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Opening Platforms: How, When and Why?

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Abstract

Platform-mediated networks encompass several distinct types of participants, including end users, complementors, platform providers who facilitate users' access to complements, and sponsors who develop platform technologies. Each of these roles can be opened—that is, structured to encourage participation—or closed. This paper reviews factors that motivate decisions to open or close mature platforms. At the platform provider and sponsor levels, these decisions entail: 1) interoperating with established rival platforms; 2) licensing additional platform providers; or 3) broadening sponsorship. With respect to end users and complementors, decisions to open or close a mature platform involve: 1) backward compatibility with prior platform generations; 2) securing exclusive rights to certain complements; or 3) absorbing complements into the core platform. Over time, forces tend to push both proprietary and shared platforms toward hybrid governance models characterized by centralized control over platform technology (i.e., closed sponsorship) and shared responsibility for serving users (i.e., an open provider role).

Keywords: platforms, network effects, open innovation, standards, two-sided networks

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Selecting optimal levels of openness is crucial for firms that create and maintain platforms (Gawer & Cusumano, 2002; West, 2003; Gawer & Henderson, 2007; Boudreau, 2008; Eisenmann, 2008; Parker & Van Alstyne, 2008). Decisions to open a platform entail tradeoffs between adoption and appropriability (West, 2003). Opening a platform can spur adoption by harnessing network effects, reducing users' concerns about lock-in, and stimulating production of differentiated goods that meet the needs of user segments. At the same time, opening a platform typically reduces users' switching costs and increases competition among platform providers, making it more difficult for them to appropriate rents from the platform.

In this chapter, we review research on factors that motivate managers to open or close mature platforms. We focus on a subset of platforms: those that exploit network effects by mediating transactions between platform users (Eisenmann, Parker & Van Alstyne, 2006; Evans, Hagiu, & Schmalensee, 2006; Evans & Schmalensee, 2007). Our inquiry excludes platforms that do not mediate network transactions but instead enable a firm to offer product variety by sharing common components (as with Chrysler's K-car or Boeing's 777).

A platform is "open" to the extent that: 1) no restrictions are placed on participation in its development, commercialization or use; or 2) any restrictions—for example, requirements to conform with technical standards or pay licensing fees—are reasonable and non-discriminatory, that is, they are applied uniformly to all potential platform participants. As described in the next section, platform-mediated networks encompass several distinct roles, including: 1) *demand-side platform users*, commonly called "end users"; 2) *supply-side platform users,* who offer complements employed by demand-side users in tandem with the core platform; 3) *platform providers,* who serve as users' primary point of contact with the platform; and 4) *platform sponsors,* who exercise property rights and are responsible for determining who may participate in a platform-mediated network and for developing its technology. For a given platform, each of these roles may be open or closed. Consequently, characterizing a platform as "open" without referencing relevant roles can cause confusion.

The Linux platform, for example, is open with respect to all four roles. Any organization or individual can use Linux (demand-side user role). Likewise, any party can offer a Linux-compatible software application (supply-side user role). Any party can bundle the Linux operating system (OS) with server or personal computer hardware (platform provider role). Finally, any party can contribute improvements to the Linux OS, subject to the rules of the open source community that maintains the OS kernel (platform sponsor role). For Linux and other platforms, openness at the sponsor level entails greater openness at the user level, as it implies not only non-discrimination in platform access, but also in the process of defining platform standards.

By contrast, in 2008 Apple's iPhone was closed with respect to three of the four roles, and is only open for some prospective demand-side users under onerous terms. In the U.S., only AT&T Wireless subscribers can use an iPhone. To buy one, other mobile carriers' customers must switch to AT&T, incurring inconveniences and contract termination fees. Other roles in the iPhone network are closed. Software

applications for the iPhone are only available through Apple's iTunes Store. Apple reserves the right to reject third-party applications due to quality or strategic concerns, and often does so (supply-side user role). Finally, only Apple manufactures and distributes the iPhone (platform provider role) and Apple is solely responsible for the iPhone's technology (platform sponsor role).

Between these extremes, we find platforms that mix open and closed roles in different patterns (Figure 1). For instance, Microsoft's Windows platform is closed at the sponsor level but open with respect to other roles. Apple's Macintosh platform is closed at the sponsor and provider levels but open with respect to both user roles. Since all of the platforms in Figure 1 are successful, it should be clear that without careful definitions, we cannot make general statements about the attractiveness of open versus closed platform strategies—notwithstanding enthusiasm about the profusion of open source software and content created in collaborative communities like Wikipedia and Second Life.

Figure 1: Comparison of Openness by Role in Platform-Mediated Networks

	Linux	**Windows**	**Macintosh**	**iPhone**
Demand-Side User (End User)	Open	Open	Open	Open
Supply-Side User (Application Developer)	Open	Open	Open	**Closed**
Platform Provider (Hardware/OS Bundle)	Open	Open	**Closed**	**Closed**
Platform Sponsor (Design & IP Rights Owner)	Open	**Closed**	**Closed**	**Closed**

This chapter examines decisions to open or close platforms in mature markets rather than new ones. An extensive body of research analyzes decisions to pursue compatibility with rivals' technical standards when launching new products (e.g., Farrell & Saloner, 1985; Katz & Shapiro, 1985; David & Greenstein, 1990; Besen & Farrell, 1994; Shapiro & Varian, 1999). Likewise, a burgeoning literature focuses on competition between open and closed (i.e., proprietary) platforms (e.g., Economides & Katsamakas, 2006; Hagiu, 2006; Lee & Mendelson, 2008; Parker & Van Alstyne, 2008). Most of these papers analyze new markets where user mobilization is a priority and network effects are highly salient. However, there has been less research on the relative advantages of open and closed architectures once platforms mature and users are on board (exceptions include Gawer & Cusumano, 2002; West, 2003; Baldwin & Woodard, 2007; Gawer & Henderson, 2007; and Boudreau, 2008). By focusing on mature markets, our chapter aims to help fill this gap in the literature.

The chapter is organized into four sections. The first defines our terms and expands on the discussion above of different roles in a platform-mediated network. Section two examines horizontal strategies that open or close a platform, encompassing decisions to: 1) interoperate with established rival platforms; 2) license additional platform

providers; and 3) broaden a platform's sponsorship. Section three considers vertical strategies that open or close the supply-side user role, including choices regarding: 1) backward compatibility with prior platform generations; 2) securing exclusive rights to certain complements; and 3) absorbing complements into the core platform. The final section reviews management challenges confronting closed/proprietary and open/shared platforms in maturity, speculating about forces that push both types of platforms toward hybrid governance models typified by central control over platform technology and shared responsibility for serving users.

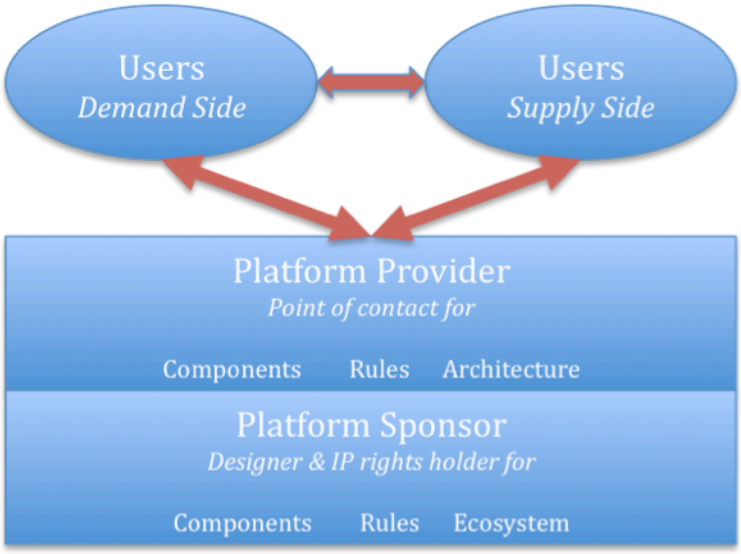
Definitions

A *platform-mediated network* is comprised of users whose transactions are subject to direct and/or indirect network effects, along with one or more intermediaries that facilitate users' transactions (Rochet & Tirole, 2003; Eisenmann, Parker & Van Alstyne, 2006; Evans & Schmalensee, 2007). The *platform* encompasses the set of components and rules employed in common in most user transactions (Boudreau, 2008). *Components* include hardware, software, and service modules, along with an architecture that specifies how they fit together (Henderson & Clark, 1990). *Rules* are used to coordinate network participants' activities (Baldwin & Clark, 2000). They include standards that ensure compatibility among different components, protocols that govern information exchange, policies that constrain user behavior, and contracts that specify terms of trade and the rights and responsibilities of network participants.

Platform-mediated networks can be categorized according to the number of distinct user groups they encompass. In some networks, users are homogenous. For example, although a given stock trade has a buyer and seller, these roles are transient; almost all traders play both roles at different times. Networks with homogenous users are called *one-sided* to distinguish them from *two-sided* networks, which have two distinct user groups whose respective members consistently play a single role in transactions (Rochet & Tirole, 2003; Parker & Van Alstyne, 2000, 2005; Armstrong, 2006). Examples of two-sided networks include credit cards (comprised of cardholders and merchants), HMOs (patients and doctors), and video games (consumers and game developers).

In traditional industries, bilateral exchanges follow a linear path as vendors purchase inputs, transform them, and sell output. By contrast, exchanges in platform-mediated networks have a triangular structure (Eisenmann, Parker & Van Alstyne, 2006). Users transact with each other and simultaneously affiliate with platform providers (see Figure 2). For example, with Sony's two-sided Playstation platform, developers on the platform's *supply side* offer games to consumers on the *demand side*—the first set of bilateral exchanges. Developers must also contract with the platform's provider, Sony, for permission to publish games and for production support: the second set of exchanges. Finally, consumers must procure a console from Sony: the third set of exchanges.

Figure 2: Elements of a Platform-Mediated Network



In a two-sided network, from the perspective of demand-side users, supply-side users like game developers offer *complements* to the platform. However, such complements are not part of the platform itself: a platform encompasses components used in most user transactions, and only a fraction of platform use involves any given game. Hence, although games and consoles must be consumed as a system, in the context of the Playstation platform, the developer is a platform *user* rather than a platform *provider*.

Every platform-mediated network has a focal platform at its core, although some complements offered by supply-side users may themselves be platforms nested inside the focal platform (e.g., a multi-player game like *Madden NFL 09* with respect to Playstation), as described below. To create and maintain the focal platform, one or more intermediaries must fulfill two distinct roles: platform provider and platform sponsor. *Platform providers* mediate users' transactions; they serve as users' primary point of contact with the platform. They supply its components and adhere to its rules. *Platform sponsors* do not deal directly with users; rather, they hold rights to modify the platform's technology. They design the components and rules, and determine who may participate in the network as platform providers and users.

A platform's sponsor and provider roles each may be filled by one company or shared by multiple firms.[1] These possibilities define a 2x2 matrix depicting four possible structures for platform governance (Figure 3). With a *proprietary platform* such as eBay, the Miami Yellow Pages, or Nintendo Wii, a single firm plays both the sponsor and provider role. A *shared platform* such as the UPC barcode, DVD, or Wi-Fi has multiple sponsors who collaborate in developing the platform's technology then compete with each other in providing differentiated but compatible versions of the

platform to users. Rival providers of a shared platform employ compatible technologies; hence, users who rely on different providers (e.g., Ubuntu Linux vs. Red Hat Linux) can access a common set of complements (e.g., any Linux-compatible application). If users switch between rival providers of a shared platform, they forfeit neither platform-specific investments in complements nor time spent learning the platform's rules.

Figure 3: Models for Organizing Platforms

		Who Provides the Platform (*Provider Role*)?	
		One Firm	**Many Firms**
Who Controls Platform Technology (*Sponsor Role*)?	**One Firm**	***Proprietary*** • Macintosh • Playstation • Monster.com • Federal Express	***Licensing*** • Palm OS • American Express-branded MBNA cards • Scientific-Atlanta set-tops
	Many Firms	***Joint Venture*** • CareerBuilder (created by three newspaper groups) • Orbitz (created by several major airlines)	***Shared*** • Linux • Visa • DVD • UPC barcode

By contrast, *rival platforms* employ incompatible technologies (e.g., Playstation vs. Wii). *Platform-mediated markets* are comprised of sets of rival platforms, each serving distinct platform-mediated networks. For example, the console-based video game market includes the Xbox, Playstation, and Wii networks; the U.S. credit card market includes the Visa, MasterCard, and American Express networks. Two platforms are rivals in the same platform-mediated market if they employ incompatible technologies and if changing the price that users pay to affiliate with one platform influences the other's transaction volumes.

Continuing with analysis of the 2x2 matrix, some platforms combine proprietary and shared elements in hybrid governance structures. With a *joint venture* model, several firms jointly sponsor the platform, but a single entity serves as its sole provider. For example, by jointly creating the online recruitment site CareerBuilder, three large newspaper groups shared development expenses and avoided competing with each other.

Finally, with a *licensing* model, a single company sponsors the platform then licenses multiple providers. Several factors may motivate licensing. First, licensees may have unique capabilities to create platform varieties that meet users' differentiated needs. For example, licensing Windows has spawned a greater variety of PC designs than are available with the proprietary Macintosh platform. Second, a sponsor can boost platform adoption by harnessing partners' marketing clout—a key ingredient in JVC's success with the VHS videocassette format, which was more widely licensed

than Sony's Betamax (Cusumano, Mylonadis & Rosenbloom, 1992). Finally, powerful customers may insist upon a second source of supply to reduce vulnerability to hold-up and supply interruptions (Farrell & Gallini, 1988). Scientific-Atlanta, for example, has licensed its cable set-top technologies to a few "clone makers" in response to demands from large cable system operators (Eisenmann, 2004b).

Horizontal Strategy

Horizontal strategies target a firm's existing and prospective rivals, as with horizontal mergers that consolidate a monopoly.[2] In this context, opening a firm's platform means: 1) allowing a rival platform's users to interact with the focal platform's users; 2) allowing additional parties to participate directly in the focal platform's commercialization; or 3) allowing additional parties to participate directly in the focal platform's technical development. Below, we analyze the conditions under which these three strategies for opening mature platforms will be attractive for sponsors.[3]

Interoperability

As markets mature, the sponsors of rival platforms who previously have eschewed compatibility may find it attractive to make technical modifications that allow *interoperability,* that is, cross-platform transactions between their respective users (Katz & Shapiro, 1985; Farrell & Saloner, 1992). For example, text-messaging services from various U.S. mobile phone carriers were incompatible for many years, until carriers finally agreed in 2002 to allow their subscribers to exchange messages. When two platforms become interoperable, they become more *open:* users of platform A can interact with platform B's users, including supply-side users who offer complements.

Properties of Converters. Interoperability is achieved through the use of converters, which are also known as adapters or gateways (David & Bunn, 1988). For example, in 2004, RealNetworks created converter software—called "Harmony"—that allowed iPod owners to use Real's music store instead of iTunes. However, Real's Harmony initiative was not welcomed by Apple, which had designed iPods and iTunes to only work with each other, not with third-party music management software or music players. Apple broke compatibility with Harmony's through subsequent upgrades to iTunes—a tactic often employed when platform providers are targeted for interoperability against their wishes.

Several properties of converters are salient:

- Converters can be costly. Their expense is typically borne by the weaker platform, as with Real's Harmony (Farrell & Saloner, 1992).
- Converters can be one or two way. For example, early Macintosh computers could read DOS-formatted floppy disks, but the reverse was not true. Conversely, Microsoft Word can both read and save files in WordPerfect format.

- Converters may be developed unilaterally—like Real's Harmony—or bilaterally, depending on engineering considerations and intellectual property protection. If a unilateral converter is technically and legally feasible, then an increase in either platform's profitability is sufficient for its introduction. If technical or legal constraints preclude unilateral efforts, then an increase in total industry profits is a sufficient condition for interoperability, assuming the possibility of side payments between platforms (e.g., licensing fees). Absent side-payments, an increase in both platforms' profitability is necessary for interoperability (Katz & Shapiro, 1985).

- Finally, due to technical compromises and the functional redundancy required to achieve interoperability, cross-platform transactions can suffer quality degradation compared to intra-platform transactions (Farrell & Saloner, 1992; Ulrich, 1995). Also, platforms may deliberately limit the quality of cross-platform transactions to maintain differentiation (Cremer, Rey & Tirole, 2000).

Interoperability with Established Rivals. When a market is young and first-time users are affiliating with platforms in large numbers, a dominant platform is likely to avoid interoperating with smaller rivals. Once platforms are established and user acquisition rates slow, however, it may make sense for rivals to reconsider compatibility policies—especially if their market shares approach parity. These dynamics are evident in the 2005 instant messaging interoperability agreement negotiated between Yahoo! and Microsoft's MSN, which had similar shares of a maturing market. Likewise, after years of operating incompatible automatic teller machine networks, the comparably sized Cirrus and Plus platforms agreed in 1990 to interoperate (Kauffman & Wang, 2002).

The appeal of interoperability to a platform sponsor will depend on the resulting impact on market size and on the sponsor's market share and profit margin.

- **Market Size.** If network effects are positive and strong, then users' aggregate willingness to pay (WTP) for platform affiliation should increase when interoperability provides access to a larger total user base. However, increased user WTP does not automatically translate into greater industry revenues. As explained below, platform prices may decline due to heightened competition. Also, interoperability may eliminate the motivation for some users to multi-home (i.e., affiliate with multiple platforms), resulting in lower industry unit volumes.

- **Market Share.** Post-interoperability market shares will depend on several factors, including: 1) the extent to which platforms are differentiated in terms of standalone properties unrelated to network size; 2) switching costs; 3) multi-homing costs; and 4) converter costs.

- **Margins.** The impact of interoperability on platform pricing is not clear-cut. With homogenous platforms and elastic demand, prices may decline (Katz & Shapiro, 1985). However, in a growing market, interoperability may blunt the drive to race for new users. Also, when converter costs are borne by a weaker

platform's users, the dominant platform has an ability and incentive to raise prices (Farrell & Saloner, 1992). Finally, a dominant platform provider's margin may improve if it can charge weaker rivals for interoperability rights.

Entry Deterrence. An archetypical challenge in industries with strong network effects pits an established platform provider against an entrant with a superior proprietary technology but no installed base. If the market is still young and expected to grow substantially, then prospective users are more likely to favor the entrant's superior proprietary platform (Katz & Shapiro, 1992; Matutes & Regibeau, 1996). Under these conditions, an incumbent's profit in a duopoly with compatibility may exceed profits under an incompatible scenario (Xie & Sirbu, 1995).

By contrast, if the market is mature and little growth is expected, then the entrant will only be viable if the incumbent offers interoperability. Under these conditions, the incumbent may be able to deter entry through a credible commitment to avoid interoperability. If the incumbent cannot profitably deter entry but it can license its standard, then there should be an optimal royalty rate that causes the entrant to adopt the incumbent's standard, boosting the incumbent's profit relative to an incompatible scenario (Kulatilaka & Lin, 2006).

Licensing New Providers

When a market is young, serving as sole platform provider offers a big advantage: a proprietary provider can mobilize users through subsidization strategies, without fear of free-riding rival providers draining away profits (Katz & Shapiro, 1986; Eisenmann, 2008). This advantage is less salient once users are on board. The proprietary provider of a mature platform may find it attractive to license additional platform providers while preserving control over platform technology. For example, after serving as sole platform provider for several years, Palm licensed its operating system to Sony, Samsung, Handspring, and many other handheld device manufacturers (Yoffie & Kwak, 2001; Gawer & Cusumano, 2002). Likewise, in 2004, after decades of operating as the sole provider of its proprietary platform, American Express agreed to let MBNA issue American Express-branded affinity cards. Of course, opening the platform in this manner will introduce competition and put downward pressure on platform pricing. The platform's sponsor can limit pricing pressure and guarantee itself a base level of profits by levying license fees on new providers.

Licensing is most attractive when new providers can offer innovative versions of platform products, rather than simply creating clones. As the market grows and matures, user segments with differentiated needs usually emerge. A single firm may be unable to create a sufficiently broad array of products to satisfy increasingly diverse needs. For example, Palm-licensee Sony built advanced photo, video, and audio playback into its CLIÉ PDAs. Likewise, Handspring's Palm-powered Visor had an expansion slot that supported modules for games, eBooks, cellular telephones, MP3 players, and digital cameras. In both cases, licensees provided platform extensions that were beyond Palm's in-house engineering capabilities. Arguably, one reason that Apple terminated the license that allowed Motorola and others to sell Macintosh-compatible hardware during the mid-1990s was its licensees' inability to deliver

differentiated products. Instead of expanding the market, Apple's licensing strategy created competitors.

Competition with rival platforms may encourage a focal platform's sponsor to license additional providers with the goal of harnessing network effects and attracting additional users. In this way, some of the rents that are competed away by new platform providers can be recovered in the form of increased fees collected from a larger user base (Parker & Van Alstyne, 2008). Verizon, for example, sought to blunt competition from the AT&T/Apple iPhone alliance by opening its mobile communications platform to a wider array of mobile devices.

Sponsors who license additional platform providers should anticipate conflict with new partners over the division of platform rents as well as the platform's technological trajectory and strategic direction. Palm, for example, faced complaints that its control over OS software gave it an unfair advantage over licensees in designing new devices. In response, Palm separated its hardware and software units into separate public companies in 2003.

Broadening Sponsorship

The strategy discussed immediately above, licensing additional platform providers, involves recruiting partners who create and market variants of platform goods and services. In this scenario, the platform's sponsor still retains sole responsibility for designing the platform's core technology. Licensees may engineer variations that extend the platform, but they take its core technology as a given.

A more radical option for opening an established platform entails that platform's sole sponsor inviting other parties to jointly develop the platform's core technology. Opening the sponsorship role has several potential advantages. First, assuming that costs incurred in creating and maintaining a platform's core technology are to some extent fixed and independent of the number of firms involved in development, then the original sponsor should be able to reduce its R&D costs by sharing those costs with additional sponsors. Also, competition among sponsors to incorporate their respective technologies into a common standard may result in survival of the fittest proposals. Finally, open processes for jointly developing technologies invite ongoing feedback, which may yield higher quality products (Chesbrough, 2003; West, 2006).

On the negative side for opening the sponsorship role, innovation in formal standards-setting organizations (SSOs) and similar forums may be slowed by political maneuvering and complex coordination processes (Garud & Kumaraswamy, 2002; Simcoe, 2006a). Also, "least common denominator" dynamics in SSOs may yield lower-quality standards due to "tyranny of the majority" voting (e.g., when most SSO members lack the skills to work with leading-edge technologies) or due to vested interests (e.g., when incumbents reject an entrant's innovations in order to protect their sunk investments). Finally, with a proprietary model, engineering choices are subject to hierarchical direction rather than multi-lateral negotiation. Especially when core technologies are immature or in flux, proprietary platforms may engineer more tightly integrated systems that out-perform those developed through shared platforms.

It is difficult to generalize about conditions under which the various advantages and drawbacks cited above will weigh more heavily. Consequently, the impact of shared sponsorship on rates of innovation is ambiguous, relative to proprietary models. In his study of handheld computing platforms, Boudreau (2008) observed an inverted "U" relationship between rates of innovation and platform openness. As a platform moved from low to moderate levels of openness, innovation increased as new providers tailored platform variants that leveraged their distinct capabilities. However, in moving from moderate to high levels of openness, disincentives to invest due to excessive competition eventually offset the positive impact on innovation of new providers' diverse capabilities.

The impact of proprietary versus shared sponsorship models on rates of innovation is also difficult to assess because the models seem to favor different types of innovation. Greenstein (1996) argued that a proprietary platform provider will tend to pursue systemic innovation, leveraging its ability to control the pace and direction of concurrent improvements across all of a platform's various subsystems. By contrast, according to Greenstein, divided technical leadership under shared sponsorship is more likely to promote a more modular architecture and to yield component-level innovation.

West (2003) concluded, based on his case studies of IBM, Sun Microsystems, and Apple, that established platform sponsors will generally prefer the superior rent-capturing regime of proprietary governance models and will only open the sponsorship role when:

- Their established platform faces significant pressure either from rival platforms or from users demanding open standards to avoid lock-in.
- Commoditizing the platform significantly enhances its appeal, allowing the original platform sponsor to increase its profits from the sale of complementary products and services.

The first motivation is evident in moves by Netscape, RealNetworks, and Sun Microsystems to release their respective platforms' software under open source licenses. Each firm was operating under severe competitive duress when it made the decision to open the sponsorship role: Netscape had lost significant browser market share to Microsoft's Internet Explorer; RealNetworks' streaming media platform had been displaced by Microsoft's Windows Media Player; and Sun's Solaris server operating system was facing low-end competition from both Linux-based products and from Windows Server.

West's second motivation is evident in IBM's decision to champion Linux and to transfer intellectual property rights for its Eclipse software development tools to an independent foundation responsible for stewardship of an open source community (Baldwin, O'Mahony & Quinn, 2003; O'Mahony, Diaz & Mamas, 2005). In this manner, IBM has been able to promote the sale of its proprietary middleware software that leverages the Linux OS and other open source software. IBM also profits from the

sales of system integration services to enterprise users who rely on a mix of open source software and in-house applications developed using Eclipse.

Vertical Strategy

Firms that sponsor platforms face familiar decisions about vertical strategy. For example, they must decide when to rely on third-party suppliers versus in-house units for platform components. In general, platform sponsors approach such "make-buy" choices in the same way as counterparts in traditional industries. Consequently, we focus here on decisions about vertical strategy that are distinctive to platform-mediated networks.

Vertical strategy is especially complex for platforms with supply-side users that offer complements that are consumed by demand-side users. Sponsors of such platforms must make three sets of choices regarding to the extent to which they open or close the supply-side user role. First, when upgrading their platforms, they must determine whether to extend backward compatibility to complements developed for past platform generations. Second, sponsors must weigh the advantages of granting exclusive access rights to selected complementors. Finally, sponsors must consider the arguments for and against absorbing certain complements into the core platform. Below, we analyze the conditions under which platform sponsors are likely to pursue these vertical strategies.

Backward Compatibility

When launching next-generation platform products and services, platform sponsors must decide whether to engineer them to be backward compatible with complements developed for previous platform generations. Failing to provide backward compatibility can be construed as *closing* a platform to the extent that it limits existing complementors' access to new versions of the platform.

With generational change, optimal strategy will depend on whether platform providers can price discriminate between existing and new users (Fudenberg & Tirole, 1998). Openness decisions matter less if platforms can price discriminate. With backward compatibility and no price discrimination, existing users will ignore network effects in their adoption decisions. Specifically, they only will adopt the next-generation platform if its price is less than the increase in standalone utility it offers (i.e., utility that is independent of network effects), compared to the current generation. Consequently, if technical improvements are large, then a platform provider should market an incompatible next-generation platform to both existing users and unaffiliated prospects. If improvements are modest, then the intermediary should offer a backward-compatible next-generation platform at a price that will appeal to new users but will be ignored by existing users (Choi, 1994).

Platform and Category Exclusivity

Agreements between sponsors and third-party complementors that restrict complementors' platform access have two dimensions—platform exclusivity and

category exclusivity. First, agreements may dictate whether or not a given complement can also be made available to a rival platform's users (i.e., whether it can be "ported" across platforms). For example, versions of the non-exclusive video game *Spore* are available for all consoles, whereas early versions of the hit game *Grand Theft Auto* were only available for the Playstation platform. Second, agreements may specify whether or not a third-party complementor is granted the sole right to offer complements of a given category to the focal platform's demand-side users. For example, the Mozilla Foundation has given Google's search engine an exclusive position on the Firefox browser's menu bar.

For convenience, we refer to the first type of agreement—a sponsor denying a complementor access to rival platforms—as a platform *exclusivity*. Such agreements make a *rival's* platform less open. We refer to second type of agreement—a sponsor granting privileged platform access to a complementor—as category exclusivity. Such agreements make the *focal* platform less open. These "yes/no" options regarding exclusivity and exclusionary agreements define a 2x2 matrix with four possible combinations.

Platform Exclusivity Agreements. When competing against rival platforms, securing the exclusive affiliation of complementors can accelerate a platform's growth. In order to secure exclusive rights when a platform is young and there is uncertainty about its prospects, sponsors typically must offer economic concessions to third-party complementors.

After users are mobilized, however, the value of exclusive supply agreements to a platform provider typically will decline—unless exclusivity serves to deter platform entrants. In fact, in a mature market with a dominant proprietary platform and several smaller rivals, the dominant provider may be able to demand exclusivity under terms that prove onerous for complementors. If the dominant provider's market share is large enough, it can levy fees for platform access that are so high that they extract almost all the expected rent from supplying complements. If complementors refuse to pay these fees, they may not be able to generate enough sales from smaller platforms to cover their fixed development costs. In that scenario, they will be forced to exit the market or will be unable to afford market entry in the first place.

Such dynamics are evident in the console-based video game industry, where one platform often garners a large share of sales for a given generation of competing consoles (Eisenmann & Wong, 2004; Lee, 2007). For example, Sony's PS2, which was launched in 2000, had a 75% worldwide share of 128-bit generation console sales through 2005. By then, Sony was positioned to easily force platform exclusivity on every third-party video game title, but it chose not to do so.

In addition to the risk of provoking antitrust litigation (as Nintendo did by aggressively pursuing exclusivity during earlier generations), strategic considerations may explain Sony's restraint. Game developers and console makers play a repeated game. Sony might have been less inclined to exploit its late-cycle dominance because extortionate demands might reduce developers' willingness to support Sony's next-generation console. Also, as shown by Mantena, Sankaranarayanan, & Viswanathan

(2007), late in a console generation, a game developer may have increased incentives to negotiate category exclusivity with a *small* platform. With fewer developers supplying games to a small platform, its more modest market potential is offset by less intense competition within a given game format.

Category Exclusivity. Complementors may be reluctant to make platform-specific investments if they will face a serious problem with "business stealing" by their close rivals. One way for platform sponsors to profit from this situation is to deliberately exclude all but a few supply-side users, then charge that sole user high fees for the privilege of trading with platform's demand-side users. Of course, the platform provider must ensure that sellers granted this privilege do not abuse their monopoly position; otherwise, demand-side users will avoid the platform. Online car buying services like Carpoint, which forwards consumers' queries to a single dealer in any given geographic territory, have succeeded with this strategy (Eisenmann & Morris, 2000).

More generally, Parker & Van Alstyne (2008) and Rey & Salant (2007) have found that platform sponsors can profit by reducing competition among complementors. This stands in contrast to Shapiro & Varian's (1999) analysis showing that platforms may benefit by commoditizing complements. The difference can be traced to assumptions about the ways in which platforms capture value. In Parker & Van Alstyne's analysis, sponsors can charge fees to complementors as well as end users—a pricing structure that prevails in the video game industry, among others. With such a pricing structure, platforms benefit directly from the success of complementors. In contrast, Shapiro & Varian consider a case in which platforms profit solely from sales of platform goods and services to demand-side users. With this pricing structure, cheaper complements increase the demand-side user base.

Absorbing Complements

As platforms mature, proprietary providers may absorb complements previously supplied by third parties. For example, the Windows OS has incorporated many functions that began as standalone software applications from third parties, such as web browsing, disk management, streaming media, modem support, and fax utilities. Absorption can be construed as *closing* a platform to the extent that third-party suppliers of standalone complements find it more difficult to compete once the platform provider bundles a variant of their product.

Efficiency Gains. When a complement is consumed by a large fraction of a platform's users, bundling its functionality with the platform provider's core offering may be more convenient for users, who can avoid shopping among alternatives, spend less time configuring the complement, and value a single point of contact for customer service.

Likewise, platform providers can improve efficiency in several ways when they bundle complements (Davis, MacCrisken & Murphy, 2002; Eisenmann, Parker & Van Alstyne, 2007). First, they should realize economies of scope in customer acquisition activities because they can sell a more valuable bundle with a single marketing

campaign. Second, integrated designs may yield quality advantages through simplification of interfaces, as with Apple's iPod/iTunes system.

Third, an absorbed complement may be a platform itself, nested—like a Russian matryoshka doll—inside another platform (e.g., a web browser vis-à-vis a PC operating system). In such cases, users' willingness-to-pay for the absorbed complement will depend in part, due to indirect network effects, on the availability of additional complements—that is, a *third* set of smaller matryoshka dolls—that leverage the absorbed complement's platform functionality (e.g., "plug-ins" that extend a browser's capabilities). If bundling results in a dominant share for the platform provider's version of the absorbed complement, then the supply of "complements to the complement" by third parties should be stimulated by a reduction in their risk of making platform-specific investments (Davis, MacCrisken & Murphy, 2002).

Cisco Systems Inc. employs a particularly salient test: absorb complements when competition for a given feature has emerged across multiple industry or category vertical markets (see Figure 4). Competitive supply indicates broad demand for the feature, establishes a common standard for downstream development, and harms complementors less since they have already seen their margins erode. Platform firms often extend this test to absorb particularly critical complements. Sorting applications on the basis of popularity, the platform sponsor can choose to own the highest rank order items, as Microsoft has chosen to do for its operating system and game platforms.

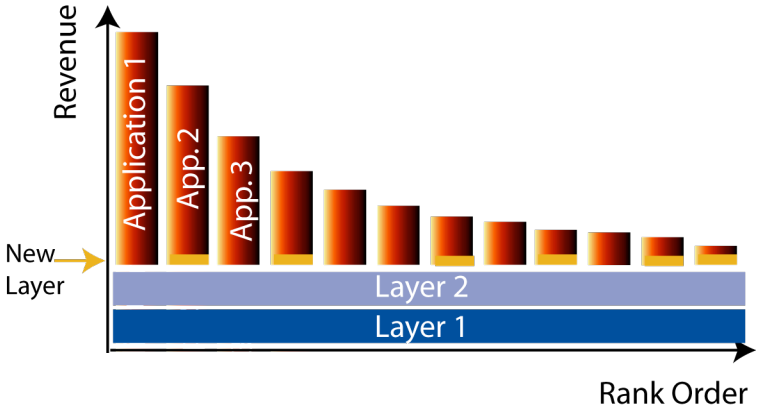
Finally, profits can be improved by avoiding double marginalization when bundling complements that otherwise would be supplied by separate monopolists (e.g., Microsoft Windows and Microsoft Office), who each would ignore the externality that their high price imposes upon the other (Nalebuff, 2000; Casadesus-Masanell & Yoffie, 2007).

Other profit improvement opportunities normally available through bundling are less likely to be salient when a platform provider absorbs a complement. Specifically:

- **Price Discrimination Gains.** Generally, bundling reduces heterogeneity in consumers' aggregate valuations for a set of items, allowing a firm with market power to extract a larger share of available surplus than it would earn from selling the items separately (Schmalensee, 1984; Bakos & Brynjolfsson, 1999). However, profit gains from price discrimination are weaker to the extent that customers' valuations for bundled items exhibit strong, positive correlation, as is typically the case for complements.

- **Economies of Scope in Production.** By their nature, complements fulfill different functions, which implies they will be comprised of different components. This limits opportunities for economies of scope in production and operations from bundling.

Figure 4: Complement Absorption Targets



Strategic Advantages. Beyond the efficiency gains described above, absorbing a complement can also yield strategic advantages. For example, in businesses that entail ongoing customer relationships through subscriptions or upgrades, bundling complements can improve customer retention rates (Eisenmann, Parker & Van Alstyne, 2007). To illustrate, assume that a subscriber to a standalone service (i.e., one that is not part of a bundle) is negatively surprised with respect to her initial expectations regarding the utility derived from the service, relative to rival offerings. After factoring in switching costs, if disappointment is big enough, the subscriber may be motivated to change vendors. Now consider the same service consumed as part of a bundle. Assuming that disappointments balance windfalls among bundled elements (i.e. surprises have mean zero and are uncorrelated), then a comparable disappointment with respect to a given feature is less likely to motivate a subscriber to drop the entire bundle. The reason: negative surprises for one bundle element will tend to be offset by positive surprises for another. Even in the absence of positive offsets, a negative deviation for a single component represents a smaller deviation relative to the bundle's value and thus may not exceed the switching threshold.

Under certain conditions, bundling may also allow a monopolist to profitably extend its market power into a complement market (Whinston, 1990; Carlton & Waldman, 2002; Farrell & Weiser, 2003). By foreclosing access to its customers, the monopolist can deny revenue to standalone complement suppliers, weakening them or even forcing their exit (Church & Gandal, 1992 and 2000). Furthermore, using this strategy, a dominant firm may be able to undermine existing rivals or deter entrants in its core market if they are dependent on standalone suppliers for a crucial complement (Nalebuff, 2004).

For example, before acquiring PayPal in 2002, eBay launching its own payment service, Billpoint, in a failed effort to displace PayPal (Eisenmann & Barley, 2006b). Consider a counterfactual in which eBay had banned PayPal and mandated that its auction participants instead use Billpoint. In that scenario, eBay might have caused

PayPal's failure, and in the process, made it more difficult for rival auction sites to serve their users.

Likewise, in 1998, Microsoft launched Windows Media Player (WMP), enveloping RealNetworks' then dominant streaming media platform (Eisenmann & Carpenter, 2004). Bundled with Windows, WMP rapidly gained share. WMP's compatibility with other PC operating systems was intermittent; for example, new versions did not work with Apple's Macintosh prior to 2000 or after 2003. Hence, Microsoft bolstered its Windows OS by effectively closing rivals' access to an important complement.

New Market Viability. Sometimes a platform sponsor must serve as a supplier in a new applications layer to help build users' confidence that a market will emerge. To resolve "chicken-and-egg" dilemmas, platform sponsors sometimes step into the user role on one side of their network, producing complements valued by users on the other side. Chicken-and-egg dilemmas become acute when users must make platform-specific investments. Complement suppliers are unlikely to invest without the assurance of access to a critical mass of end users. End users, in turn, are unlikely to affiliate with the platform unless they are confident that complements will be available. For example, when it added contactless integrated circuit technology (called "FeliCa") to facilitate payments using mobile phones, NTT DoCoMo entered joint ventures to offer electronic money and phone-based credit card services. The availability of these DoCoMo-backed services stimulated consumer adoption of FeliCa, which in turn attracted other payment services to the new application layer (Bradley, Eisenmann & Egawa, 2004).

Cross-Layer Envelopment. Moves like Microsoft's to absorb essential complements play an important role in the evolution of industries that are organized into hierarchical layers. As platforms mature, their providers sometimes embrace modular technologies and cede responsibility for supplying certain complements to partners (Langlois & Robertson, 1992; Suarez & Utterback, 1995; Baldwin & Clark, 2000; Jacobides, 2005; Boudreau, 2008). Reduced integration may result in an industry comprised of multiple layers, each with a separate set of suppliers. In the personal computer industry, for example, the layers consist of semiconductor manufacturing, PC assembly, operating system provision, and application software, among others (Grove, 1996; Baldwin & Clark, 2000). The credit card and telecommunications industries have similarly layered structures (Fransman, 2002; Evans & Schmalensee, 2005).

Over time, dominant players typically emerge within layers that are subject to strong scale economies due to fixed costs and/or network effects. These powerful players will seek to extract a greater share of industry rents and often vie with the focal platform's original sponsor for technical leadership (Fine, 1998; Bresnahan, 1998; Bresnahan & Greenstein, 1999; Gawer & Cusumano, 2002; Iansiti & Levien, 2004; Gawer & Henderson, 2007).

Friction over divided technical leadership is exacerbated as new layers with new leaders emerge. With a modular architecture conducive to experimentation, technological change may yield new, complementary uses for a platform, for example,

browsers or streaming media software vis-à-vis PC operating systems. The original platform's sponsor may be slow to integrate the new complement's functionality due to inherent uncertainty about technology and demand. By the time the original platform sponsor absorbs the complement, network effects may have propelled the new complement's pioneering third-party supplier to a dominant position in a new layer, setting the stage for a cross-layer clash between monopolists.

When the absorbed complement is itself a whole platform—as with browsers or streaming media software—a cross-layer attack takes the form of "platform envelopment" (Eisenmann, Parker & Van Alstyne, 2007). Microsoft has enveloped not only RealNetworks' streaming media software but also Netscape's browser (Cusumano & Yoffie, 1998) and Adobe's PDF standard. Likewise, Google has bundled its paid search platform with a new payment service, "Google Checkout," in a cross-layer envelopment attack on eBay's PayPal unit (Eisenmann & Barley, 2006b). Prospectively, Google is positioned to envelop Microsoft Windows, linking a Linux-based OS to Google's applications (Eisenmann & Herman, 2006).

Managing Mature Platforms

Whether a platform becomes more open or closed as it matures depends on whether it was originally structured as a proprietary platform or a shared platform. By its nature, a proprietary platform can only become more open. In contrast, a shared platform is already open; the available options are mostly more closed. These dynamics suggest that as proprietary and shared platforms mature, their sponsors and providers will face very different management challenges. Below, we discuss some of these challenges.

Proprietary Platform Priorities: Dealing With Dominance

By definition, a proprietary platform provider is the central participant in its ecosystem. This can be a position of considerable power, especially when the platform is a monopolist in its market. Managers of proprietary platform providers must consider how to leverage their dominance without provoking a damaging response from end users, complementors, regulators, and antitrust authorities (Gawer & Cusumano, 2002; Iansiti & Levien, 2004; Yoffie & Kwak, 2006; Gawer & Henderson, 2007).

Successful proprietary platform providers are often able to extract a large share of the economic value generated through platform transactions, leaving little for demand- and supply-side users. When they fully exploit their market power, proprietary platform providers can earn high profits, which may attract entrants who hope to usurp the platform leadership role. If an incumbent has been too aggressive in extracting value, demand- and supply-side users may rally around entrants, as Nintendo learned. When it dominated the console market, Nintendo dealt with third-party game developers in a hard-fisted manner. Consequently, developers were pleased to support Sony when it launched the Playstation console in 1996.

In the prior section, we explored reasons for platform sponsors to absorb complements, including profit improvement opportunities from price discrimination and economies of scope in production and marketing. Whether or not such absorption is perceived by users to be an abuse of a proprietary sponsor's dominance depends in part on whether the targeted complement was previously produced by just a few third-party suppliers with market power, or in a highly competitive market. In the latter scenario, intense competition will limit the profitability of third-party complementors, so they have less to lose following absorption.

The challenge for managers of proprietary platforms is finding the right balance between behavior that is too timid and too belligerent. Intel and Microsoft executives walk this line every day. Intel's Architecture Lab was deliberately made a cost center in order to promote PC architectural evolution in concert with ecosystem partners (Gawer & Henderson, 2007). Intel's partners might otherwise be deterred from making platform-specific investments if they perceived Intel to be too motivated to maximize profits from each new technology developed by Intel's engineers.

Similarly, with an eye toward the threat of entry, Microsoft has priced Windows below levels that would maximize its short-term profits. Microsoft also deals with emerging threats to its operating system monopoly in an uncompromising manner, as evidenced by Netscape's fate. Microsoft's willingness to move so boldly may be due to lessons learned from IBM. There are many explanations for IBM's failure to capture a greater share of value from the PC platform it created. One is that IBM worried about structuring coercive contracts with key component suppliers—Microsoft and Intel—that might have been perceived as abusing its monopoly power. According to this view, IBM's managers were too cautious after being hounded by antitrust authorities for decades.

Shared Platform Priorities: Dealing With Stalemates

As a shared platform matures and saturates its market, growth tends to slow and industry profits slide as more providers match "best-of-breed" features and costs. Attention shifts to the platform's next-generation products and services, which promise renewed growth and higher profits—at least for a while, and at least for some providers. As they did at the platform's inception, firms will strive to incorporate their own technologies into the platform's next-generation standards. By doing so, they can earn license fees, secure a time-to-market lead, or gain an edge in offering proprietary complements (Simcoe, 2006b; Eisenmann, 2008). These are among the few paths to profitability available to a shared platform provider. Absent such advantages, shared platform providers suffer margin pressure because they offer compatible products and their users confront low switching costs.

Competition between sponsors to build their own technologies into next-generation products can lead to the dissolution of a shared platform in two ways. The platform can splinter into incompatible versions. Alternatively, paralysis over the platform's design may retard innovation and expose it to rivals.

Splintering. In designing next-generation platform products, the stakes are sometimes so high that firms would rather wage standards wars than cede technical

leadership. For example, since the early 1980s, the Unix operating system has forked into many incompatible variants, each sponsored by a different firm or consortium. Likewise, the recent battle over high-definition DVD formats involved two camps—Blu-ray and HD DVD—respectively comprised of firms that previously had cooperated in offering the original DVD platform.

Stalemates. In other cases, platform participants will prefer the status quo of the current generation's low growth and poor profitability to a full-blown standards war. Stalemates are especially likely when shared platforms rely on established standards-setting organizations (SSOs) with formal voting procedures (Simcoe, 2006a). To attract more members and gain votes, a faction backing a next-generation proposal generally must promise some value to new members, that is, an attractive share of the total profit that platform providers ultimately will earn if the faction's proposal prevails. However, as a faction grows, each member's share of the total profit pool necessarily shrinks. Exploiting this, smaller factions may offer more value and steal some votes. As balloting seesaws, the stalemate festers and the stakes escalate. Month after month, the rival factions spend more on R&D to refine their respective proposals, and the time-to-market gap between eventual winners and losers grows.

Such a standoff often ends in one of two ways: a "reset" or a coexistence compromise. With a reset—like the one that ended a recent impasse over next-generation 802.11/Wi-Fi standards (see Box: "Brinksmanship Over Next-Generation Wi-Fi")—participants merge competing proposals and tweak all technical elements just enough that no player will realize a significant time-to-market advantage. With a coexistence compromise, the SSO simply endorses competing proposals as options under a single umbrella standard, as with the incorporation of both interlaced and progressive scanning in U.S. digital TV standards (Eisenmann, 2004a). Like a classic standards battle, "coexistence" moves the factional SSO dispute into the marketplace by asking users to choose between competing, incompatible technologies.

Accommodating New Platform Providers

The management skills needed as a shared platform matures overlap with those required during the platform's early phases. Executives and entrepreneurs must time their proposals carefully, manage intellectual property strategically, practice peer-to-peer diplomacy, and, when necessary, reengineer platform governance arrangements. However, as a shared platform matures, diplomacy is often complicated by the appearance of two types of new players who seek platform leadership roles: startups with breakthrough technologies and established firms who leverage platform technologies into new domains.

Startups vs. Incumbents. Startups may struggle to gain support for new technologies because their managers lack relationships, experience, and clout in standards-setting processes. Logrolling is not a credible option for a newcomer with all its eggs in one basket—especially one that may not survive to fulfill promises. By contrast, diversified incumbents can gain allies for their proposals by lending support elsewhere. Due to the powerful vested interests of incumbents, the next generation of a shared platform may forego a startup's superior innovations in favor of "least common

denominator" technology that puts all providers on a level playing field. Alternatively, slow-moving incumbents with political clout may deliberately stall standards-setting processes while their engineers try to match the startup's innovations.

New Demands in New Domains. As a shared platform evolves, it often attracts new providers who apply the platform's technology in new domains. For instance, stock exchanges had to accommodate a surge in trading through online brokerage firms. Likewise, Wi-Fi technologies are moving beyond laptops into a range of portable devices, including music players, gaming devices, and mobile phones (Eisenmann & Barley, 2006a). When negotiating over next-generation technologies, established firms that extend a shared platform into new domains will lobby hard to ensure that their technical and strategic priorities are met. For example, when formulating the 802.11n standard for the next generation of Wi-Fi, mobile phone makers were highly concerned about power management, since their phones have smaller batteries than laptops. After Motorola, Nokia, and Qualcomm got involved in the 802.11 committees of the Institute of Electrical and Electronics Engineers (IEEE), an already complex political environment turned into a Byzantine web of shifting alliances (see Box).

Centralizing Governance

Vertical Governance. As described above, a mature platform's sponsor may choose to absorb complements previously supplied by third parties, especially when the complements are consumed by a large fraction of the platform's end users. Upon absorption, the functionality of such complements becomes a part of the platform that other complementors can build upon (e.g., developing location-aware applications that rely on location-sensing technologies built into smart phones and laptops). In this way and through other mechanisms described above, absorption may increase the aggregate value realized by participants in a platform-mediated network.

However, not all parties benefit uniformly from a post-absorption increase in platform value. Third-party complementors whose functionality is absorbed will likely see their sales shrink; at the extreme, they may be forced to exit the market. Consequently, in a shared platform lacking a strong sponsor, complementors might rationally choose to withhold their functionality from the platform, profiting instead by selling proprietary goods. Parker & Van Alstyne (2008) explored conditions under which complementors prefer to submit to decisions made by a platform sponsor regarding the timing of complement absorption. A strong sponsor can credibly commit to defer absorption long enough to allow a third-party complementor to earn an acceptable return on platform-specific investments. Under fairly general conditions, complementors prefer that a strong sponsor solve the coordination problem—even at the cost of eventually having their applications folded into the platform.

In related work, Baldwin & Woodard (2007) analyzed the tension between a firm's private incentives and the health of its modular industry cluster. Baldwin & Woodard noted that investors are likely to care more about cluster profits than those of an individual firm. Consequently, investors should prefer that platform leaders not abuse

their power by moving into adjacent layers too aggressively, lest the cluster's growth be impeded.

Box: Brinksmanship Over Next-Generation Wi-Fi

In 2005, the market for wireless networking equipment built around the IEEE's 802.11g (11g) standard—branded as Wi-Fi—was becoming commoditized (Eisenmann & Barley, 2006a). The next generation of Wi-Fi technology, 802.11n (11n), would offer significant improvements over 11g in terms of communications speed and range, and thus had the potential to catalyze industry growth and revitalize flagging prices. However, two competing proposals for 11n had emerged, and neither could garner the 75% of IEEE votes required for ratification. After one group pushed for royalty-free licensing, patent-rich companies formed a rival camp. Mobile phone equipment makers (e.g., Nokia, Qualcomm) entered the 802.11 standards-setting process for the first time, complicating alliance structures. To make matters worse, a startup with breakthrough technology—Airgo Networks—was shipping proprietary product based on its interpretation of 11n, hoping to capitalize on the standards stalemate.

Intel, which counted on laptop semiconductor sales for profit growth, worried that more companies would introduce incompatible proprietary solutions. Intel recruited a handful of other large chipmakers from both 11n camps and formed a special interest group, the Enhanced Wireless Consortium (EWC), to forge a compromise 11n proposal. The proposal incorporated technologies from both camps and thus leveled the time-to-market playing field. Since the EWC's organizers collectively sold the lion's share of 11g chips, they could credibly threaten to ship EWC-compliant next-generation products *without* IEEE ratification. At the same time, Intel's move was risky: working outside the IEEE could provoke a backlash. In the worst case, competitors might gain IEEE approval. Denied access to the trusted 802.11 standard, EWC products would face a tough market battle. However, Intel's gamble paid off: the EWC's proposal eventually secured IEEE approval.

The case of 802.11n illustrates some of the challenges that shared platform providers encounter when they create next-generation products. Firms that incorporate their technologies into new standards gain a big edge. As firms maneuver for this advantage, an impasse can easily result—especially when platform partners rely on SSOs with democratic voting procedures. Problems are compounded when new players with new technical and business priorities—like mobile phone manufacturers—join the platform. Likewise, startups like Airgo with disruptive technology and a "do or die" attitude can draw fire from incumbents. In a complex political environment, brinksmanship by a small, powerful coalition—"accept our proposal, or else"—is one way to break the deadlock.

Horizontal Governance. Reengineering horizontal governance arrangements may also be a priority as a shared platform matures. To prevent splintering and stalemates, platform partners may recognize a need to create or strengthen a central authority that can dictate priorities (Farrell & Saloner, 1988). Likewise, when a shared platform faces an external threat, a strong central authority can rally a response.

The joint sponsors of a shared platform can centralize its governance in at least two different ways. The first approach is to create a "special interest group" (SIG)—such as the Enhanced Wireless Consortium organized by Intel to end an impasse in the IEEE over 802.11n standards (see Box). Likewise, to end a stalemate over standards for Web Services technologies, IBM and Microsoft organized a SIG, the Web Services Interoperability Organization (Eisenmann & Suarez, 2005).

SIGs are often used to exert control over formal standards-setting organizations, but they usually do not seek to supplant SSOs. Specifically, SIGs serve as forums where a subset of powerful platform providers can privately negotiate technical specifications and strategic priorities. To facilitate bargaining, SIG membership typically excludes minor players or parties deemed to be "difficult." When SIG participants reach agreement on standards and strategy, they present their proposal to the relevant SSO as a *fait accompli*.

A second approach to centralizing governance of a shared platform is available when platform participants coordinate their efforts through a dedicated association rather than an established SSO. Assuming that the association can earn material profits by charging fees to platform providers and users for access to shared infrastructure and services, its members can take the association public. By contrast, an IPO would not be practical for an SSO like the IEEE, which earns only modest membership fees and—by charter—is not empowered to collect intellectual property licensing fees or to invest in shared services and infrastructure.

After an association becomes a publicly traded company, its directors and senior managers have a fiduciary duty to advance shareholders' interests. While original association members may retain board seats in the new public company, their ability to veto strategic initiatives solely for self-serving reasons is limited. This can streamline strategic decision-making processes, compared to processes in a private association.

For example, to facilitate a move into computerized trading (among other reasons) the New York Stock Exchange (NYSE) implemented a far-reaching reorganization, culminating in a 2006 IPO. NYSE had previously been owned and controlled by specialists who held seats on the exchange—and whose profits from human-mediated transactions were threatened by a shift to computerized trading. In the same vein, MasterCard completed an IPO in 2006 and Visa followed suit in 2008. With stronger central governance, the credit card associations will be better able to promote the adoption of smart cards and Internet-friendly technologies.

Conclusion

Platform openness occurs at multiple levels depending on whether participation is unrestricted at the 1) demand-side user (end-user), 2) supply-side user (application developer), 3) platform provider, or 4) platform sponsor levels. These distinctions in turn give rise to multiple strategies for managing openness. Horizontal strategies for managing openness entail licensing, joint standard setting, and technical interoperability with rival platforms. Vertical strategies for managing openness entail backward compatibility, platform and category exclusivity, and absorption of complements. Each strategy grants or restricts access for one of the four platform participants.

When proprietary platforms mature, they often are opened to encompass new providers. Once network mobilization winds down and free-rider problems are no longer salient, proprietary platform sponsors may find it attractive to license additional providers to serve market segments with diverse needs. Naturally, these new providers

will seek a say in the platform's direction; they will try to force a previously proprietary platform to open its governance.

Likewise, as shared platforms mature, their renewal may hinge on partners ceding power to a central authority that can set priorities and settle disputes over who will provide next-generation technologies. This closes the governance of a previously open platform. Thus, forces tend to push both proprietary and shared platforms over time toward hybrid governance models typified by central control over platform technology and shared responsibility for serving users.

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[1] The balance of this section is adapted from Eisenmann, 2008.

[2] The term "horizontal strategy" is also used to describe efforts in diversified firms to integrate product offerings and/or functional activities across business units. Such strategies are employed by firms offering multi-platform bundles, but the distinction between "open" and "closed" is not relevant in this context. See Eisenmann, Parker & Van Alstyne, 2007, for analysis of envelopment strategies encompassing bundles of weak substitutes or functionally unrelated platforms.

[3] Portions of the following subsections on interoperability, licensing, and backward compatibility are adapted from Eisenmann, 2007.

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