Standard Setting and the Creation of New Internet Services

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Abstract. Two conditions for a successful new Internet service are the formation of a network and the formation of standards. The network consists of all players, such as suppliers and customers, who benefit from each other's contribution and participation in the new service. Standards set specifications for technology, products and components that the new service needs. They enable the members of the network to share resources or to communicate with each other. The Internet standard setting process is an open, consensual process of negotiation between experts. This approach to standard setting is under stress as private companies introduce innovatory Internet services based on proprietary technologies. Internet standard setting organizations try to accommodate this new development. Private companies, too, have an interest in collective and open standard setting. Can these objectives be reconciled? The traditional ways of standard setting in telecommunication, Internet, and computing industries have broken down, and the contours of new systems are becoming visible. This paper studies how the need to introduce the new service and create a network affect the timing and the organization of the standardization process. Its propositions identify the determinants of the standardization process in the converging Internet/ telecom/ computing environment.

Keywords: Internet, standardization, new services, collaboration

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Introduction

Internet economics is based on the premise that competitive success depends on the position taken in networks. The essential condition for creating a network is the connectivity of people and products. Standards are specifications for products or technologies that guarantee that they can interconnect or share resources. Users benefit from standards either directly, if they enable them to communicate among each other using standardized media, or indirectly, if the use of standards creates economies of scale (and thus associated benefits for users such as low prices or high quality) in developing, producing, or distributing product components. These benefits are called network externalities. In a famously laconic definition, Tirole (1988, p. 405) even entered these benefits in the very definition of a standard: A standard is ‘a choice of a particular technology to be adopted by everyone’.

In the Internet community we find two propositions about standards. The first is: creating a standard is an essential step in the creation and diffusion of new Internet services (products) and networks. In the absence of a standard, the existence of competing technologies raises the costs of supplying or using a new service. The need for potential customers to evaluate products that use competing technologies increases their transaction costs. If gateways or other equipment need to be installed to connect networks using different (incompatible) standards, this generates costs. If competing technologies forego potential economies of scale, that too, increases costs. These costs hamper diffusion of the new service. For instance, Taaffe (2000, p. 23) notes that initially there was a lack of interoperability between the SMS (Short Messaging Services) of different mobile GSM networks. This reduced the adoption of the new SMS services, especially in the business community. The costs of incompatible competing technologies reduce the size of the network that forms around the new service (all else remaining equal). As a result, there is a social value in having a standard, whenever network externalities exist.

The second proposition about standards in the Internet community is: an open, collective and consensual process should develop and select standards that are available for free or reasonable cost to all potential users. An open process invites capable input from anyone with an interest in the technology. The Internet community prefers these open standards to proprietary and incompatible competing technologies. The fundamental value of the Internet community is that everyone should be able to have access to information. Free availability of software, standards and technology is a special case of free access to information. This belief has merit, and is a major factor in the rapid diffusion of the Internet and the world wide web.

The second proposition does not follow automatically from the first. There may be advantages to having firms compete with different technologies. Anticipated profits are a powerful motive to develop proprietary standards. The market process will eliminate competing technologies over time, until a standard comes about. Moreover, the market process allows customers to have a say, whereas in negotiated standardization processes customers are often notably absent. Unfortunately, these arguments are not always true as incompatible technologies that are sponsored by private companies can persist for a long time. Users can be locked in to a technology, even if they regret having chosen that technology. A technology may fail because it is unsponsored, rather than because consumers reject it.

Commercial interests clash with the Internet community's negotiated consensual standardization process. There are various cases where private companies introduce competing Internet technologies. Streaming audio and video over the Internet is an example, with multiple competing technologies from the MPEG group, Apple, Microsoft, and Real Networks. Since the Internet is no longer a government service, standardization has evolved into a hybrid process, with cooperation to develop or set standards, while firms use the market to test their technology or to armtwist others to adopt their technology for standard. Some studies indicate that this is a workable, perhaps even optimal approach to standard setting (Farrell and Saloner 1988; and David and Shurmer, 1996). It balances the coordination advantage of a negotiated settlement with the incentives of proprietary technologies. A pure market approach would be inconsistent with the fundamental value of Internet economics: to spread information to everyone. Proprietary technologies and incompatibility are barriers to the diffusion of new information services.

This paper explores standard setting strategies and their effect on the development of a new Internet service. It raises two questions: first, how does the Internet standardization process cope with business strategies and, second, the timing of standard setting: is a standard developed before market opening or is it selected out of competing technologies during the product life cycle of the new services that it enables? We consult various perspectives that are relevant for cooperation and standardization: industrial economics, perspectives on systems and technological change, social networking, and multi-market competition theory. We also study several cases, and summarize our findings in propositions. Thereby we prepare the ground for an empirical study on this field.

Standards and standardization process

In this paper, rather than using Tirole's normative definition of standards, we prefer the more descriptive definition in Tassey (2000, p. 588): an industry standard is ‘a set of specifications to which all elements of products, processes, formats, or procedures under its jurisdiction must conform. The process of *standardization* is the pursuit of this conformity, with the objective of increasing the efficiency of economic activity’. Technologies that have different specifications are incompatible, if two users using different technologies give up some of the benefits (positive network externalities) of using the same technology.

The Internet has a highly evolved mode of standard setting. It is aptly described by a document from the IETF (Internet Engineering Task Force): "These procedures are intended to provide a fair, open, and objective basis for developing, evaluating, and adopting Internet Standards. They provide ample opportunity for participation and comment by all interested parties. At each stage of the standardization process, a specification is repeatedly discussed and its merits debated in open meetings and/or public electronic mailing lists, and it is made available for review via world-wide on-line directories." (IETF, *Request for Comments 2026*, http://www.ietf.org/rfc/rfc2026.txt, Aug. 2000).

A new Internet service creates its own network of users, subcontractors, suppliers, intermediaries and regulators. Players in the network develop strategies to create, control, position, and earn revenues from the network. For the sake of optimizing performance, firms need networking, innovation, and standardization strategies that re-inforce each other. The main trade-off for timing the standardization is that early standardization means that market opening is delayed until the standard has been hammered out, while late standardization means that network externalities are forgone during the introduction phase of the service with incompatible technologies (Kristiansen, 1998).

The IETF is well aware of the trade-offs: "The goal of technical competence, the requirement for prior implementation and testing, and the need to allow all interested parties to comment all require significant time and effort. On the other hand, today's rapid development of networking technology demands timely development of standards. The Internet Standards Process is intended to balance these conflicting goals." (IETF, *Request For Comment 2026*, http://www.ietf.org/rfc/rfc2026.txt, Aug. 2000). In the remainder of the paper we try to ascertain whether this process can be upgraded to include business interests.

Timing and mode of standardization

Internet innovations by pioneering, new, companies change this standard setting process. Firms that innovate a new Internet service need to integrate somehow their standard (setting or adoption) strategy with their product innovation strategy. This calls for a comprehensive view at two aspects of standardization and innovation.

A key aspect that we will look at is the *mode* of standard setting: the organizational process through which a standard emerges. Firms may develop competing technologies. In this case, the market process determines the standard as suppliers or users choose which technology to adopt: *market selection of standards*. This selection may occur on the supply side (suppliers choose which technology to license) or on the demand side (customers choose which product to buy). Firms may also cooperate in order to jointly either develop a standard, or to select one among competing specifications: *cooperative standardization*. Finally, an official body may develop or set the standard: *de jure* standardization.

An associated aspect of standardization with the mode is the relative timing of standardization: a standard may precede market introduction or it may occur after the market introduction, during the product life of the innovation. The development of a standard may be the innovation that triggers the development of services and a new market: *ex ante* or *innovative standardization* (David and Shurmer, 1996). It is also possible that the introduction of competing services triggers a market process or cooperation that in turn generates a standard: *ex post standardization*. Finally, technology and standards may develop over time along with the evolution of the product: *evolutionary standardization*. During the product's lifetime, suppliers may work on the inter-operability of their technologies and processes. That is, they finetune their technologies to the point that standards may emerge.[1]

Strategies and competition

Industrial economists tend to take issue with the notion in the Internet standardization community that consensus and cooperation should develop standards, which in turn are the appropriate basis for developing new products and services. The theoretical (game theoretic) industrial economic literature studies strategies and their impact on market structure. It offers three reasons why standardization and compatibility tend to delay the (market introduction of an) innovation.

The first result about timing is in the seminal paper by Farrell and Saloner (1988). This paper compares three modes of standard selection: the committee mode, where firms exchange proposals until they agree, the market game, where each firms chooses between pre-emption of a technology and waiting for the rival to make a pre-emptive move, and the hybrid coordination game, where firms participate in a committee but can also pre-emptively adopt a technology. The disadvantage of the pre-emptive market game is that both firms may simultaneously adopt their own technology, which destroys the network externality when there is only one technology in the market. If a committee selects the standard, its bargaining may slow down standard selection, but at least it prevents the loss of network externalities due to having multiple technologies in the market. Hence, a committee system offers better value for the firms than market selection. This result would indicate that the market introduction phase of a new service will start only after a committee has settled on an industry standard. Life is not that simple, as the remainder of the Farrell and Saloner (1988) paper shows.

Farrell and Saloner (1988) show thay firms achieve higher pay-offs by the hybrid coordination mode than by the other two modes. Firms will only introduce multiple technologies in the chance event that, the committee having so far failed to select a standard, the firms decide simultaneously to pre-empt by a unilateral market introduction. Other than that, either the pre-emptive move or the committee will select a single technology that both players adopt as the standard. As for the timing of the market introduction, firms will wait until there is a committee to select a standard, but if there is a committee, one firm may sometimes unilaterally adopt a technology, which the other supplier then immediately adopts as the standard.

In the Farrell and Saloner scenario, the rivals develop competing technologies, and then face the problem of selecting a standard so as to achieve network externalities. Does it make sense for them to develop these competing technologies in the first place? Kristiansen (1998) argues that standardization and compatibility will affect the incentives to do R&D. If technologies are incompatible, firms have an incentive to pre-emptively build an installed base. This requires them to speed up development, which in turn requires them to increase their R&D outlay. If they choose *ex ante* to develop compatible technologies, they don't have a competitive urge to build an installed base, and can thus afford to relax their development effort, which in turn reduces their R&D outlays. Hence, Kristiansen concludes that compatibility tends to delay innovations. Not only the bargaining process in standardization tends to delay an innovation, therefore, but also the private companies' reduced incentives for pre-emptive moves.

If firms develop competing, incompatible, technologies, they duplicate their research. This duplication of effort can have social gains. Duplication allows firms to experiment with different technologies in the early market introduction phase (Choi, 1996). In high tech industries, suppliers may value customer feedback and early creation of brand name recognition so highly, that they ship products which are functionally limited (e.g., rapid prototyping) and still need debugging. This may give an incentive for late *ex post* standardization. In other words, technological uncertainty is a factor that may delay standardization initiatives until after competing technologies have been developed and tested in the market.

We can summarize the theoretical industrial organization literature in the following proposition:

Proposition 1 (competition strategy): The following factors tend to delay standardization of technology till after the market introduction of a new service, during its product life cycle:

- time consuming bargaining process in committees
- pre-emptive built-up of an installed base, and
- experimentation, to resolve technological uncertainty

Other conditions of technology, supply and demand, also have an effect on the timing and mode of standardization (see Van Wegberg, 1999, which focuses on the mode of standardization). The following paragraphs explore these conditions.

Technology and architectures

Ideally, standards should specify only that part of a technology, that potentially creates network externalities. Standards often fall short of that: partial standardization offers some common specifications, but not enough to prevent interoperatibility problems between services that use different technologies that satisfy the same incomplete standards. Partial standardization may create interoperability problems, but it also helps firms to continue their innovations and to differentiate their product from rivals. In this situation, firms may be willing to participate in standardization. They can benefit both from creating a large network and from supporting their competitive position within the network.

Various aspects of technology have an effect on how the participants want to organize and time their standardization. If a large technological effort is required to innovate the new service, the appropriability of these investments may be the prime condition for an innovator. This may lead to competition between proprietary technologies and market selection of standards. If these costs are either very small or excessively large, firms may instead opt for collaborating. Technological uncertainty may make it more difficult for firms to agree on specifications. It calls for experimentation, and we saw above that this suggests firms will delay standardization until their experiments have delivered results (Choi, 1996).

If the technology is complex, the innovation will start rather simple and limited, compared to later generations. In this case, firms may develop standards during the lifetime of the product, while it is extended with new technologies and functionalities. Complexity also tends to raise the R&D costs, which in turn may stimulate cooperation and, as part of that, early standardization attempts.

Standards can be part of architectures. Morris and Ferguson (1993, p. 88) define an architecture as a "complex of standards and rules [that allow hardware and software products from many vendors to blend seamlessly into the network]". Several firms in the ICT industry (Information and Communication Technology) owe their competitive advantage to a proprietary architecture. To perpetuate and cement their competitive advantage, they may develop or adapt new technologies to extend their own architecture, and incompatible with rival architectures. Morris and Ferguson defend the incompatibility that tends to come with architectural competition on the grounds that it is more dynamic than committee standard setting. Committee standards tend to change very slowly. Moreover, committees tend to compromise on lowest-common-denominator solutions.

Faced with Morris and Ferguson's (1993) preference for proprietary standards, proponents of Internet-style standardization would argue that, instead, an open standard facilitates contributions from many fields, thus improving the quality of the standard. A common standard may delay innovation, but speed up subsequent diffusion.

Customers may have to make a commitment to a technology. If competing technologies exist, these commitments are sunk costs that can be foregone if the wrong technology is chosen, the one, that is, which does not become the ultimate standard. The greater the commitments by customers, the more important the technology choice is for their utility, and the more durable their investments in a technology, the higher these switching costs. The less likely customers will buy the new service. An exception can be very large customers. If a business customer is large enough, it can jump-start a technology (for example, a launching customer). Even if the technology does not become the standard, the individual user is able to achieve some of the network externalities all by itself. If the innovation offers great revenues for customers, they may adopt the innovation early, even before standards have set in.

Proposition 2a (technology): the following supply-side characteristics of technology support standardization **B**efore, **E**arly, or **L**ate into the product life cycle of an Internet service:

- R&D costs (B, if R&D costs are very high)
- Technological uncertainty (E, L)
- Technological complexity (B, E)
- Partial standardization is feasible, where the standard specifies only a part of the technology (B)

Proposition 2b (technology): the following demand-side characteristics of technology support standardization **B**efore, **E**arly, or **L**ate into the product life cycle of an Internet service:

- Customer benefits from the innovation are high (E, L)
- Customers' commitment to the new technology (B)
- Size of individual customers (L)
- Network externalities are high, for example, the service includes direct communication between users (B)

Networking

The firm's standardization strategy should be consistent with its network strategy. Opening up standardization to partners is an early move to build up a network. Standardization, like networking, is partially a social and political process. It calls for forming coalitions, generating trust, and creating a joint vision of what the standard is going to achieve. Gulati (1995) showed that earlier alliances create trust and thus allow firms to enter into non-equity alliances, where they have a greater exposure to each other's potential opportunism. Likewise, firms who meet each other in the standardization process may build up the trust to collaborate in other alliances, and vice versa: collaborative standardization may build on experiences created in other alliances. Standard setting alliances often are non-equity alliances, for example, joint research work or membership organizations, and thus sensitive to opportunism.

Organisations who build new services on the basis of a new technology, need to have confidence in the technology and its survival. Bargaining may lead to compromise solutions, but may also increase legitimacy of the technology. Submitting a technology to a standard setting organization of high repute enhances the credibility of the technology, and may attract partners to one's technology. Partners may contribute their own technology and knowledge to the development of the standard, thus sharing the costs and the risks. Cooperating in standardization gives the partners leadtime to develop products and start investments.

Conditions that make networking and coordination more difficult, may lead to a breakdown of collaboration, and the resulting development of competing technologies. If firms are very heterogeneous, for example, if they originate in different industries, they may have difficulties in collaborating with each other.

Lack of reputation is another condition that makes networking more difficult. Internet pioneers are often new firms. These firms do not yet have the reputation to help them create a network and organize a standardization process. They feel forced to start their service before making steps to standardize the technology. Some initial success in the Internet may be necessary to give existing players an incentive to collaborate with them. This innovation then forces upon existing players a difficult choice: to adopt the pioneering technology as a standard, or to develop a competing technology. In the former case, what we see is a new standard forming the basis for a new service. In the latter case, instead, we observe incompatible technologies, which may call forth subsequent steps towards creating an industry standard.

The combination of networking and the complexity of new ICT technologies mean that a pure market approach to standard setting becomes increasingly rare. The opposite, an industry-wide collaboration to specify a single standard, is a special case too. In many cases we see competing groups of companies developing standards, sometimes in conjunction with competing standard setting bodies. Gomes-Casseres (1996) coined the term *collective competition* for this phenomenon of group-based competition. Unlike in the beginning of the Internet era, private companies have a vital input in developing new technologies and standards. And, also unlike in the beginning, collaboration too can lead to competing technologies.

Proposition 3 (networking): the following characteristics of networks support standardization **B**efore, **E**arly, or **L**ate into the product life cycle of an Internet service:

- Heterogeneous firms (industry, size, age) (E, L)
- Prior contacts between the leading companies involved (B, E)
- Existing standard setting bodies with an acknowledged reputation stimulate collective standardization (B, E)

Vested Interests in Related Markets

A new Internet service may be a substitute of an existing product or service. The wider context of non-Internet suppliers and products (the new and old economy) and the Internet supplier's existing product line (its multimarket scope) need to be included in the analysis of the interaction between standard setting and product innovation (see Van Wegberg, 1996).

If a new service will have strong links to an established firm's businesses, it may be reluctant to share control with other companies. Exploring the intra-firm spillovers between its new and existing services may be more promising for the firm than expanding network externalities between its new service and competing technologies and products. If the new standard creates and expands a new Internet service, it may substitute for an existing market. Firms with a vested interest in the existing markets affected, may try to delay the new development (Lint and Pennings, 1998). And they try to develop standards that protect their existing revenue flows. In many Internet technologies, copyright protection is a bone of contention. Even if ownership can be maintained, e.g., by watermarking information, payment techniques over the Internet are still underdeveloped. Information products are thus often distributed for free over the Internet, thereby threatening existing revenue streams. Licensing revenues from standardized technologies can be a reason to participate in standard setting. The standardization process itself may have the intended side-effect of delaying the market introduction.

Established firms in related markets have resources that could support a new Internet market. Internet pioneers and vested interests may threaten each other, therefore, but they may also be complementors. The resources of the old markets can be redirected or redeployed in new Internet products. Standards are instruments in this complicated play. The need to balance potentially opposite interests can affect the choice of features that the standard is equipped with. Bundling new and old products may be an attractive proposition for customers. Established players already have goodwill, brand name recognition, and reputation with their customers. This may support their new Internet activity, and may give a new Internet product credibility among customers. With these advantages, established players may be able to overcome the first move advantages of Internet pioneers.

Proposition 4 (vested interests): the following characteristics of existing activities affected by the new technology or its services support standardization **B**efore, **E**arly, or **L**ate into the product life cycle of an Internet service:

- Pre-emption strategy (links with established businesses, first move advantages) (E, L)
- Suppliers of substitutes favour standardization to delay and influence the new opportunity (B), otherwise they introduce or adopt competing technologies (L)
- Suppliers of complements may support the new market by adopting the standard and contributing by adding technology (B)

How these interests balance out

In short, suppliers of a new service need to balance various objectives: to create a new product, a network, a viable business model, a competitive advantage, and profitable links to its existing businesses. The innovators of new technology need to create a network too, and they face a trade-off: standardize technology (to create the network) or differentiate it (for their competitive position). In choosing the number of partners, technology developers face the trade-off between control and industry-wide support, between early timing and legitimacy. In choosing whether to enter a new service, established firms may face a choice between cannibalization and being left behind. Existing standardization institutes, reputations and routines of the various ICT industries also have an impact on how firms can influence standardization.

The interaction between these players determines the relative timing and organization of standardization. Together, the propositions give a framework for predicting the timing of standardization in the life cycle of a new Internet service. We turn to case studies to find insights that may complement our analysis.

Cases

Some small case studies can illustrate the issues here. We use them to further develop the propositions 1 to 4. See the reference list for the sources of the information used. These cases are *typical* in that they share characteristics with many new Internet services: entry by new players, (partial) substitution for existing non-Internet products or services, rapid international diffusion, and free distribution of client software to speed up diffusion.

Case 1: Online music distribution

The Internet features many online music distribution networks. These combine two developments: the Internet as a distribution network for digital data, and the development of digital music formats, which began with the CD. The German Fraunhofer Institute developed the MP3 audio component of the MPEG4 compression standard for video streams. MP3 compresses sound streams such that a small file can still give a good representation of a piece of music. The Institute released the specifications in order to stimulate the use of MPEG. There are alternative specifications for video streams, namely, those developed by Apple, Microsoft, and Real Networks. In an unanticipated side effect of this release, Internet websites came forth that use MP3 to distribute music files. Since the bandwith for data transport over the Internet is still very small (narrowband), data need to be compressed before being transmitted. MP3 does this, without reducing music quality so much that the human ear picks this up.

Music tends to be expensive. CD prices tend to exceed CD production costs by a wide margin. The combination of free technology (MP3) and free music files turned free distributors of MP3 files into popular distribution networks for music files. They threaten the revenue flow of traditional music distributors. These companies have started to develop a compressed music format with copyright protection. The Secure Digital Music Initiative (SDMI) will develop open technology specifications for digital music to enable copyright protection. Members include America Online (which owns the Time Warner media company), EMI Capitol Music, Microsoft, and the Recording Industry Association of America (RIAA). Apart from these 'usual suspects', the website also mentions the Fraunhofer Institute and Napster as members. The possibility is there that different priorities lead to incompatible technologies.

Case 2: Programming for e-commerce

Java is a programming tool that turns static Internet pages into a setting for interaction between a user and a supplier of information. Sun developed Java for interactive television; only later did it realize its potential for the Internet. Business users develop websites with Java as an essential part of their e-commerce services. E-commerce is technically possible without using Java. Nevertheless, it is widely believed that comprehensive e-commerce services do need Java or a competing technology, such as Microsoft's ActiveX. Several IT development companies have already commited to Java. It is believed that IBM employs more Java programmers than Sun.

Sun has wavered whether or not to hand over control over Java's standardization to a standard setting body. It first negotiated with the International Standards Organization (ISO) and later with the ECMA (European Computer Manufacturers Association). Sun pulled out of these negotiations, leaving many Java users such as IBM feel that it retains too much control over a standard that they base new e-commerce services on. As an alternative to formal standardization, Sun launched the Java Community Process, which "fosters evolution of the Java technology in Internet time, and in an open, participative manner" (Sun, the Java Community Process program, http://java.sun.com/aboutJava/communityprocess/index.html, Aug. 2000).

Microsoft adopts Java technology. It is also developing an alternative, called C#, which it has submitted to the ECMA for standardization (ECMA's homepage, 24-8-2000). This appears like an attempt to capitalize on dissatisfaction with Sun's standards' strategy.

Case 3: Mobile Internet Access

The Japanese mobile telephone company NTT Docomo pioneered Internet access via a mobile telephony network. It developed iMode: a combination of technology and services that give a mobile handset a permanent ('always on') access to the Internet. It has effectively combined two fast growing networks: Internet and mobile telecom. European and American companies are developing a similar approach, using a different technology: the WAP, Wireless Application Protocol. A mobile handset equipped with a WAP browser enables Internet access via a mobile telephone. This provides an alternative route for Internet access, compared with the conventional one of a PC equipped with a modem and an Internet browser. Mobile handsets are cheaper and easier to use than PCs. They promise to enable Internet access for customers who do not as yet have adopted a PC with Internet access. It also spreads the Internet from the office and the home desk to the street, thus enabling this elusive objective of pervasive computing. The WAP is a clearcut case of a standard that ushers in a growth of new services. It should be said, however, that before WAP, some interactive applications were already possible. For example, sending SMS messages via a GSM is not unlike sending e-mail via the Internet. In a technical sense, WAP does not build on this approach. These early services did show the potential for a fully developed gateway between the mobile network and the Internet.

Case 4: Instant messaging

Instant messaging is an Internet communication application, like e-mail. An instant messaging service contains a directory of members, and it notes who of them are currently online. The service enables online members to send a message that, unlike e-mail, arrives almost at once, and can immediately be responded to by the receiver. The conversation is akin to a telephone conversation, apart from the fact that people type text rather than speak.[2] Apart from generic tools such as a PC with Internet access, users only need software. Instant messaging service providers often distribute the client software for free. Their income comes form the large number of users, which attracts advertising revenues. Each program creates its own proprietary network of members: America Online's AOL IM, ICQ (which belongs to AOL), Microsoft Netmeeting, Yahoo! Messenger, etc.

Network advantages are thus lost, as users in different networks cannot communicate with each other. However, since the software is free, a user can subscribe to various networks. Moreover, America Online's network is extremely large, at about 131 million registered members, which would consitute a market share of 80%.[3] Hence, America Online would not gain much by connecting to other networks. Still, there is some pressure to create standards for interoperability of these networks. Suppliers of proprietary software want to continue using their own software, while still enabling their users to communicate with people in other networks. AOL has taken active steps to prevent its rivals from enabling their members to communicate with members of the AOL instant messaging networks. Users are reluctant to subscribe to various networks, as this takes time, costs storage space on their PC, and requires different learning processes for each program. In the tradition of the Internet, where services are based on standards that are developed collectively, the IETF is working on an IM standard. Although AOL does not appear to be actively engaged in the development work, it did promise to adopt the standard.

Case 5: Internet telephony

Internet telephony started with various incompatible voice codecs that translate the human voice into digital files that can be transported over the TCP/IP Internet. Vocaltec pioneered this service in 1995. It used the Internet chat technology (for instant messaging) to transport voice messages instead of the traditional text messages. A piece of software, a voice codec, translates the human voice into a digital sound file, which then travels over the Internet, where a compatible codec re-translates it back into voice.

The ITU (International Telecommunications Union) was quick to develop an architecture for Internet telephony. In 1996 it ratified the H.323 architecture of standards. The aim of the H.323 architecture is to create interoperability among Internet telephony software and services, and interoperability between Internet telephony and the traditional telephone network. This has been an important step in enabling data and voice communication network providers to develop high quality Internet telephony services. The H.323 architecture is incomplete: it leaves gaps where technologies are not yet standardized. Products that use H.323 tend to be hybrids: they adopt the H.323 architecture where it is clearly specified, and use proprietary technology otherwise. This is a hybrid standard setting process, using both the ITU committees and the market process.

Internet telephony services are evolving from a low quality, low cost option for international telephone calls to a basic technology for IP-based backbone networks that expand their services from data to voice communication.

The IETF's SIP technology (for Session Initiation Protocol) is an architecture for call signalling via the Internet that is partly an alternative to H.323. H.323 products have beaten SIP to the market. Part of the IETF's work takes place in the SIP-H.323 Interworking Team, which intends to formulate gateways between the H.323 and SIP networks. The SIP network also needs to be connected to the traditional telephony network via gateways. Gateways are a, usually costly, way to combine networks so as to increase the scope for network externalities.

Table 1: Standards and New Internet services		
Internet service	Standard(s)	Standardization
Online music distribution	MP3, Real, Quicktime, Windows Media	MPEG developed MP3; SDMI develops an alternative technology.
E-commerce	Java ActiveX; C#	Sun started a Java community process with partners to develop Java in a more controlled way than via a standard setting body. Microsoft develops alternative technologies.
Mobile Internet access	iMode WAP	The WAPforum develops and controls the standard.
Instant messaging	AOL IM, ICQ, Yahoo! Messenger, Netmeeting	The IETF develops the Instant Messaging and Presence Protocol in cooperation with instant messaging service providers.
Internet telephony	H.323 SIP	The ITU and IETF develop alternative networks. Gateways will connect them.

Table 1 summarizes these case studies.

Some lessons from these cases

These cases show that new communication services do not per se start with developing standards first (unlike proposition 2b). Notwithstanding the strong network externality of communication services, incompatible technologies exist or are being developed for digital music, Internet programming, instant messaging, and internet telephony. The WAP standard appears to be the only industry standard (at least within Europe). The strong network externality of communication services has the opposite effect expected. The importance of developing a network, makes it worthwhile for companies to control the network (Kristiansen, 1998). Experimentation, linking the innovation to existing activities, pre-emption and positioning are motives for developing competing technologies even (or especially) for activities with considerable network externalities. Hence, competing technologies emerged for Internet communication services.

Once the introduction phase is over, pressures mount to create standards. Users, regulators and suppliers of complementary products are wary of dominant positions in competing networks. Sun's control over Java and AOL's dominance in Instant messaging are examples where companies who developed a technology face pressures to hand over control of that technology. Firms face a kind of prisoner's dilemma: each needs industry standards, and wants others to adopt them, while introducing its own proprietary technology.

Collaborative initiatives at standard setting can not always avoid incompatibility: namely when the plethora of standard setting initiatives leads to a breakdown of coordination (Genschel, 1997, p. 612). The SIP-H.323 controversy is an example. Within the Internet, the IETF is the legitimate standard setting organization. But in the telecom world, the ITU takes this place. The result: a lack of overall coordination. Convergence between technologies or industries may create barriers to ex ante standardization. Standardization is thus a hybrid between coordination and competition, much as Farrell and Saloner (1988) predicted. Unlike what they expected, however, competing committees (alliances) too are a potential cause of competing technologies.

The MP3 case is interesting as it is a very successful standard, that is closely tied to a particular business model for services. Its very success leads to opposition by firms with a different business model. They develop a different standard to facilitate their own business model, based on copyright protection. Internet standards are not, therefore, purely technological but have an economical aspect to them. Internet telephony is another example, where it is difficult to develop a business model where users pay for quality of the service. From the start, Internet telephony services were delivered on a best effort basis, rather than with a Quality of Service guarantee.

A reputational problem is that pioneers do not always have connections to the standardization world. Alliances can overcome this. The WAPforum was formed, for instance, by connecting the WAP pioneer Phone.com with established companies who have the reputation to drive telecommunication technology.

Another major problem is that private companies develop competing technologies to expand their proprietary architectures. The network externalities based on their multi-market scope are more important to them than the network within a new market (proposition 4). The market process may not be able to eliminate any of these competing technologies, as they are sponsored by high-valued enterprises. Microsoft's Windows CE is an example of a technology that notwithstanding lack of market success, has already entered its third development generation (called Pocket PC). In this milieu, the consensual Internet standardization process still has a function, as a means of overcoming these strategic interests. The IETF's proposal for an instant messaging standard is a good example of this.

Suppliers with proprietary technologies benefit from customer lock-in as this creates their installed base. They recognize that customer lock-in is the result of investments by customers into their technology. Customers (users) too sponsor a technology. In many cases not only with money, but also with time, effort, and even some amount of psychological commitment (resulting perhaps from the need to avoid cognitive dissonance). Many users feel that this should make them part-owners and controllers of the technology. Private business strategies may not sufficiently yield to that need.

To sum up, the following proposition complements the four that we derived from the theoretical and empirical literature:

Proposition 5 (fragmentation): the following characteristics of Internet innovations support standardization to either **F**ail (persisting competing technologies) or to occur after market introduction, in the **E**arly or **L**ate stages of the product life cycle of an Internet service:

- Users, regulators and suppliers of complementary products exert pressures to hand over control of the new technology (E, L).
- The presence of multiple standard setting initiatives or organizations leads to a breakdown of coordination (F).
- Pioneering new players find it difficult to fit into existing standardization processes. If they launch their own process, they support fragmentation (L, F).
- Standards closely tied to a particular business model for services arouse opposition, that may lead to competing technologies (L, F).
- Private companies introduce competing technologies if multimarket spillovers among their established and new activities are more important than network externalities between users (L, F).

Conclusion

The increasing importance of the Internet to business interests, especially within Information and Communication Technology industries, has disrupted the traditional Internet standardization process. The Internet has changed the business environment; but not without private businesses having changed the Internet way of setting standards. The consensual process has given way to collaboration in competing alliances, consortia, and other institutions. The market is used to launch new technologies and services. Existing economic theories portray this hybrid setting process as the optimal arrangement, in between pure market setting and pure negotiated standardization processes. For private technology companies this may offer the best combination of private control and network building. For Internet users, however, it means a lack of open standards and a loss of network externalities. The market process can take a long time to eliminate technologies due to sponsoring by powerful suppliers with an architecture to defend and lock-in of customers. While business interests are productive in starting new services, a collective and consensual standardization process is still needed to achieve widespread diffusion. The Internet community should not acquiesce in a fragmented standardization community.

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Generic (ICT, Internet)
- Automatisering Gids (http://www.automatiseringgids.nl/) (Dutch-language)
- C:Net (http://www.news.com/?cnet.tkr)
- Computable (http://www.computable.nl/) (Dutch-language)

MP3
- Standard setter: Fraunhofer IIS-A Institut, http://www.iis.fhg.de/amm/index.html
- Alternative to MP3: DMAT (Digital Music Access Technology), being developed by a forum, the Secure Digital Music Initiative (SDMI), http://www.sdmi.org/index.htm
- Service provider: MP3.com, and Napster, http://www.napster.com/
- News and information: Wired, http://www.wired.com/news/mp3/

Java
- Standard setter: Sun (http://www.sun.com/). Sun initially wanted to submit Java to the standard setting organization the ECMA, the European association for standardizing information and communication systems (http://www.ecma.ch/). It started the Java Community Process Program as an alternative to formal standardization (http://java.sun.com/aboutJava/communityprocess/index.html)
- Alternative: Microsoft develops technologies that can substitute for Java in client server networks, for example, ActiveX (http://www.microsoft.com/data/ado/) and C# (http://msdn.microsoft.com/vstudio/nextgen/technology/csharpintro.asp)
- News and information: http://java.sun.com/ (from the horse's mouth)

WAP
- Standard setter: WAP forum, http://www.wapforum.com/
- Alternative: NTT Docomo pioneered wireless Internet access in Japan with its iMode network (there is an as yet useless homepage http://www.nttdocomo.com). While WAP is based on the XML language, iMode is based on the HTML markup language.
- Service provider: Altavista search site for WAP (http://wap.raging.com/), m-info, Dutch WAP service provider (https://minfo.nl/index.html)
- News and information: http://wap.pagina.nl/ (Dutch WAP portal overview site)

Instant messaging
- Standard setter: IETF, Internet Engineering Task Force (http://www.ietf.org/home.html) in the workgroup for the IMPP, Instant Messaging and Presence Protocol (http://www.ietf.org/html.charters/impp-charter.html and http://www.imppwg.org/)

- Service provider: AOL, America Online (http://www.aol.com/), with its own proprietary instant messaging network & technology (http://www.aol.com/aim/home.html)

Internet telephony
- Standard setter: ITU-T, ITU Telecommunication Standardization Sector (http://www.itu.int/ITU-T/index.html), standard: H.323.
- An architecture that provides an alternative to H.323 signalling is the SIP, Session Initiation Protocol, from the IETF, The Internet Engineering Task Force (http://www.ietf.org/html.charters/sip-charter.html)
- Service provider: ITXC Corp. (http://www.itxc.com/intro.html), or Netspeak's Webphone (http://www.webphone.com/).
- News and information: IP xStream (http://www.iptelephony.org/) and CommunicationsWeek International (http://www.totaltele.com/cwi/).

[1] It is also possible that no standard is developed. Suppliers may still enable customers to benefit from network externalities by building gateways between incompatible communication networks, or adapters or converters between the incompatible products. See Katz and Shapiro (1985).
[2] Instant messaging services such as Yahoo! Messenger now also offer voice chat, using technology akin to Internet telephony.
[3] Source: C:Net, "Group to weigh instant messaging standard proposals", Aug. 4, 2000, and "FTC unlikely to use messaging against AOL Time Warner", Aug. 21, 2000.