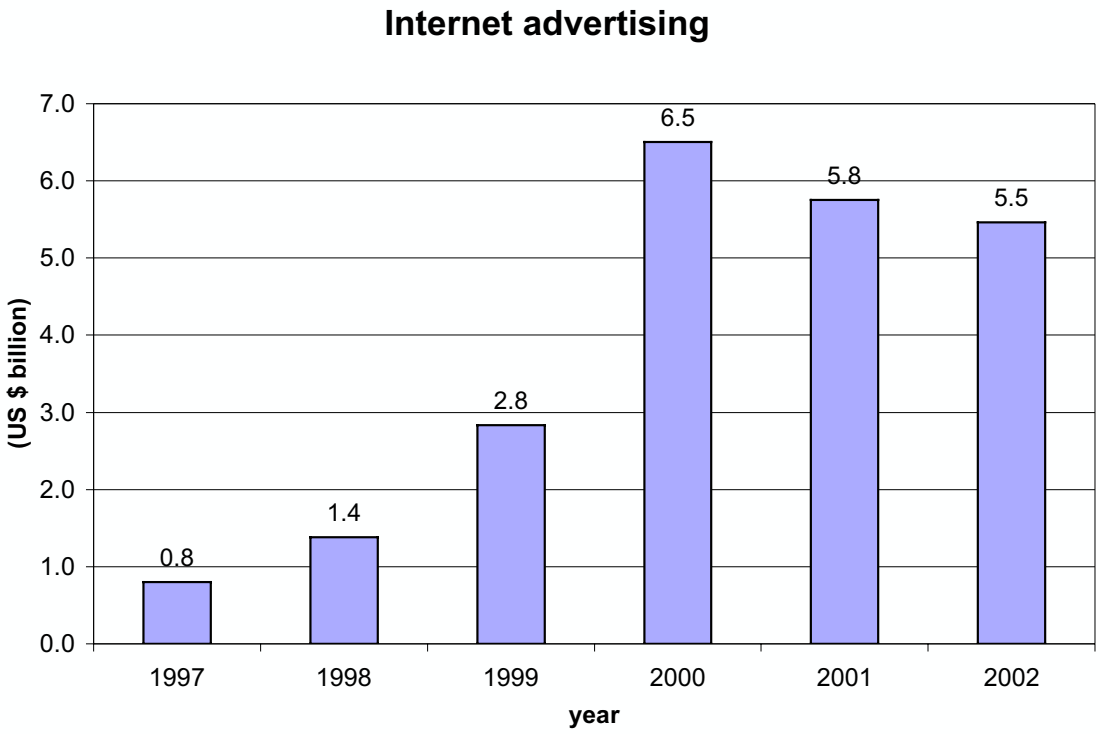
[4] For a recent account of the subscriber balance between AOL and MSN, see Spring (2002). Yahoo's revenues for 2001 were $717M, down from $1.1B in 2000.

[5] Coen (2002)

Figure 5. Internet advertising market



Web hosting

The web hosting industry, as seen on the map, is situated between higher-level services and the backbone providers. Before its bankruptcy, the leading web hosting companies Exodus Communications and PSInet were attempting to expand into the ASP market, where they would have been competing with some of their customers. Meanwhile, backbone carriers have been seeking higher margins up the value chain (following the unsuccessful model of PSInet,) and have been attempting to expand into the hosting business.

In any case, the hosting business suffers from a dilemma—it makes money based on the space and infrastructure that it sells to its customers, though Moore's Law for computing guarantees that customers will require less and less space for increasingly powerful

servers. At the same time, the price of connectivity is falling, making it difficult for the hosting companies to make much by charging a premium on Internet access.[6]

In 2000, according to industry reports, the hosting market's revenues were approximately $4B.[7]

Application Service Providers (ASPs)

Application Service Providers, or ASPs, are reportedly one of the fastest growing segments of the Internet economy. The classical conception of an ASP is a company that provides software and computational resources to provide services that a customer might otherwise perform for itself on its own computing infrastructure. The proliferation of ASP-like providers has led to the development of the "xSP," where the "x" may be left as-is, or may be replaced by a letter that provides more specificity about the service offered.

It is difficult to define an ASP; it is equally difficult to define ASP market revenue. Industry estimates vary from the $1B to $3B range. Assuming that the difference is largely in the scope of the definition of an ASP, the higher number would likely be appropriate for a broad definition of the category.[8]

Internet backbone providers

The Internet backbone industry is a highly concentrated segment of the Internet industry. Despite the level of concentration, margins are, judging by the health of firms in the sector, not generous. Backbone providers enjoy exponential growth rates in the volume of carriage they sell, but they also operate in a market in which prices are falling to match the growth in optical communications technology and in which consumers view

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[6] On Moore's Law and the hosting company's dilemma, see the discussion of Logic Tier in Kaplan (2002)

[7] Vaidya (2001)

[8] Aberdeen Group (2001)

backbone carriage as a commodity good. Under such conditions, it is difficult for a provider to distinguish itself from the crowd and raise its prices.

Boardwatch (http://www.boardwatch.com) counts some forty backbone providers in the United States, though the top four providers in 2000 (WorldCom, AT&T, Sprint and Genuity) controlled 50% of the market. The problems of the number one backbone carrier have been headline news for months; the number four carrier has recently issued warnings. Other companies in the 2000 top ten have had their share of financial difficulties: PSINet, XO Communications, Qwest, and Global Crossing.) As of 2000, the top ten backbone carriers accounted for two-thirds of the market.[9]

Cahners In-Stat/MDR estimates the size of the US and Canadian backbone market in 2002 to be $81.6B. The shake-out in the backbone market has had a predictable effect on concentration in the industry: In-Stat finds that the current top-ten backbone providers control 92% of the market.[10]

Content delivery networks (CDNs)

Content delivery networks expedite the transmission of Internet content. Information publishers pay CDN operators to host their information on servers located at provider access locations so that users can access information without fetching it from a distant server. The most widely recognized CDN operator is Akamai, with a 60%-70% market share.

CDN operators rely on large ISPs and backbone operators to open up their facilities to CDN equipment. The terms under which the CDNs have access to the facilities is proprietary, based on negotiations between the CDN and the carrier.

Cahners In-Stat/MDR valued the CDN market at approximately $300M in 2001.[11]

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[9] Pappalardo (2001)

[10] ISP-Planet Staff (2002)

[11] In-Stat/MDR (2001)

Internet Service Providers (ISPs)

ISPs are the one sure Internet expenditure for consumers. Businesses, depending on their size, may bypass a local "ISP" and contract directly with an Internet backbone provider. The ISP category includes dial-up access for consumers and small businesses, and broadband providers (including DSL, cable modem and fixed wireless providers for consumers and small businesses, and commercial-level services made available by local and regional providers.)

IDC estimates the 2002 ISP market to be approximately $31B, almost equally divided between consumer and business markets.[12]

e-commerce

The revenues from e-commerce should probably not entirely be counted as Internet industry revenues. After all, when you buy a book on line, the e-commerce vendor has to pay for the book you buy, plus ship the book to you. Both of those components are more properly counted as old-economy revenues. Below, when we calculate the contribution of e-commerce to the Internet infrastructure, we will count only a portion of e-commerce sales as contributing to Internet infrastructure.

The US Department of Commerce tracks e-commerce activity. According to Census Bureau estimates, the value of B2C commerce in 2002 will be approximately $40B.[13]

The B2B market is substantially larger than the B2C segment. The estimated volume of B2B transactions during 2001 was approximately $1B.[14]

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[12] IDC (2002). See the description of report IDC761589 at http://www.marketresearch.com

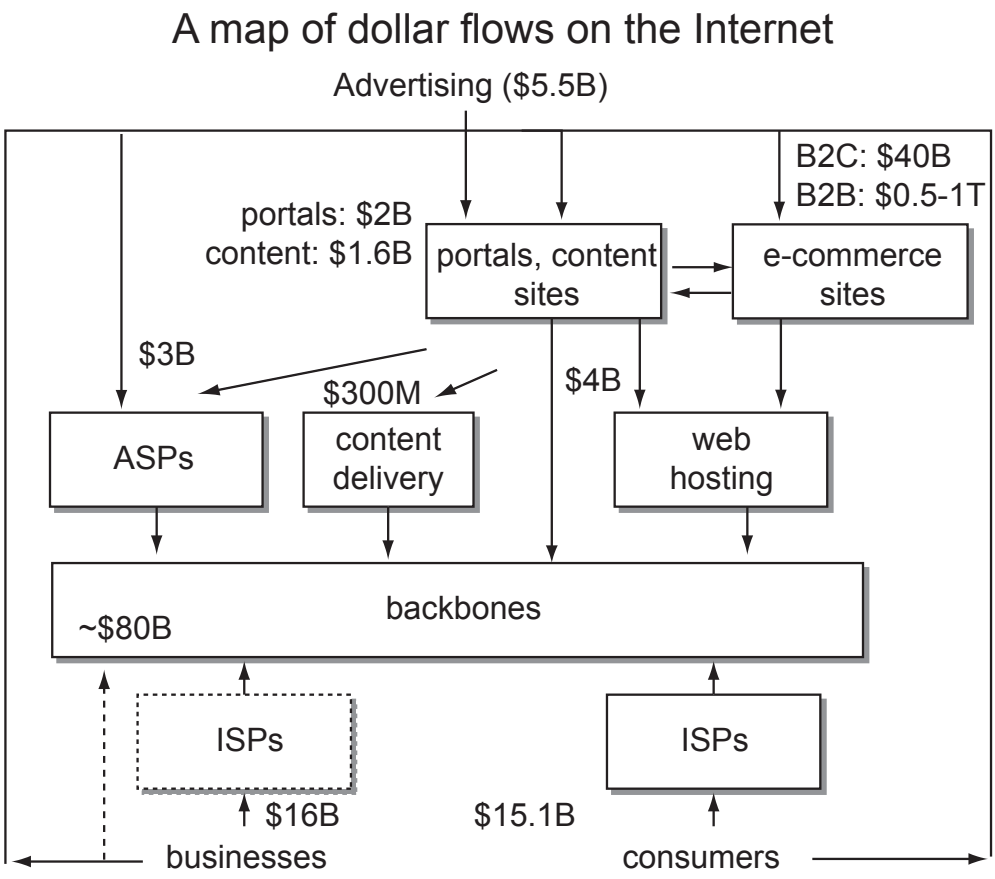
[13] US Census Bureau (2002)

[14] ITAA (2001)

An economic map of the Internet, with numbers

Now we are ready to present the economic map of the Internet with the numbers for each industry segment as discussed above. The figure below represents the status of the industry as of 2001-2002.

Figure 6. An economic map of the Internet, with dollar flows



Economics of Consumer Internet access: narrowband & broadband

For consumers, the first step in getting on the Internet is to contract for service with an Internet service provider. For many consumers, the monthly ISP bill is the only direct contribution they make to the Internet industry's bottom line. (Jupiter Media Metrix

anticipates 63% of American households will be online by the end of 2002.[15] Of those online households, nearly one-quarter are expected to be accessing the Internet via broadband connections. According to the NTIA, one third of US households, or about one half of those on line, make purchases online.[16] So the ISP bill remains, for the majority of Internet users, the most significant financial contribution to the industry.)

We can look a little more closely at the ISP box to try to determine what happens to the Internet user's ISP dollar. We might ask, for example, how much of the typical $20/month fee goes to paying for connectivity, equipment, and maintenance?

Based on company SEC filings, we can create a profile of the dial-up service provider's expense profile. Of course, dial-up providers come in different shapes and sizes, so the expense profiles will vary. The table below presents financial information for Earthlink, Juno, and AOL. The Juno and AOL data are from financial filings before their respective mergers. The Earthlink data is from early 2001.

ISP Expenses	AOL	Earthlink	Juno
Cost of revenue	63%	55%	35%
Sales, marketing	18%	19%	56%
Misc	7%	14%	5
G&A	11%	10%	4%

(Sources: Juno 10-Q, March 2001. AOL, November 2000 (pre-merger.) Earthlink: InternetFundManager.com report, Feb 15, 2001)

The expense categories for AOL and Earthlink are close, but the expenses for "free" ISP Juno are rather unlike those of the larger, pay ISPs. According to the report from which the Juno data was collected, at the time, Juno was attempting to convert 'free' customers to paying customers. The marketing expenses for the conversion were responsible for the disproportionate size of the sales & marketing figures for Juno.

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[15] Jupiter Media Metrix (2001)

[16] NTIA (2002)

Unfortunately, ISPs tend not to provide a breakdown of their "cost of revenue" expenses. It is in these details that we would be able to learn more about the disposition of subscriber dollars into the core of the Internet.

Broadband providers, fortunately, provide slightly greater detail on their expenses. The following table shows data made available in the financial filings and bankruptcy.

Broadband Expenses	**BlueStar**	**Covad**	**NorthPoint**
Network Expenses	26%	53%	35%
Equipment leases	14%	-	-
Sales & Marketing	25%	36%	47%
General & administrative	35%		
Depreciation	1%	10%	18%

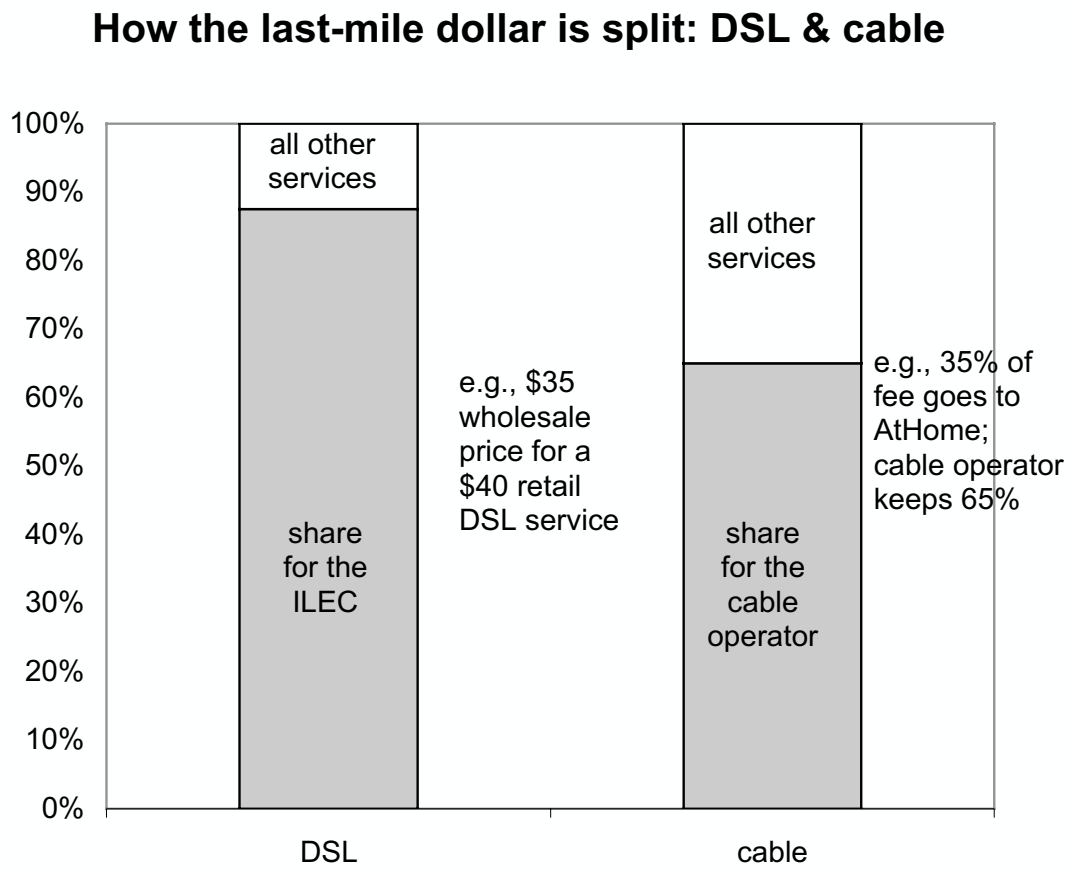
(Sources: BlueStar and Covad 10-Ks, Northpoint 10-Q)

There are a limited number of independent cable modem ISPs. The former largest firm in the category, Excite@Home, went out of business in 2001 after a brief period operating in bankruptcy. In filings with bankruptcy courts, Excite@Home revealed some details on its spending for various cost components of its service. As shown in Figure 6, CLECs providing DSL service operated on much thinner margins than ISPs providing Internet access over cable plant. It should not be surprising that CLECs would have difficulty breaking even under this regime—even a dial up ISP, which would bear much lower network connectivity costs per customer than a DSL provider, were collecting around $20/month from subscribers. CLECs that hoped to remain competitive with DSL offerings of ILECs were forced to get by with only a fraction of the revenues collected by the average dial-up ISP.

Given the greater load that broadband subscribers impose on the network compared to dial-up Internet users, we might expect that the average cost for network connection for dialup customers to be below what might be expected for dial-up customers. In the analysis below, we will conservatively estimate that 40% of the ISP subscription dollar,

across all Internet consumers, goes to pay for networking infrastructure in the core of the network.

Figure 7. DSL vs. cable modem and payments to network incumbents

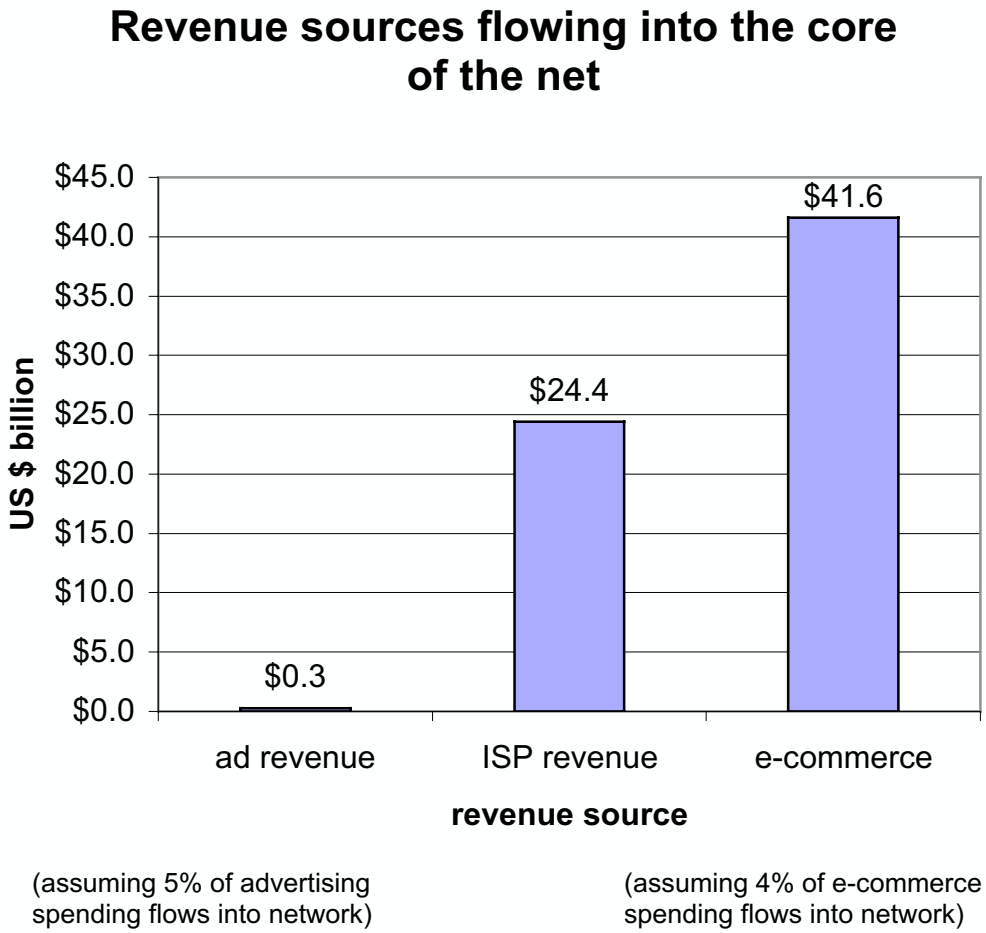


Feeding the core of the Internet

Figure 8 shows an estimate of how much each of the three pillars of Internet revenue are funding the core of the network. By referring to a variety of financial statements from companies engaged in a range of Internet services, I estimate that approximately 4% of advertising revenues go to paying for network infrastructure, while 5% of e-commerce revenues go to pay for networking infrastructure. At this point, paid content is an insignificant contributor to networking infrastructure, so only access fees from the user-

funded services category contribute to the estimate here. Using the logic discussed above, I estimate that some 40% of access fees goes to pay for networking infrastructure.

Figure 8. Financing the core of the Internet



As is evident from the figure, the bulk of the funds for sustaining the core of the network appear to be coming from access subscription and e-commerce transactions. Advertising and paid content, at this early date, do not represent a significant source of funding for the Internet backbone.

Conclusion

The estimates of Internet industry segment size presented here are likely to change. In the future, as a larger percentage or the population switches to broadband services, and as broadband services themselves become even broader than they are today, we can expect a shift in the burden for funding the core of the Internet. If and when consumers switch their consumption of entertainment media from broadcast and broadcast cable technologies to IP-based delivery, we would expect that user fees—or advertiser support—will have to take up a larger share of the burden of maintaining the core of the Internet. Of course, not all content will be distributed via an architecture that requires large amounts of backbone traffic, but the economic rationale described here could very well apply to metropolitan and access networks as well.

One of the side effects of moving the responsibility of funding the core of the Internet to subscription services and paid-for-content could be the increased willingness of service providers to offer higher quality of service to applications for which consumers are willing to pay a premium.

Over time, it might be useful to track the dynamics of the growth of various segments of the Internet industry depicted on the map. Additional information about the operations of companies in each of the sectors, such as relative dependence on capital, might also yield insights into likely trends in industry structure. Ideally, information about the margins available in each sector would be available, but at this early stage of development of the Internet economy, there may be too much noise in the system for such information to support reliable inferences about the evolving structure of the Internet economy.

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