America OnLine’s Internet access service: how to deter unwanted customers

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Received 17 June 2004; received in revised form 5 October 2004; accepted 11 October 2004
Available online 30 October 2004

Abstract

Some dial-up Internet access providers, such as the market leader America OnLine (AOL), require customers to install proprietary connection software to use their service. This is puzzling, because while the software helps certain users, it creates disutility for others (especially expert users and early adopters of Internet service). Why, then, does AOL insist on this connection manager? Why not also offer a standardized service with Internet access and AOL-managed service to the power users? This paper proposes different possible explanations for why firms might willfully create barriers to entry for customers by forcibly bundling a feature that is negatively valued by a customer segment. We postulate that AOL wants to limit sales to unprofitable customers such as IT-savvy expert users. In the absence of other viable mechanisms for screening out such customers, AOL’s product design may be viewed as a smart approach to solve the adverse selection problem: the connection manager reduces valuations of IT-savvy users, making the service unattractive to them. A second possibility is that AOL considers IT-savvy users undesirable because their presence might cause novice users to learn to manage without AOL’s proprietary software; these customers might switch to the cheaper access-only option in future periods.

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1. Introduction

Millions of American households are proud recipients of computer disks containing free software from America OnLine (AOL). AOL emerged as the dominant Internet Service Provider (ISP) in the 1990s [14, Chapter 4], differentiated on account of its IT-enabled content services: Internet chat rooms, carefully screened content and commercial services (travel services, online entertainment, financial news, etc.), a clean design, and a unique “sense of community.” Another differentiating
factor in AOL’s service was its client software – a proprietary connection manager – that purportedly simplified the setup and installation process. This approach suited millions of consumers who, in the early 1990s, suddenly had access to the Internet but lacked the technical knowledge to configure suitable telephone access numbers, aiming to provide the friendliest access ramp to the Internet, while Other ISPs placed the burden of initial installation on the consumer. Finally, AOL’s strategy was distinctive in offering an integrated service combining the connection manager with access to AOL content and the Internet.

AOL’s connection manager implemented non-standard connection protocols and modified certain generic operating system files. While this design facilitated a friendly, customized look-and-feel, it restricted AOL users from using certain non-AOL communication programs (such as for email, file-sharing and web browsing) and peripheral devices. Anecdotal evidence indicates that the dial-up market consisted of two customer segments with diametrically opposite perceptions of the connection manager. Novice users, those who were new to the Internet, appreciated the friendly hand-holding approach. But this appreciation was not shared by power users who had Internet experience and application programs, technical competence in software installation, and ability to navigate Internet and Web content. These users not only found no value in the “friendly on-ramp,” but also disliked the need for frequent updates and extra overhead during startup and shutdown. Power users suffered a loss in valuation because of the restrictions and inefficiencies imposed by the connection manager. Indeed, customer feedback on AOL was polarized, with rave reviews from novice users (very friendly, easy to use, nice interface, community services and parental control) and complaints from more serious users (slow download speeds, slow search, terminated connections and poor browser).

Since the connection manager caused substantial loss in benefit to some users, it is puzzling that this feature was forced on everyone. One argument is that the connection manager’s design was critical to delivering better performance to AOL’s customers (most had lower speed modems): its “Rainman” technology allowed web pages from collaborating web sites to load faster. But this still does not explain why AOL did not choose a mixed bundling strategy by also offering power users an access only option (see Fig. 1). Marketing strategy suggests the superiority of mixed bundling, because AOL’s service contains two components (connection manager and managed content services), each of which is differentiated from competitors’ offerings.

While most other firms distribute free software to attract consumers, we view AOL’s distribution of free software as an approach to deliberately create entry barriers for a certain group of unwanted customers. Such entry barriers are commonly used to provide a positive value in the aggregate even though those facing the barrier are temporarily worse off. A to-be murderer might feel clueless on being refused a gun, but the potential victim is better off. Teenagers might suffer from being turned away from a bar, but statistics tell us that the rest of us on the road are rendered safer. These examples demonstrate a positive externality due to the barriers – the disutility to the “bad” customer is offset by gains to good customers. But the analogy breaks down in the AOL case: there is no indication that novice users benefit from forcing power users to install the connection manager.

Why, then, did AOL willfully and voluntarily impose entry barriers that made at least some cus-

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tomers balk at purchase? We examine this question by developing analytical models whose premises are consistent with the above discussion (negative correlation between Internet expertise and value from connection manager), and where the conclusions fit the observation of “pure bundling” in the design of AOLs Internet service. This logical analysis therefore offers only plausible hypothesis into AOLs marketing strategy, confirmation of these hypothesis would require additional research or surveys of AOL decision makers. Our research is set in the early to late 1990s period, when AOL grew from a small online service to be a dominant Internet firm.3 Our analysis assumes that AOL has some pricing power, which seems reasonable because of AOLs unique content services.

2. Model formulation and customer preferences

To better understand different consumers’ preferences towards dial-up service, it is useful to consider the evolution of dial-up Internet service. Juliussen and Petska-Juliussen[14] give specific data regarding overall number of Internet users, market shares of major ISPs, new product introductions, and major industry developments, at specific times in the 1990s. There was an exponential increase in non-expert Internet users in the mid-1990s and AOL’s focus on “customer-friendly” approach can be seen as a natural response to this growth.

2.1. Evolution of dial-up Internet access

In the late 1980s and early 1990s, dial-up Internet access was provided by: (a) universities and military/government organizations that were on the Internet, or (b) a few private firms such as AOL, Prodigy and Compuserve. The service provider ran a modem bank either in a specific geographical location (typical under case a) or with national coverage (case b). Commercial ISPs typically employed usage-based pricing, charging as high as $2.95 per hour of use beyond the first 5 hours or

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3 AOLs 1998 acquisition of Compuserve might seem that AOL now employs a mixed bundling strategy. However, we believe this is not the case. Compuserve is neither inexpensive, nor an access-only standardized dial-up service, and it is not offered under the AOL brand. AOL seems to target Compuserve towards a niche high-value segment that highly values certain types of content and international Internet connectivity.
so per month. While universities and government networks were based on TCP/IP (the Internet), the networks run by firms such as AOL constituted private worlds based on proprietary network protocols. Connectivity between these two kinds of networks was limited but improved over time (the networks are nearly interoperable today). For example, sending email traffic between such networks progressed from impossible to difficult to standardized. More to our point, the procedures and software for dial-up access were highly complicated. Modems were slow (1200 bps, for example) and subject to proprietary communication schemes, settings and software. The user had to configure various parameters in the modem (compression, mode, telephone number, data rate, etc.) and match these with the provider’s modem configuration, a task made harder because of multiple existing “standards.” Dial-up Internet access captured only a small market of users who were expert enough in IT to deal with these issues or those who had very high value for access.

In the mid-1990s after privatization of the Internet, the demand for dial-up access grew rapidly, and a number of local and national-level ISPs entered the industry. The national players included the major telephone companies, as AT&T, MCI and Sprint began offering dial-up Internet service. Flat-rate pricing (typically, $15–$17/month) was introduced around 1996 and soon became the industry standard. Casual users far outnumbered power users in this time period. Given the profile of novice users, many service providers concentrated on simplifying the access experience for such users. After some initial missteps, AOL emerged as a leader, both in offering “user-friendly” easy access to the Internet and in offering additional content services such as online communities, content filtering, email virus detection, chat rooms, and travel services. This strategy helped AOL capture a major share of the market for dial-up access, even while charging a higher monthly fee.

2.2. Customer preferences

Building on the idea that customer preferences for the connection manager and access to the combination of content/Internet are heterogeneous and negatively correlated, we model Internet users along a type parameter $\theta \in [0,1]$. A higher $\theta$ denotes a higher level of IT/Internet expertise and use. Let $V_a(\theta)$ represent user $\theta$’s valuation for access to Internet and AOL content, while $V_s(\theta)$ is user $\theta$’s valuation for the connection manager software. Let $V_b(\theta)$ represent a user’s valuation for the integrated service, which combines access with AOL’s connection manager. Note that the connection manager has no value by itself, so that $V_a(\theta) = 0$. The incremental contribution of the connection manager, when it is bundled with Internet access, is $V_b(\theta) - V_a(\theta)$. We require the valuation function to satisfy the following properties: (a) power users have greater valuation for Internet access than novice users; (b) the connection manager increases valuations of novice users; and (c) the connection manager reduces valuations of power users. Formally, we can encode these requirements into the following assumptions.

A I: $V_a$ and $V_b$ are continuous and differentiable in $[0,1]$.

A II: Valuation for Internet access increases with IT-expertise. $V_a' \geq 0$.

A III: The incremental contribution of the connection software is positive for novice users but negative for power users. Formally, there exists a threshold type $\alpha \in [0,1]$ for which the incremental contribution is zero, and

- $V_b(\theta) - V_a(\theta) > 0$ for $\theta < \alpha$: these are the novice users.
- $V_b(\theta) - V_a(\theta) < 0$ for $\theta > \alpha$: these are the power users.

To facilitate the analysis and exposition, we adopt a specific valuation function that satisfies these assumptions.

$$V_a = \theta q,$$
$$V_b = \theta q + (\alpha^2 - \theta^2)s,$$

where $q$ and $s$ are scaling parameters, and can be interpreted as the quality level of access and connection software, respectively. Note that the incremental value of the connection software is $V_b(\theta) - V_a(\theta) = (\alpha^2 - \theta^2)s$. Fig. 2 provides a graphical illustration.
2.3. Outcomes under pure and mixed bundling

We consider two bundling strategies – pure and mixed. Let $p_a$ and $p_b$ represent prices for the access-only service and integrated service bundle, respectively. Then we write the consumers’ net utility ($V_i(h)/C_k$) for these two options as

$$U_b(h) = h q + (z^2 - \theta^2) s - p_b; \quad (1)$$

$$U_a(h) = h q - p_a. \quad (2)$$

Let $c$ denote the variable cost per user, representing mostly the pro-rated cost of access, since the marginal cost of connection software is negligible.

2.3.1. Pure bundling

When the ISP offers only the integrated bundle at price $p_b$ it captures users in $[h_1, h_2]$ where the indifference points $h_1$ and $h_2$ (specified in Appendices A and B) satisfy $U_a(h_1) = U_b(h_2) = 0$. Users in $[0, h_1]$ (low-end novice users) and $(h_2, 1]$ get negative surplus, and choose not to purchase the service. When $h_2 > \alpha$, some power users purchase the bundle, and when $h_2 < \alpha$ no power users purchase the bundle. The ISP’s profit is

$$\pi_b = (p_b - c)(h_2 - h_1).$$

2.3.2. Mixed bundling

For the case, where users have a choice between the integrated and access-only services, two additional indifference points are relevant. Let $\theta_3$ denote the marginal consumer who gets equal surplus from the two options, so that $U_a(\theta_3) = U_b(\theta_3)$. Let $\theta_4$ denote the marginal consumer who has zero surplus for access ($U_a(\theta_4) = 0$). The indifference points $\theta_3$ and $\theta_4$ are specified in Appendices A and B. Now, two scenarios are possible, as depicted in Fig. 3.

1. $(U_a(\theta_3) \geq 0) \equiv (\theta_3 < \theta_2)$. In this case, users in $[\theta_1, 1]$ purchase the access-only service, and users in $[\theta_1, \theta_3]$ purchase the integrated bundle. The firm’s profit is $\pi_1 = (p_b - c)(\theta_3 - \theta_1) + (p_a - c)(1 - \theta_3)$.

2. $(U_a(\theta_3) < 0) \equiv (\theta_3 > \theta_2)$. Here, users in $[\theta_4, 1]$ purchase the access-only service, and users in $[\theta_1, \theta_3]$ purchase the integrated bundle. In other words, the two service options do not compete with each other. The profit function is:

$$\pi_2 = (p_b - c)(\theta_2 - \theta_1) + (p_a - c)(1 - \theta_4).$$

Which scenario is realized depends on which one yields the higher profit. Thus, the ISPs optimal profit under mixed bundling is $\pi_{(a,b)} = \max_{p_a, p_b} \{\pi_1, \pi_2\}$.

2.4. Is mixed bundling better?

Given the negative correlation of preferences for internet access and connection manager, bundling the two features should increase price and profits [28,26,25,5]. True, but mixed bundling – offering the bundle to novice users and giving
power users a more standard gateway – should be even better. Adam and Yellen [1] and McAfee et al. [18] show that “we can immediately rule out pure bundling as a (uniquely) optimal strategy, because mixed bundling is always (weakly) better”. The literature on versioning and price discrimination [17,27] also supports this argument. In this case, mixed bundling is a form of versioning, with a quality-differentiated menu of high and low quality versions (the bundle and standalone service, respectively); customers self-select the option intended for their type, and the firm earns greater profits relative to offering the high-quality alone.

While these arguments suggest that AOL would have been better off with the mixed bundling approach, they are not complete. First, the problem may have a boundary solution: pure bundling can achieve the same optimal profit as mixed bundling. Second, our model setting is different from that studied in prior literature. The integrated service bundle is subadditive (\( V_b \) is lower than \( V_a + V_s \)) for power users, while superadditive for novice users. Hence, we cannot directly apply results from prior literature on bundling, which assume either sub- or superadditive valuations. Similarly, the versioning literature cannot be directly applied because not all users agree that the bundle is of higher quality than the access-only service. However, we formally prove (see Appendices A and B) that

*Mixed bundling is superior.* A mixed bundle, allowing a choice between the integrated bundle and an access-only option, is strictly superior to a pure bundling approach which offers the integrated bundle only.

### 3. Explanations for proprietary connection manager

The puzzle regarding AOL’s product design is why it chose to make its connection manager non-standard when doing so reduced the valuations of some customers? Why not use this approach for novice users, and add a second standardized access-only service targeted to power users? First, we discuss the role of *adverse selection* in AOL’s design, explaining that AOL was able to deter unwanted power users because of its connection manager. The flat-rate pricing regime for Internet service allowed power users to engage in wasteful use. Power users impose very high costs on the system, reducing AOL’s profitability, so AOL designed the connection manager to be unattractive to them. We also offer a second possible explanation that involves a long-term view of the problem. We argue that AOL chose not to sell the service to power users (even though it might be profitable to do so in the short term) because this would, over time, cause customers to defect: some novice users would learn from power users, and defect from the more profitable and distinctive integrated service to the more competitive access-only service.

#### 3.1. Non-standard connection manager reduces unprofitable customers

Consider the possibility that different users impose different costs on the system, due to the amount of traffic they generate or the time they are online tying up resources in the ISPs modem pool.
3.1.1. Power users impose substantially high costs

It seems reasonable to postulate that the cost imposed on the system increases rapidly with a user’s expertise. For example, certain power users stay online for many hours – as much as, say, 10 hours a day. This is about 20 times the time spent by an average AOL user (32 min/day in January 1997, [21]). Besides occupying modem lines, power users also generated far greater bandwidth costs for AOL: they were frequent users of complex file-sharing applications, audio and video streaming services, and downloaded large multimedia files. Thus, if $c(\theta)$ denotes the cost imposed by a type $\theta$ user, it seems reasonable to claim that AOL’s service costs increased rapidly for more IT-savvy users: $c'(0) > 0$ and $c''(0) \geq 0$.

Our hypotheses about behavior of different segments of AOL users are supported by data from the INDEX trials of Internet use at UC Berkeley [11] and the Data Center at the University of Florida, which functions as a non-profit ISP for UF faculty, students and staff [12,8]. In the INDEX trials (conducted in 1997–1998), Edell and Variaya report that users (university students, staff and faculty) were online for an average of 50 min/day, utilizing 2% of an available 28 Kbps line. They reported that heavy users generated about 30 times more traffic than light users and had a connect-time differential of between 20 and 54. In studies at the University of Florida in the mid-1990s, Elnicki finds that half the users were online less than 5 h/month (the lowest quarter were online less than 1 h/month), while 2.7% used more than 60 hours in a month (the heaviest 0.6% used more than 120 h/month). The cost implications of such heavy use are obvious: in the 1990s, an ISPs approximate per-user costs were $2.50/month for a modem, and 1 cent per MB for access charges [11].

The argument that usage costs increase substantially with Internet expertise is further strengthened by considering the commission revenue to AOL from providers of premium content services, content goods like weather, news and entertainment, or collateral information about commodi-

ties. Content and goods providers pay AOL advertising revenue for the customers it brings. The industry standard for such revenues is performance-based, measured as the number of eyeballs. We can view the commission revenue as reducing the net cost imposed by a user. Novice users are more likely to use content services; however, power users tend not to be heavy users of these services and thus impose an even higher net cost relative to novice users.

3.1.2. Deterring power users under flat pricing

Given the high-cost behavior of power users, it is quite easy to see that AOL would like to deter power users from joining its flat-rate service. Were AOL to offer an Internet access service with a standardized connection manager – user-friendly for novice users, but not unattractive to power users – it would face the scenario depicted in Fig. 4. The standardized service would attract high-cost power users, but these users are loss-producing and reduce AOL’s profit. AOL would prefer not to sell its service to such customers. However, it cannot eliminate them by raising price. This would only worsen the situation by increasing the proportion of power users among the buyers. Many industries face this kind of adverse selection problem [2,13]. For example, banks do not wish to provide loans to some high-risk borrowers (here the borrowers’ risk is not directly observable to the bank), however raising the price of loan (interest rate) only deters the more desirable low-risk borrowers [29].

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4 The heaviest 25% of users accounted for more than 75% of traffic, while the lightest 50% of users accounted for only 10% of traffic.

Fig. 4. Internet access with standardized connection manager.
How should a firm deter or fire such unprofitable customers? One alternative is to develop screening mechanisms such as usage-based pricing (price is based on connect-time or bandwidth), so that heavy users pay more than light users. Could this have improved AOL’s situation? It appears not. First, flat-rate, unlimited use pricing was the industry standard. There is also evidence in marketing research that flat-price regimes are sticky, because consumers perceive a higher switching cost when moving from flat-price to usage-based pricing, than for the reverse switch [19]. Second, it appears that flat-rate pricing benefited the ISPs because of consumer behavior issues. The INDEX trials indicate that a majority of users spent more under flat-price schemes than what they would under a usage-based regime [3,11]. Similar evidence exists with respect to health clubs, where subscribers pay more under annual membership pricing than under per use pricing [9] as well as other products [15]. This might be because consumers overestimate their likely usage at the time of accepting a flat-price offer or they are willing to pay a high premium for flexibility in use [22]. The INDEX trials indicate that the median premium was 50% of the average flat-price expenditure.

When price-based screening mechanisms do not work, firms can develop non-price mechanisms to screen profitable and unprofitable customers. For example, firms or governments can ration by quantity or income [6,16]. Banks can evaluate a borrower’s risk or require high collateral of high-risk borrowers [29]. Similarly, automobile insurers have learnt that age (below 25) is an excellent predictor of accident risk, hence they can employ this exogenous factor in separating drivers. Even these measures are, respectively, draconian, expensive and rather imperfect. But, for AOL, the power users’s aversion to a non-standard connection manager became an ideal and inexpensive weapon in its armor. We hypothesize that

Non-standard connection manager deters unwanted power users. America OnLine adopted a non-standard connection manager in order to make the service unattractive to heavy power users, thereby deterring them from purchase and improving profitability.

We postulate that, in the absence of other viable alternatives for managing the adverse selection problem, AOL adopted a damaged goods approach to screen out its most unprofitable customers. By making the connection manager non-standard, AOL was able to reduce the valuation of high-cost power users’, enough to deter them from buying the service. Making the connection manager non-standard had the ideal (for AOL) effect: it hurts power users while benefiting novice users. Other punitive measures – such as dropping connections after some time, or causing delays in initial connection – would have hurt both types of users. This approach is similar to, say, suicide exclusion clauses in life insurance policies, which deter just those individuals who are contemplating suicide in the near future. In many customer management programs identifying bad customers is highly individualized and very expensive. Firing bad customers, after they have been acquired, is even worse and the methods are often questionable. In contrast, AOL’s damaged goods approach was a smart, inexpensive, completely legal, way to deter its most unprofitable customers.

3.2. Why not offer both integrated service and access-only service?

While the damaged goods argument is sufficient to suggest that AOL should make the connection manager non-standard, it does not explain why it should not also offer a separate access-only service to power users. We develop this argument in the following.

3.2.1. Flat-rate pricing encouraged wasteful use

Given a cost function $c(h)$, we define a “bad customer” as one whose valuation for service is below the cost they impose on the system (i.e.,

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5 We have conversed with some heavy users of Netflix (which offers unlimited DVDs by mail for a flat monthly fee): it appears that Netflix's movie assignment algorithm gives heavy users only their least favorite choices. This might be an attempt to dissuade such users and ultimately to fire them.
there exists a threshold customer type $\theta$. The flat-rate pricing scheme, prevalent in the ISP market since the mid-1990s, encourages free-riding behavior: users engage in costly activities which offered them little value. For example, many power users stayed connected, but idle, for hours at time, getting no benefit but occupying system resources; they often ran continuous-time streaming audio and video services, generating high bandwidth costs even when they were not viewing the streaming content; or they downloaded massive multimedia files which had little value to them. Data from the INDEX trials support this argument (Edell and Varaiya note that flat-rate pricing “encourages waste” and that “heavy users waste more”). As explained above, a higher price does not solve the problem, but only deters the profitable customers. Hence it is plausible that some high-end power users were “bad” customers.

To convert this observation into an explanation of AOLs bundling strategy, we use the specific cost function $c(\theta) = c \theta^2$. Solving for $V_a(\theta) < c(\theta)$, we see that bad customers are $\theta > q/c$, where $\theta \in [0,1]$. Hence all power users are “good customers” when $c \leq q$; all power users are bad customers when the cost function is sufficiently steep ($c > q/x$); and there exist both good power users and bad power users when $c \in [q,q/x]$. See Fig. 5 for an illustration.

We focus on the case where $c \in [q,q/x]$, covering cost functions such as the dashed curve in the figure. This case is interesting because there is a potentially large surplus in the market (the sum of $V_a(\theta) - c(\theta)$ over $\theta : V_a(\theta) > c(\theta)$). This surplus, or part of it, can be extracted if the firm can restrict sales to profitable customers only. Thus, if $c \in [q,q/x]$, the market contains both good power users and bad power users, with the following characteristic: the surplus from serving a customer is decreasing in the level of IT-expertise.

**Lemma 1.** For cost functions $c(\theta) = c \theta^2$ with $c > q$, there exists a threshold customer type $\theta$ such that all customers with type greater than $\theta$ are bad customers, and the firm’s loss is greater for the more IT-savvy customers. Formally,

$$V_a(\theta) - c(\theta) < 0 \quad \text{for all } \theta > \hat{\theta},$$

and the loss $c(\theta) - V_a(\theta)$ is increasing in this interval.

3.2.2. Access-only service is unprofitable

Under mixed bundling, where the ISP offers both the integrated service and the access-only service, the profit function is the higher of the two cases discussed in Section 2.2.

$$\pi_1 = \int_{\theta_1}^{\theta_2} (p_b - c \theta^2) \, d\theta + \int_{\theta_3}^{\theta_4} (p_a - c \theta^2) \, d\theta,$$

$$\pi_2 = \int_{\theta_1}^{\theta_2} (p_b - c \theta^2) \, d\theta + \int_{\theta_3}^{\theta_4} (p_a - c \theta^2) \, d\theta.$$

In either case, AOL cannot profitably offer the access-only service (second integral) when $c > q$, that is when the market contains some bad customers (see Appendices A and B for proof). This result follows from Lemma 1 and is not surprising because AOL faces an adverse selection problem. Thus, the mixed bundling approach does not work, and we postulate that

**Access-only service is unprofitable when there are bad customers.** The market for dial-up Internet service in the 1990s contained some bad customers – power users who indulged in wasteful use under
flat-rate pricing. Since these users have higher valuations than casual users, AOL could not target standardized access-only service to good customers without also attracting the most unprofitable customers.

3.3. Rotten apples spoil the barrel: power users influence novice users

A second intuitive explanation for not offering the access-only service to power users is the potential for learning or knowledge transfer from power users to novice users. The presence of access-only power users could cause a change in novice users’ preferences. Novice users might reduce their appreciation of the connection manager after observing access-only power users. Hence in subsequent periods, some percentage of novice users would no longer be willing to pay a high price for the restricted AOL service, leading to a reduction in future profits.

To study this explanation formally, consider the game in two periods. To make the argument conservative, let us grant that the mixed bundling approach improves the ISP’s profits in the first period. Thus, some consumers choose access-only service in the first period. Assume also that in the next period, some proportion of consumers who originally choose the integrated service are going to learn from those using access-only, hence their valuation for integrated service is reduced. The extent of learning depends on \( M_a \), the first period market size for access-only service. If there are more users of access-only service, there is a greater chance that some novice users of the integrated service will learn to manage without AOL’s software. Further, users with higher \( \theta \) are more likely to learn and stop using the integrated service. Hence the effect of learning is captured via a shift in the \( \theta \)-threshold that separates power and novice users, which shifts left from \( z \) to \( \bar{z} \). The distance between \( z \) and \( \bar{z} \) can reflect the learning cost, which we did not model in detail. Equivalently, we may write the second-period valuation function for integrated service as

\[
U_b(\theta, \bar{z}) = \theta q + (\bar{z}^2 - \theta^2)s - p_b,
\]

where \( \bar{z} = z - \delta(M_a) \), and \( \delta() \), which denotes the intensity of learning, is a function of \( M_a \), with \( \delta(0) = 0 \) and \( \delta(1) = z \). Customers’ utility function for access-only service remains the same in the second period: \( U_b(\theta) = \theta q - p_a \).

Now AOL’s decision problem is to choose the optimal \( p_a \) and \( p_b \) to maximize its two-period profit, if it offers the mixed bundling options. Let \( \pi^i(-p_a; p_b, z) \) represent the \( i \)th period profit when offering mixed bundling, with novice users and power users being separated by \( z \), we can express the decision problem as:

\[
\max \pi^1(p_a, p_b; z) + \pi^2(p_a, p_b; \bar{z}). \tag{3}
\]

If AOL were to not offer the access-only option in the first period, then there is no learning, thus the decision problem is:

\[
\max 2\pi^1(p_b; z), \tag{4}
\]

where \( \pi^1(p_b; z) \) represents the profit of only offering integrated service.

To fully characterize Eq. (3) requires a total of 16 \((4 \times 4)\) cases, since in the second period there are the same number of cases to discuss as in the first period. For simplicity, we omit the formal analytical approach and present the numerical computation results. Our objective is to determine whether there exist conditions under which pure bundling yields the optimal solution. We postulate that

Power AOL users might encourage defection. The market for dial-up service in the 1990s consisted of a high fraction of novice users who could potentially defect to the less profitable access-only service in the second period, if they observed an access-only user group in the first period. This fraction \( (z) \) was sufficiently high such that the second period loss due to defection exceeded the additional profits obtained from the access-only service.

Fig. 6 illustrates the result when \( q = 0.9, s = 0.8, \bar{z} = \max\{z - 0.1(1 - \max\{0.3, 0.4\}), 0\} \), where “*” represents the performance of the mixed bundling strategy, and “o” represents that of the pure bundling strategy. The performance improves under both strategies as the number of novice users increases. More importantly when \( z > 0.6 \), the optimal strategy is to not sell the access only option.
So we can explain AOL’s insistence on proprietary connection software in the following way. When the market has a high proportion of novice users, then offering access-only service to the power users increases the chance that some of AOL’s integrated service customers will learn from the access-alone service users. These now-learned customers’ valuation for the connection manager will drop, while their willingness to pay for access-only service is no greater than before. Thus in the second period, either these customers will switch to the lower-priced access service (if they had positive surplus for both services in the first period) or drop out of the market. The larger the first-period market for AOL’s access-only service, the greater is the risk of losing market share in the second period.

4. Discussion

Our research was motivated by the observation that AOL offered only one approach to Internet access – in which non-standardized software is bundled with access to its content and the Internet – a strategy that seems suboptimal since AOL’s approach is disliked by power users and effectively eliminates them from AOL’s market. Capturing such users by offering a second access-only service without the software (or standardizing the connection manager) should increase profits. This argument is compatible with a versioning approach and with the superiority of mixed bundling over pure bundling. In this paper, however, we develop two explanations for the observed pure bundling approach, arguing that it may be optimal either if power users impose substantially higher costs or if a community of access-only users would cause novice users to drift away from the high-priced AOL software-access bundle. We interpret AOL’s product design as a smart and inexpensive damaged goods strategy to identify and deter unwanted customers.

Our explanations relate AOL’s product design strategy to the concepts of adverse selection, screening [13] and damaged goods [10]. Marketing departments in firms routinely spend vast sums of money on customer relationship management, identifying profitable and unprofitable customers, and figuring out how to fire bad customers. AOL’s strategy, we have postulated, might be an inexpensive damaged goods approach for screening out bad customers. This is interesting since typically the objective behind both screening and the damaged goods approach is to enable versioning – the damaged good captures low-type consumers while preserving high-type consumers’ incentive to purchase the standard product – whereas AOL’s objective in applying these concepts is to limit its market share. Under the flat-price “all you can eat” framework, AOL could not restrict bad customers’ purchase by specifying limitations regarding extent of use (unlike, say, life insurance firms which can exclude death by suicide). Adding the connection manager, we feel, is a very smart way to invent a product feature with opposite effect to certain customers, thereby achieving a special kind of non-price rationing.

Our research suggests potential avenues for further work. There may be other explanations for the observed phenomenon. For example, the existence of competition in the dial-up market for standalone service may prevent AOL from charging a sufficiently high price (necessary to prevent cannibalization) for this option. Or, AOL’s strategy might be motivated by a desire...
to minimize technical troubleshooting and support costs: having all customers on a single standard interface also reduces training costs for customer support agents. While our work generates plausible hypotheses based on analytical modeling, other techniques could be employed to validate the actual reasoning behind AOL’s observed practice.

The “deter unwanted customers by damaging the good” strategy may also be relevant in other settings. Insurance companies deter high-risk customers by specifying inconvenient clauses. Product manufacturers deter returns for repairs by imposing high transaction costs for shipping and handling. Sometimes, though, heavy users are not bad customers. For example, Internet game rooms (which are mostly free or flat-fee based) often experience congestion due to a few very heavy players, however such users also create positive externalities: they often provide training to newcomers, and increase the probability of finding a matching player. A similar logic applies in health clubs, which also do not try to deter heavy users. Finally, an interesting example where society might want – but has not figured out a means – to deter bad customers is email spam under the industry standard of flat-rate pricing. Wouldn’t it be great if email service included a feature that was an absolute nuisance to spammers?

Acknowledgments

We are grateful to participants, reviewers and co-chairs of HICSS-37, and to Vidyanand Choudhary, Eitan Gerstner and Ramayya Krishnan, for excellent suggestions on earlier drafts. We also thank Richard Elnicki for Internet usage data at University of Florida.

Appendix A. Indifference points under pure and mixed bundling

A.1. Pure bundling

Solving the condition \( U(\theta_1) = U(\theta_2) = 0 \), subject to \( \theta_1, \theta_2 \in [0,1] \), yields

\[
\theta_1 = \max \left\{ 0, \frac{q - \sqrt{q^2 - 4ps^2 + 4s^2x^2}}{2s} \right\}, \quad (A.1)
\]

\[
\theta_2 = \min \left\{ \frac{q + \sqrt{q^2 - 4ps^2 + 4s^2x^2}}{2s}, 1 \right\}. \quad (A.2)
\]

The firm captures customers in \([\theta_1, \theta_2]\).

A.2. Mixed bundling

Solving the indifference equations \( U_a(\theta_3) = U_b(\theta_3) \) and \( U_a(\theta_4) = 0 \) yields

\[
\theta_3 = \min \left\{ \max \left\{ 0, \frac{\sqrt{p_a - ps + x^2s}}{s} \right\}, 1 \right\}, \quad (A.3)
\]

\[
\theta_4 = \min \left\{ \frac{p_a}{q}, 1 \right\}. \quad (A.4)
\]

If \( \theta_3 < \theta_2 \), then the indifferent consumer \( \theta_3 \) enjoys positive surplus for both options, \( U_a(\theta_3) > 0 \). Users in \([\theta_3, 1]\) have a greater surplus from the access-only service, while users in \([\theta_1, \theta_3]\) prefer the integrated bundle.

However, if \( \theta_3 > \theta_2 \), then the indifferent consumer has a negative surplus in both cases, hence chooses not to buy at all. Here, users in \([\theta_4, 1]\) purchase the access-only service, and users in \([\theta_1, \theta_3]\) purchase the integrated bundle.

Appendix B. Technical details

Proof. (Mixed bundling is superior) Suppose that the optimal price for offering the bundle only is \( p_0 \), we show that ISP can improve profits by offering additional access-only service. Let \( \theta^*_1 \) and \( \theta^*_2 \) be the optimal indifference points so that the bundle covers consumers in \([\theta^*_1, \theta^*_2]\).

1. If \( \theta^*_2 > x \), then the firm attracts some power users under the pure bundling approach. Now suppose the firm adds an access-only service at the same price \( p_0 \). Since novice users get lower utility from access-only, none of them will switch. Since power users get higher utility, all the current power buyers will switch to access-only. In addition, all
the other power users to the right of $\theta^*_2 > \alpha$ will also buy the access service, thus increasing both market share and profit.

(2) If $\theta^*_2 < \alpha$, then the pure bundling approach covers only novice users. Now power users present an additional market to the ISP, without any threat of interference between the two markets. Thus the ISP can determine a price for the access-only service, independent of any effect on the current market for its bundled service; any price which attracts some power users will increase profits. □

In both cases, $\pi^*_h > \pi^*_p$, mixed bundling is strictly better than pure bundling.

**Proof.** (Access-only service is unprofitable) For case 2, where there is no competition within the firm’s product line (i.e., between the integrated service and access-only service), the net profit from the access-only component is $\int_{\theta^*_2}^{\theta^*_1} (p_a - c\theta^2) \, d\theta$. By definition, $\theta_a = p_a/q$ so that the ISPs profit is

$$\pi_a = \int_{\theta_a}^{1} (p_a - c\theta^2) \, d\theta.$$  

Computing the integral, we see that whenever $c > q$, which corresponds to the case where there is at least one bad customer (see Fig. 5), then the ISP cannot earn positive profit at any price.

Case 1 corresponds to competition between the integrated and access-only services, hence the profit for each component is lower than the profit for that component under no competition. Specifically, this implies that the access-only service cannot contribute a positive profit. □

References