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The Broadband Bandwagon: Faster to 10, Slower to 50?

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Defenders of current broadband regulatory policy note that broadband deployment to date tops the pace of key consumer technologies of recent decades. Attaining the 10 percent threshold of consumer adoption took 12 years for color TV, 10 years for the VCR, eight years for the cell-phone and five years for the CD player.¹ Broadband hit 10 percent after only four years in the market. The "stand pat" argument of regulatory status quo advocates is hardly a frivolous one.

But there are crucial differential factors in the cited earlier cases that explain why broadband was adopted faster: the general level of economic prosperity, product, service and switching costs, and quality issues. A recent book by economist Jeffrey Rohlfs² sheds light on which products benefit from the "bandwagon effect"; it offers clues as to why broadband grew faster early on, but may well grow slower in the next half-decade, than did other flagship consumer products.

Bandwagon Theory

In formal economic terms, bandwagon effects are external demand-side scale economies. Demand-side scale means that users benefit and the user set increases; externality means that other users benefit as well from the user's individual choice to purchase the good.³ Momentum can come from "network effects" as in telecommunications, or from "complementary products" whose value derives in part from other, related products-e.g., CD players and CDs.⁴ Products that reach a critical mass of users vault into the stratosphere via "positive feedback"-mutually reinforcing choices made by users.⁵ A key factor in bandwagon product evolution is "interlinking" of products that share common benefits. Without interlinking, the battle between suppliers to reap bandwagon benefits becomes a

winner-take-all competition for the suppliers (e.g., Betamax and VHS VCR formats).⁶

Bandwagon Products: Climbing On, Falling Off

Rohlfs analyzes eight cases, from mega-hit to mega-flop: fax; telephony, video-telephony-AT&T's original Picturephone; CD, VCR, PC, TV and Internet. With each product, bandwagon economics applied per specific circumstances. Perhaps the world record for slow product adoption was the case of the fax machine. The first fax machine was built in 1843—*not* a misprint! Fax service was inaugurated between Paris and Lyons in 1865. Based on stylus and telegraphic technology its cost/performance was insufficient. The invention of photoelectric cell technology in 1870 led to the wirephoto, first used by news organizations in 1902; wirephoto turned out to be an industry niche product. The modern fax machine made its market debut in 1966, but it took third-generation fax, 20 years later, to make the fax machine a mass market item.⁷

Telephony was first offered to the public in 1878, with competitors entering the market after the Bell patents expired in 1894. Entry was facilitated by Bell's high-price policy, which slowed Bell's growth. Ma Bell took off after the government allowed it to acquire non-Bell companies in 1921.⁸ Picturephone proved to be an expensive, clunky "Field of Dreams" ("Build it and they will come.") flop.⁹ The Internet evolved over 30 years from a defense network, to a specialized research network and then finally to a mass market, predominantly commercial network; critical mass was made possible by extensive early, federally-subsidized public investment.¹⁰ Television development, from black-and-white to color and from analog to digital, has been mainly driven by federal standard-setting decisions.¹

Consumer products are subject to complementary product effects, but not network effects. CD players and CDs were rapidly successful due to selection of the right standards¹²; VCRs, by contrast, were delayed by dueling formats, plus litigation by movie studios fearful (wrongly) that VCRs would kill live movies.¹³ The PC market evolved towards a dominant duo—Intel and Microsoft—due to business errors by competitors (Apple's closed box and IBM's refusal to buy MS-DOS). Because the "Wintel" PC was not interlinked with competing products its bandwagon benefits were not shared, and Wintel won 90 percent of the market.¹⁴

Broadband: Is the Bandwagon Rolling?

Rohlfs's historical and economic analysis lays the foundation to see where broadband today fits in the bandwagon spectrum. Broadband market evolution can be compared with other products whose slower path to 10 percent penetration is often cited by defenders of current FCC policy as evidence that broadband diffusion is a success story that should be left alone. Broadband access did indeed grow to 10 percent faster than any other consumer market technology, albeit deployment slowed in the second half of 2001. But upon closer inspection there are gaps in the tale of broadband as the roll-out champ.

In fact, mass market broadband made its debut—in 1997—in a spectacularly favorable climate. Broadband entered the residential market during a time of surging economic prosperity and a networking mega-boom. Information technology ignited five years of accelerating economic growth and the Internet-mania was the hottest story on Wall Street. Consumers desiring broadband needed merely to contract with a service provider and set up a new modem. The Internet software worked the same as narrowband dial-up access. Very modest investment was required of the user—more in set-up time than in money. For most applications, broadband access did not require (as Picturephone did) that other users have the same installed capability.

Broadband and Its Predecessors: A Closer Look at History

Let's examine in more detail the claims of broadband policy defenders that all is well, because broadband spread faster than earlier products. In fact, earlier products faced hurdles far higher than did broadband, which made its debut under a uniquely favorable set of circumstances.

Color TV

Color TV hit the market during a period of strong economic growth, but that growth took place when consumers had less income and assets than they had in the 1990s. Color sets were very expensive, and quality was very shaky for at least a decade. Although the industry color TV standard was adopted in 1953, only NBC was broadcasting 1,000 hours annually in color by 1960. ABC did not broadcast *any* color programs until 1962, when customer color set penetration was 10 percent. By 1975 it was 60 percent.¹⁵

Thus, color TV had cost, quality and standards issues that sparked supplier resistance to adoption, and thereby delayed mass market penetration. In contrast, broadband cost/ quality issues were submerged in the Internetmania that gripped the market and thus did not deter early adopters blessed with far more discretionary income in the late 1990s than their 1950s antecedents.

Picturephone

Considering how marginal the customer penetration level of video cameras mounted on today's Pentium-powered PCs has been, it is hard to imagine that AT&T offered its first video-phone 30 years ago. Even harder to fathom is that there was no way to turn the screen off! Picturephone was offered first in Chicago at \$86.50 per month, which included a half-hour of non-metered usage. This equates to \$1,038 annually, even without inflation adjustment-figure at least treble the nominal rate if so adjusted. The service was taken by 200 customers before it was discontinued. Illinois regulators denied AT&T any pass-through of costs for the failed venture to ratepayers.¹⁶

Picturephone ignored the need for a product to reach a "critical mass" before bandwagon effects can kick in, failing to solve what author Rohlfs calls the "start-up problem." AT&T's instead pursued a "Field of Dreams" strategy.¹⁷ Broadband is less risky in this regard, because users need not have broadband at both ends to communicate. With 22 percent of the nation—60 million households—online in 1997 when broadband made its debut, critical mass was already there.¹⁸ Thus broadband did not face a serious start-up problem.

VCR

The VCR made its debut in the late 1970s when the US was betwixt oil shocks and suffering from persistent stagflation. As well, dueling standards (Betamax and VHS) retarded VCR growth. Sony began Betamax production in 1975, VHS a year later; VHS production surpassed Betamax in 1978 and gained greater total market share in 1981. By 1986 videocassette sales topped movie box office receipts.¹⁹ And all this happened in the face of ferocious litigation by Hollywood studios, whose case went all the way to the Supreme Court.

Broadband faced no comparable standards battle: Internet customers naturally migrated upstream with their respective service providers, or competing ones. Litigation over asymmetric broadband regulation did not slow deployment much because phone companies challenging FCC rules made defensive investments to prevent cable from getting 100 percent of the wireline broadband market. And while broadband access switching costs between cable and telephone company provider are not trivial, involving hardware and software changes plus a few hundred dollars, they are probably lower than Beta/VHS were for most users. Users switching to VHS recording format had to junk their legacy Betamax recorder and tape library.

CD

The CD player (and cell-phone) made their entry under more favorable economic conditions than existed for color TV and the VCR, but other factors—switching costs and quality—intervened. CD users had a huge inventory of LP records that unquestionably slowed CD adoption.

For CD players to succeed they had to offer substantial user benefits, and they did. Random access and custom programming features enabled listeners to change tracks easily—and remotely, without risk of scratching a vinyl surface as with LP records. Compact size helped in the long run; initially, manufacturers felt that LP-sized packaging was needed to reassure consumers that CDs were a real product. Longer playing time also helped: Philips NV, the Netherlands audio company and CD pioneer, engineered its CDplayer standard to enable 74 minutes on a side (CDs are single-sided, unlike LPs), more than twice the 30 minutes typical per LP side. (Philips selected the unusual playingtime benchmark to fit conductor Herbert von Karajan's Berlin Philharmonic recording of Beethoven's Ninth Symphony.²⁰) CD players fell rapidly in cost, from \$1,300 in 1983 to \$300 in 1985; CDs fell in the same span from \$22 to \$12.²¹

Broadband did not have a serious legacy problem. Users with dial-up modems simply tossed them and installed new modems and the associated software. That CDs diffused as rapidly as they did despite an immense legacy inventory problem is testament to the superb quality of the product. Broadband's marginal quality was offset by a concatenation of highly favorable factors noted above.

Cell-Phones

Cell-phone adoption was retarded for years due to astronomical prices (thousands of dollars) for handsets, high prices (above \$100 per month initially) for service, poor signal quality and limited "roaming" capability (due to the US policy of regionally-balkanized cellular networks).²² Indeed, cellular handsets were so expensive that service providers began throwing them in as a loss leader inducement to sign up new customers. (I remember a Norwegian friend proudly showing off in 1990 his new, \$3,000 callanywhere-in-the-world cell-phone). Rapid growth began around 1993, when improving technology and better roaming crossed with lower prices.

Once those price, quality and geographic "inflection points" (Andy Grove's term) were crossed, wireless exploded, even before new digital (PCS) networks made their debut in 1997. Between 1993 and 2000 mobile telephone subscribership rose 584 percent (from 16 to 109 million), industry employment rose 364 percent, cumulative capital investment rose 543 percent (from \$14 to \$89.6 million), mobile minutes-of-use rose 82 percent, while price per minute fell 64 percent (from 58 to 21 cents per minute).²³ To place the last figure in perspective, cellular per-minute rates actually *rose* from 45 cents in 1991 to 53 cents in 1992 and 58 cents in 1993.²⁴ Finally, cellular spectrum allocation was simply inadequate: The FCC's original 1981 allocation of 40 megahertz was increased by 10 megahertz to 50 in 1985. Even then, analog network capacity constraints clogged Los Angeles by 1987.

No wonder cellular had a slow start—inadequate capacity, poor quality, high cost, regional isolation. It is a tribute to the strong perceived need mobile telephony users felt—from CEOs to soccer moms to the teen crowd—that cell-phones did not become a replay of the Picturephone debacle. Broadband faced some of the same hurdles, but in much milder form: moderately high cost plus quality and capacity limitation; regional balkanization was not a factor.

Personal Computers

Personal computers confronted users with daunting challenges: unfamiliar, user-hostile hardware and software; repair and maintenance complexity and high product costs. IBM's open architecture drove "Wintel" PC clone growth and gave software programmers a friendlier interface to write to than did Apple's closed box. IBM's credibility aided business market penetration. Many secondand third-tier adopters learned their computing at the office, where "Wintel" reigned supreme. It was natural for them to buy a PC when purchasing for the home.

Apple was relegated to the niche education and entertainment markets, where its vastly superior graphics gave it a sustainable competitive advantage. The relatively clunky PC interface and bewildering profusion of software made buying a PC—and learning to use it—a daunting task. Mass market consumers were only willing to undertake it when they (or their persuasive, persistent offspring) perceived a genuine need to take the plunge, and when the cost of a powerful PC came down to consumer mass market levels.

Thus, cost and complexity hurdles with PCs were far greater for users than with broadband. Cost meant a few thousand dollars until recently; complexity meant deciphering numerous cryptic software message prompts and user commands. Even today, a quartercentury after Apple introduced the first true mass market personal computer, the machines are still considered by many to be hard to use.

Internet

The pace of Internet growth cannot be measured by conventional vardsticks, for the Internet has been in reality three different products since its inception, with only the third stage predominantly commercial. From its inception in 1969 to around 1975 it was largely a military network; then it spread to private universities engaged in scientific research; commercial use began to grow in the 1990s, but did not really take off until the August 1995 twin debuts of Microsoft Windows95 and Netscape Navigator. Although commercial e-mail began in the late 1970s, it too did not really take off until the 1990s.² Internet hosts took 12 years to reach (in 1981) 213, crossed 1,000 in 1984, 100,000 in 1989, and 1,000,000 in 1992; from the 1993 release of Mosaic, the graphical browser precursor to the mass market Navigator, Internet hosts jumped from under 2 million to nearly 110 million in 2001.²⁶ Online households, 14 percent of the total in 1996 when the

Internet craze ignited, exploded to 44 percent in 2000²⁷—a pace that triples the four-year march of broadband, despite the latter's pig-gybacking on the Internet.

Has Broadband Hit a Wall?

In sum, despite a fast start out of the gate, being first to 10 does not require a bandwagon product; being first to 50 does. Broadband has yet to achieve the "must have" status of color TV, mobile phones, VCRs and CDs; it rode the Internet rocket to 10. Despite being complementary—interlinked—with the Internet, broadband still does not show demandside scale economies. Its use is largely independent of use by others, because the users with dial-up narrowband access can share files and e-mail with broadband users; having interlinked narrowband access eases pressure on Internet users to migrate to higher speed.

The increment of the average household's income required to adopt broadband was smaller than for any of the earlier cases.²⁸ Yet broadband growth to date has been limited to early adopters. Existing legacy-networkderived broadband can offer little of premium value to justify upgrading, far less than color TV's vastly richer picture, the VCR's timeemancipation and playback features, the CD's hiss-free play and random access capability, or the cell-phone's mobility. With early adopters already signed up, broadband must offer higher value services than today's mix to penetrate the mass market. This will require delivering far more bandwidth than today's broadband typically does.²⁹

Thus, comparing broadband deployment to earlier products ignores major differences in surrounding economic, technical and social circumstances. The rapid rise of broadband for early adopters was driven by unusually favorable factors—despite regulation that slowed telephone company provision of same. With fairer regulation, telephone company broadband subscriber growth would have been more robust, but phone companies made defensive investments at a loss so as not to cede the market entirely to their cable rivals, while working for regulatory reform that would enable them to make money as well.³⁰ Even skewed regulation could not stifle early broadband adoption in a marketplace superheated by economic prosperity and the rush supplied by Internet growth.

With better regulatory policy that encourages the new technology investment (mainly, local loop optical fiber) needed to enable delivery of high-value broadband services, broadband deployment will accelerate. While it is quite unlikely that "10 to 50" broadband growth will follow the pace of the fax, matching the pace of the CD or online access is a tall order. Broadband should be liberated from its regulatory legacy, to give it a boost for the 10-to-50 launch.

¹ Source: Robert Pepper, Chief, Office of Plans and Policy, Federal Communications Commission. Presented at 2001 Aspen Summit, Progress and Freedom Foundation (Aug. 20, 2001).

² Bandwagon Effects in High-Technology Industries (MIT Press 2001).

- ³ Id., pp. 14-15.
- ⁴ Id., p. 8.
- ⁵ Id., pp.27-28.
- ⁶ Id., pp. 34-35.
- ⁷ Id., pp. 61-65.

⁸ Id., pp. 69-78. In 1921, Congress passed the Willis-Graham Act to allow AT&T to buy other companies; the act was repealed by the 1996 legislation.

- ⁹ Id., p. 86.
- ¹⁰ Id., pp. 179-193.
- ¹¹ Id., pp. 137-165.

[ET CETERA]

Several air travel security items surfaced recently, pertinent to earlier newsletters. The head of the new Transportation Security Administration is planning to hire 3,000 to 5,000 law enforcement agents to bolster airport security, and will consider a "trusted traveler" ID card trial.³¹ And at Atlanta's Hartsfield International Airport, a news report says 43 of the 372 city employees have criminal records, including offenses such as drug dealing, weapons charges and forgery; seven have been fired.³²

Surveillance surfaced again: In the nation's capital the local police are phasing in the most comprehensive camera surveillance system for public places, with over 500 cameras linking a digital war room to nearly all the city's 1,000 squad cars.³³ There are more than 2 million cameras in place in the US³⁴ (a total matched in far smaller England³⁵).

Such systems bring crime reduction dividends-ex-New York Mayor Giuliani cites a 20 to 40 percent crime drop in monitored public housing; London's central financial district saw a 19 percent crime drop within three years of deploying cameras. But there are costs as well: In 1996 more than 80,000 copies of a voyeur video made from security cameras were sold in the UK; included in the footage were couples having sex, burglars plying their trade, women in their bedrooms and even a photo looking up the late Princess Diana's skirt.³⁶ Somewhere between the office closet and royal skirts lies a happy medium.

- ¹² Id., pp. 91-104.
- ¹³ Id., pp. 105-116.
- ¹⁴ Id., pp. 134-136.
- ¹⁵ Id., pp. 145-148
- ¹⁶ Id., pp. 83-85.
- ¹⁷ Id., p. 85.
- ¹⁸ *The Digital Economy Fact Book*, Progress & Freedom Foundation, p. 9 (3d. Ed. 2001).
- ¹⁹ Bandwagon Effects, pp. 110-111.
- ²⁰ Id., p. 94.
- ²¹ Id., p. 98.
- ²² There are 305 urban and 428 rural cellular networks; PCS licenses are nationwide.
- ²³ Sources: Cellular Telecommunications & Internet Association; Strategis Group, 2001.
- ²⁴ Source: Strategis Group, 2001.
- ²⁵ Bandwagon Effects, fn. 1 supra, pp. 171-192.
- ²⁶ The Digital Economy Fact Book, note 18 supra, p. 3 (3d. Ed. 2001).
- ²⁷ Id., p. 9.
- ²⁸ "Manager's Journal," Wall Street Journal, p. A18 (June 25, 2001)..

²⁹ The author has covered this theme in two earlier issues: "Fiber Fables II: The Long Distance Fiber Glut is Last-Mile Copper Scarcity" < (<u>http://www.discovery.org/bandwidth/issues/2001-11-05.pdf</u>>; and "DSL Delusions: More Bad History and Even Worse Policy" < (<u>http://www.discovery.org/bandwidth/issues/2001-12-03.pdf</u>) >

- ³⁰ See "DSL Delusions: More Bad History and Even Worse Policy."
- ³¹ "U.S. to Hire up to 5,000 Officers to Patrol Airports," USA Today.com, 2/13/02.

< <u>http://usatoday.com/hlead.htm</u> > See "Techno-Terror II: Will the Networks Be Smarter Than the People?" *Bandwidth*, Feb. 8, 2002. < <u>http://www.discovery.org/bandwidth/issues/2002-02-08_720k.pdf</u> >

³² "7 Hartsfield Employees Lose Security Clearance," *ajc.com*, 2/14/02. (AJC is the online edition of the *Atlanta Journal-Constitution*.) See the *Bandwidth* issue cited in fn. 25, supra.

³³ "Washington Police Play 'I Spy," *Wall Street Journal*, p. B1 (Feb. 13, 2002). See "Techno-Terror and the Information Society's Homeland Defense," *Bandwidth*, Jan. 8, 2002. http://www.discovery.org/bandwidth/issues/2002-01-08.pdf >

- ³⁴ "D.C. Forms Network of Surveillance," *Washington Post*, p. C3 (Feb. 17, 2002).
- ³⁵ "Washington Police Play 'I Spy," note 33 supra.
- ³⁶ "D.C. Forms Network of Surveillance," note 34 supra.

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