An Economic Basis for Open Standards

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Executive Summary

This paper provides an overview of standards and standard-setting processes. It describes the economic effect of technology standards – *de facto* as well as *de jure* – and differentiates between the impact on competition and welfare that various levels of standards have. It argues that most of what is claimed for "open standards" in recent policy debates was already well encompassed by the term "standards"; a different term is needed only if it is defined clearly in order to provide a distinct economic effect.

This paper argues that open standards, properly defined, can have the particular economic effect of allowing "natural" monopolies to form in a given technology, while ensuring full competition among suppliers of that technology. This is a distinct economic effect that deserves to be distinguished by the use of a separate term, hence "open" rather than "ordinary" standards – referred to as "semi-open" in this paper.

The paper explains why open standards must allow all possible competitors to operate on a basis of equal access to the ability to implement the standard, and why this means that the economic effect of open standards may require different conditions for different markets. In most *software* markets, where Free/Libre/Open Source Software (FLOSS) provides significant competition, open standards can only be those that allow equal access to FLOSS producers.

A case is made for public procurement to support open standards, and empirical evidence provided from an analysis of actual tenders as well as from the FLOSSPOLS survey of government authorities to demonstrate how procurement policies in practice come in the way of competitive markets for software products. Finally, some guidelines are provided for effective policy in relation to open standards and interoperability:

1. open standards should be defined in terms of a desired economic effect: supporting full competition in the market for suppliers of a technology and related products and services, even when a natural monopoly arises in the technology itself.

2. open standards for software markets should be defined in order to be compatible with FLOSS licenses, to achieve this economic effect

3. compatibility with proprietary technologies should be explicitly excluded from public procurement criteria and replaced by interoperability with products from multiple vendors;

4. open standards should be mandatory for eGovernment services and preferred for all other public procurement of software and software services.

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Contents

Table of Contents

1. An economic definition for open standards

Many applications of technology in the Information Society are subject to *network effects*: the benefits to a single user are significantly enhanced if there are many other users of the same technology. The value to a user of an e-mail system, for instance, is limited unless the system can be used to send e-mails to many others, and increases enormously with the number of other users. This value, which is over and above the value of a single copy of the technology, is the *network externality*, i.e. the additional value provided by the network effect.

Network effects can go hand in hand with entry barriers for new technologies. A new technology may be adopted if it provides recognised benefits over a previous technology. However, since the value of a widely used system is, due to network externalities, much higher than the value inherent to a single user's copy of the technology, any new technology is seriously hampered by its lack of an existing user base. A new e-mail system must be far superior to an old system in order for its inherent benefits to outweigh the severe disadvantage caused by the lack of a pre-existing network. In applications highly susceptible to network effects, where the network externalities account for a large share of the total value of the system – such as e-mail – this hurdle may be impossible to cross. Indeed, the e-mail system most widely used today has remained more or less unchanged for over 20 years.

The self-enhancing feedback loop caused by network effects together with the barriers posed to alternative technologies results in the dominance of particular products in their application areas, as *natural monopolies*. Monopolies are not obviously good for consumers, but the presumption of natural monopolies in many areas has often been thought to provide a better value for overall welfare than, say, having various incompatible systems leading to a Balkanised network of groups of users unable to talk to each other. However, monopolies are in a position to capture (or internalise) the value of network externalities – although this value is by definition not an attribute of an individual user's product or service, a monopoly or dominant player is in a position to raise the price of an individual user's access beyond its inherent value, based on the external value of the network effect. An e-mail system that allowed you to communicate with millions of others may be priced higher than a more sophisticated system that was limited to only a few thousand others. Thus, while monopolies have long been tolerated in the telecoms sector, they are usually subject to regulation to limit their natural tendency to work against consumer welfare.

Another approach to network effects, however, is to try to abstract the network externalities from specific products. This is achieved by identifying the feature of the technology that provides the network effect, and ensuring that its use is not limited to a specific product or service. Rather, products and services from different producers are made *interoperable* by agreeing on *standards* for the basic technology components that provide the network externalities. This way, in theory at least, a natural monopoly arises in terms of the technology, but competition can thrive in terms of actual products and services that interoperate.

The problem arises that the natural monopoly on the technology for interoperability may have rights associated with it, and these rights may be owned by one market player (or a consortium). Such rights may be exploited to generate monopoly rents, which may counteract the competition in interoperable products and services that are enabled through the use of the standard. E.g. if the holder of rights to the standard seeks monopoly rents from all use of the standard, it has an anti-competitive advantage over other users of the standard.

Alternatively, rights-holders can use their licensing policies to control the further development of the standard, and to influence the market of products and service around the standard. While such influence could be used to improve social welfare, it could also be used to anti-competitive ends, by selectively granting the rights to producers and service providers using the standard. Such selection need not be arbitrary, it can also be achieved through the setting of licensing conditions that favour or discriminate against specific groups of producers. If the holder of rights covering a standard is also a supplier of products and services based on the standard, it has strong incentives to set licensing conditions that disadvantage the strongest potential competing suppliers. Thus, the natural monopoly that the standard creates in terms of technology may come along with competition in the market for products and services, but this competition may be limited by the control by rights-holders of the access to the standard technology.

Standards can be *de facto*, where natural monopoly arises from market conditions that are initially competitive among different technologies, with agreement among producers on the standard technology arriving without a formal process. Usually, such a standard emerges through market dominance of the technology, often hand-in-hand with market domination of the technology vendor. Rents from such *de facto* standards are among the most attractive available to IT firms (Morris & Ferguson, 1993).

Alternatively, standards can be *de jure*, where a natural monopoly on technology is agreed upon by a body that may be an association (perhaps, but not necessarily, with a public interest mandate) of some combination of technology users and suppliers. Bodies with some level of formal process for defining such standards include ITU, ETSI, IEEE, W3C, IETF. While owners of rights over *de facto* standards clearly have the interest and ability to exploit their monopoly over the standard technology to control or dominate the market in products and services based on the standard, it is quite possible for owners of rights over *de jure* standards to do this as well. As West writes, "attempts to create advantage and lock-in are far from limited to the sponsors of de facto standards. Sponsors of de jure and consortia standards also gain advantage from attracting adopters and creating lock-in, if such standards are encumbered by private patent claims, as are standards such as W-CDMA, MPEG-4 and DVD" (West 2004).

Some standards bodies try to limit this control and rent-seeking behaviour by defining processes to allow input from a variety of players in the definition of the standard (which affects what technologies, and thus what rights holders, are involved in the chosen standard). Standards bodies also define policies on licensing rights covering the standard, with various degrees of limits placed on the rights holders' ability to control suppliers of products and services based on the standard. Common policies include the requirement that rights be licensed under RAND ("Reasonable And Non-Discriminatory") or royalty-free terms.

If technology licensing policies are adopted (whether by the fiat of standards bodies or voluntarily by the technology rights holders) allowing all potential suppliers of products and services based on the technology to use it, without providing a competitive advantage to the rights holders, the theoretical economic effect of interoperable standards may be achieved. Standards based on such licensing policies could be called "open standards", with natural monopolies in the technology itself but competition in the supply of products and services using the technology.

2. Economic effects of types of standards

Much discussion around standards relates to the institutional processes of standard selection, and this has influenced the terminology surrounding standards: *de facto, de jure,* "open standards". This paper focusses, however, on the economic effect of different frameworks for technologies, and suggests the use of terminology based on the economic effect rather than the institutional processes alone.

Based on the above discussion, one could define three broad classes of technology frameworks based on the three broad classes of economic effect that they achieve:

1. Proprietary technologies: a natural monopoly in a technology results in a natural monopoly in the market for services and products based on the technology. These often become *de facto* standards, in which case they are properly referred to as "proprietary standards".

   This occurs when the rights to the technology are available only to the rights holders, and results in a dominant position for the owner of the technology.

2. ("Semi-open") Standards: a natural monopoly in a technology arises (*de facto*) or is defined and agreed upon (*de jure*), but *some* competition in the market for products and services based on the technology is provided for, although potentially dominated by rights holders of the technology. Unlike most of the literature, we distinguish such standards from the next category and therefore refer to them as "semi-open standards", encompassing most standards set by most industry and international standards bodies.

   This occurs when the rights to the standard are made available to economic actors other than the rights holders[1], possibly under terms that provide an advantage to the rights holders over other competing economic actors.

3. Open standards: a natural monopoly arises (*de facto*) or a monopoly is defined and agreed upon (*de jure*) in a technology, but the monopoly in the technology is accompanied by *full competition* in the market for products and services based on the technology, *with no a priori advantage based the ownership of the rights* for the rights holder.

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[1] West 2004, although he uses this phrase as an initial definition of open standards as different from proprietary technologies.

This occurs when access to the technology is available to *all* (potential) economic actors *on equal terms providing no advantages for the rights holders*. In particular, rights to the standard are made available to economic actors other than the rights holders under terms that allow *all* potential competitors using *all* potential business models to compete with the same degree of access to the technology as the rights holders themselves. When *no* competitive advantage is held by some players solely by virtue of owning rights over a standard[2], then a unique economic effect is achieved of separating the natural monopoly of the technology itself from any possible monopoly among suppliers of the technology

It should be clear from this list that simple economic criteria are being used here to discriminate between different technology market models – the relationship between the natural monopoly of the technology and the extent of competition possible among suppliers of products and services based on that technology. Such criteria are meaningful for policy making, if policy is set in order to achieve a given economic effect. Clearly, a policy debate needs to distinguish between terms (such as standard and open standard) on the basis of the differences in the effect of the concepts behind them, otherwise the terms are in themselves meaningless.

It should also be clear from the above definitions that there is a distinct difference in the economic effect between "proprietary technologies" (or "proprietary standards"), "standards" and "open standards", in a progression of increased market competition. For the sake of clarity, we will refer in this paper to "standards" that are not "open standards" according to the definition above as *"semi-open standards"*. This is a progression of normative frameworks that overcome the natural monopolies in certain technologies arising from the network effects associated with them. To the extent that monopolies harm welfare, the ability to augment the natural monopolies in technologies with a competitive market in the supply of products and services based on these technologies is positive. Thus there is a basis for consumers in general and policy makers in particular to encourage these normative frameworks, and to attempt to drive suppliers and markets towards the "open standards" at the competitive end of this progression.

This list does not indicate the processes required in order to achieve its goals, or the specific licensing terms that may be required to differentiate between standards and open standards. Such details could differ between different technology domains and depend on the market conditions.

For instance, the effect of open standards may be achieved with licenses requiring significant licensing fees and restrictions on use in a market where only firms with deep pockets and strong legal support structures can implement the technology concerned – such as the market for GSM cellphones (see discussion in the next section). In such markets, where huge

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[2]   It should be noted that rights over technology are not the only way vendors can gain a competitive advantage. Developing or first implementing the technology can also provide competitive advantages. Some consideration may therefore be given to the *governance* of the development and maintenance process. However, the economic effects of an open standard more likely to be influenced by the control of rights over the technology than clear governance mechanisms, e.g. of standards bodies. So with equal, sustained and guaranteed access to the rights for all potential players, even *de facto* standards that do not have very clear governance mechanisms could be open standards in terms of the economic effect they achieve.

investments are required for product development, royalties may not pose additional entry barriers. Indeed, in such markets, licensing terms may be less important than the processes involved in determining a standard (i.e. choosing the monopoly technology), which is why discussion of open standards relating to hardware or telecommunications often focusses most on due process, participation in standards-setting and the publication of specifications rather than pure competition effects.

Similarly, in markets based on unit sales audit or "no-sublicensing" requirements may not pose additional entry barriers.

However, in a market where competing products and services could be implemented by small firms or groups of individuals without significant funds or the ability to control or audit the use of the licensed technology (such as Free/Libre/Open Source Software – FLOSS – developers publishing their work under reciprocal or "copyleft" licenses), the economic effect of open standards as described above may only be achieved by licensing terms that are free of royalty and licence-audit requirements[3]. Indeed, in some markets, not only are such producers potential providers of products, they are the *main competitors* to suppliers that hold a dominant position. In markets where FLOSS developers provide the significant existing or potential competition, royalty, audit or no-sublicensing conditions (among others) do pose barriers, and reduce competition greatly, preventing the "open standard" effect. Achieving under such market conditions the economic effect of full competition in the market for products and services based on open standards would thus require the rights to the standard being made available under terms compatible with the existing legal and technical methods of FLOSS development.

3. Open standards: different terms in different markets

The above discussion indicates that to maximize social welfare through the achievement of full competition in the market for products, the same rules can lead to different results, and different rules can lead to the same results, from sector to sector and technology to technology based on the market conditions unique to each.

For example, the success of the GSM standard for mobile telephony has been cited by the European ICT Association (EICTA), in their response[4] to the European Commission IDABC Programme's Interoperability Framework (EIF)[5]. EICTA and the Business Software Alliance, among others, use the example of GSM to argue in favour of standard adoption under licensing regimes that require royalty payments and other conditions. Indeed, such conditions have not necessarily reduced competition or overly advantaged some producers of GSM technologies over others. However, the requirements, in terms of financial, technical and legal infrastructure, to produce GSM equipment are quite demanding. Compared to, say, the capital requirements for manufacturing telecommunications hardware, the licensing and royalty conditions of the GSM standard itself are relatively undemanding. For the moment, at least,

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[3]   It may be noted here that licences that prevent FLOSS implementations are indeed neither reasonable nor non-discriminatory (i.e., not "RAND")

[4]   http://www.eicta.org/press.asp?level0=1&level1=6&level2=41&year=2005&docid=391

[5]   IDABC 2004. This included a definition of "open standards" that requires that patents covering parts of the standard must be made "irrevocably available on a royalty-free basis".

the conditions to use the GSM standard do not pose a barrier to the entry of potential competitors. So the economic effects outlined under the "open standards" definition above may be achieved without having royalty-free licensing for use of the standard. (This may change in the future, as telecommunications protocols are increasingly implemented in software, if generic hardware could be adapted to various protocols by software producers requiring much lower capital; in such a scenario, the conditions to use the GSM standard may pose a more significant barrier to the entry of additional competitors and may lead to the GSM-like licensing conditions not qualifying for the economics-based definition of open standard).

These arguments supporting royalty or other restrictive licensing conditions have no connection, however, with most parts of the market for software, and it is software and data interchange formats that are the main focus of the IDABC EIF[6].

We discuss for illustration the domain of desktop office productivity software such as word processors, where the market conditions are completely different from that of mobile telephony equipment manufacturing. There is clear market domination by one proprietary product, Microsoft Word, and the sole supplier of this product, Microsoft.

The most significant competitor in terms of current and potential usage is OpenOffice Writer, an application developed by FLOSS developers and distributed under the GNU Lesser General Public License (LGPL). Any technology that disadvantages OpenOffice developers clearly does not achieve the market effect of full competition. Any *de facto* or *de jure* standard that is not licensed under terms that are usable in the development of OpenOffice cannot achieve the market effect of full competition, as OpenOffice developers are among the most significant competitors to the dominant supplier (indeed, full competition would require allowing equal access to the technology not just to significant competitors but to *all* potential competitors).

OpenOffice is licensed under the GNU Lesser General Public License, the LGPL[7], which has the following features (among others):

1. it requires that the software may be redistributed without charge or notice

2. it does not allow distribution of the software to be monitored or audited

3. it requires that derived works of the software may be built and redistributed without charge or notice to the original developer

4. it is an irrevocable license, as long as its terms are met

Arguably, these features are the basis for the success of OpenOffice as a competitive product with significant market share. Any technology proposed as a standard for word processing, therefore, that was not available to OpenOffice developers under conditions compatible with the features above, would not allow OpenOffice to use the proposed technology. The proposed technology would thus not have the economic effect that open standards should have, in the previously proposed definition, and would thus not be an open standard.

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6   Some other standards suggested by EICTA that have royalty requirements include other hardware standards such as IEEE 1394, and software standards such as MPEG that have in some cases proven to be impossible to implement due to royalty requirements.
7   http://www.gnu.org/copyleft/lesser.html

What licensing conditions for a given word processing technology *would* have the economic effect of an open standard? To be compatible (at least) with the features of potential competing producers such as OpenOffice, the licensing terms must have the following attributes:

1. they must not require royalty payments

2. they must not require monitoring or auditing of the distribution of licensed products

3. they must allow the automatic (sub-)licensing of the technology to works derived from the product developed under the first licence, without royalty requirements, monitoring or audit requirements for the creation or distribution of such derived works. A licence that is limited strictly to implementation of the standard may prevent this, if the limitation is enforced.[8]

4. they must be irrevocable, with some possible exceptions compatible with FLOSS licensing terms (e.g. revoked in defence, if the licensee sues the licensor for patent infringement)

The OpenOffice document format itself meets these requirements and could reasonably be called an open standard in terms of its economic effect. Indeed, the OpenOffice format has, since being initially a *de facto* standard, been accepted as the basis for the OASIS Open Document Format. This has been submitted as a proposed format to ISO. After its likely acceptance by the ISO, the format is also guaranteed to follow well-defined governance procedures for its further development.

The economic effect of the OpenOffice format is seen by the existence of numerous products from independent producers, in addition to OpenOffice itself, that support the format[9]. While Microsoft recently announced that it will not support this format[10], there is nothing in the licences covering the format that would prevent Microsoft's support. The same could not be said for Microsoft's own formats for Microsoft Office, which have not met the present definition of open standards. Microsoft Office formats have previously been proprietary, and recent XML-based formats have been encumbered with licences that, while royalty-free, appear to have been designed to prevent implementation by Microsoft Office's main competitor, OpenOffice[11]. A new irrevocable covenant not to enforce Microsoft's patents over Office 2003 XML against software products "conforming" to the format appears to make this format an open standard in terms of their economic effect, as it appears this format could now be implemented by OpenOffice and other potential competitors[12].

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[8]   Derived works could obviously include variations on the standard implementation. See e.g. Stallman 2005.

[9]   A list, including FLOSS applications as well as proprietary offerings from firms such as IBM, Sun and others is available at http://en.wikipedia.org/wiki/OpenDocument#Current_support

[10]   See e.g. news article at http://informationweek.com/story/showArticle.jhtml?articleID=170700325

[11]   The patent licence for Office 2003 XML places restrictions on derivative works. Microsoft 2003.

[12]   Microsoft 2005. Commentators (e.g. Updegrove 2005) have raised questions regarding the wording of the covenant, and noted that it does not apply to future versions of the format. So, while Office 2003 XML appears now to be an open standard, one couldn't say the same for future versions of the Microsoft Office format, such as Office 12 XML. The latter has been proposed to ECMA International, which approves a number of "semi-open" standards.

The above discussion shows that while the economic effects of an open standard can be achieved in some telecommunications markets while charging significant royalties for access to the standard technology (as with GSM), in the market for word processing, *royalty-free licensing alone would be necessary but not sufficient to create an open standard.*

This is important in the context of some existing government definitions of open standards. For instance, the European Commission's IDABC, in its European Interoperability framework, defines open standards as having the following minimum characteristics[13]:

1. adopted and maintained by a non-profit organisation with a decision making process open to all interested parties

2. published specification document available at nominal or no charge

3. patents irrevocably made available on a royalty free basis

4. no constraints on the re-use of the standard

As argued by BSA and EICTA and referred to in section 3, this definition, by requiring royalty-free patent licensing may be too strict for mobile telephony. On the other hand, the definition is not strict or clear enough for the word-processing market, since it does not clearly prevent "no-sublicensing" or audit requirements necessary to ensure full competition.

The IDABC EIF may also be too strict in its requirement of irrevocable patent licensing. This does not allow for defensive suspension, which, if compatible with FLOSS licensing models, would also be compatible with open standards as defined on their basis of economic effect. Indeed, a number of FLOSS licences themselves include defensive suspension clauses specifically in cases of rights holders being sued for patent infringement

Similarly, other definitions of open standards (such as the proposed decision of the Commonwealth of Massachussetts[14]) that accept Adobe PDF as an open standard are inappropriate if the economic effect is used as a basis for measuring openness. Although some ISO standards are based on Adobe PDF[15], Adobe's PDF licensing terms[16] are not irrevocable. In theory, Adobe could wait until naïve public bodies all use its format, then arbitrarily terminate the patent licences allowing PDF readers from competing vendors, then charge for its own PDF Reader software.

Going beyond word-processing

While this analysis has focussed on the specific example of word processing and text documents, it should be noted that the leading competitors to dominant market players in several parts of the software market are produced by FLOSS developers, and FLOSS software provides increasingly viable (and certainly future potential) competition.

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[13] IDABC, 2004.
[14] See Massachusetts, 2005. It lists PDF not as an open standard but as an "Other Acceptable Format" that "while not affirmed by a standards body, meet the other criteria of openness".
[15] Adobe 2005b.
[16] Adobe 2004, Adobe 2005

The above discussion suggests that for large parts of the software market free/libre/open source software is closely linked to the effective implementation of open standards, for two reasons. First, if FLOSS provides an existing or potentially competitive solution for a given problem domain, an open standard would have to be compatible with the development and distribution of under FLOSS licensing terms.

Second, for most software standards the formal specification is insufficient and the actual standard may differ from across implementations. Thus, some bodies (such as the IETF) require multiple interoperating implementations before recognising a standard. As West writes, "for complex digital systems standards, the formal specification is inherently incomplete and the actual standard is defined both through the written specification and through actual implementations... for any firm trying to implement a standard, knowledge of both the formal specification and existing implementations is valuable. Otherwise, the implementer faces an extended trial-and-error process as it seeks to discover how other firms have resolved specification ambiguities. So a typology of openness must consider the openness both of the specification and implementation."

This suggests the need for a *reference implementation* to augment – if not, perhaps, replace – the formal specification of the standard. When such a reference implementation is available under a FLOSS licence, it may achieve the economic effect of an open standard as defined above, even without the institutional processes of standard setting, since the reference implementation may act as the formal specification (especially if sufficiently well documented) and be reproduced without economic restrictions by any potential vendor of the technology[17].

Thus, in this regard the IDABC EIF definition of open standards is in one sense too restrictive in requiring a formal institutional process of standards-setting. As shown in the previous section, formal institutional processes are neither sufficient, nor, as just discussed, even necessary to achieve the economic effects desired of open standards.

The above discussion shows that although open standards and FLOSS are certainly not equivalent, they are closely related in terms of the economic effect they achieve, and the way in which they do this. The next section examines how this relates to public procurement policy.

4. Standards, software and procurement

Beyond the general description of the economic effect of standards, there are several issues specifically related to the public procurement of software and the provision of eGovernment services (government services for citizens and businesses) in particular.

Private consumers and firms may have some interest in furthering market competition so as not to lock themselves into technologies associated with continuous rent-seeking from dominant players. This is rarely an obligation. Public sector consumers, however, have in

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[17] Reference implementations that are *not* distributed under a FLOSS licence clearly do not in themselves achieve the economic effect of open standards. Even with a FLOSS reference implementation, clear, documented specifications separate from the implementation are probably required to allow other implementations.

many situations an obligation to support (and certainly not to harm) competition through their procurement practices, for a number of reasons:

1. they are obliged to avoid explicitly harming competition in the market of private consumers. Thus, public agencies should not require citizens to purchase systems from specific vendors in order to access public services, as this is equivalent to granting such vendors a state-sanctioned monopoly.

2. they are obliged to save costs – taxpayer money – over the very long term. This is equivalent to an obligation to further net welfare, which is harmed by rent-seeking behaviour and weakened competition.

The first point implies that eGovernment services should provide access based on open standards, as defined previously in this paper on the basis of their *economic effect*: fostering a fully competitive market. In particular, the public sector should never require citizens to purchase systems from specific vendors in order to access public services: this is equivalent to granting such vendors a state-sanctioned monopoly. It is absurd to pursue vendors for anti-competitive practices, while at the same time entrenching the dominant market positions of vendors by requiring that citizens buy their software in order to access public services, or requiring that businesses buy their software in order to compete for public tenders. Examples abound, from the Dutch Tax Authority requiring the use of Windows for filing electronic tax returns[18], or the US Federal Emergency Management Agency requiring the use of Windows and Internet Explorer by New Orleans Hurricane Katrina victims filing claims for relief. While many such examples involve Microsoft, befitting its role as the dominant vendor in several end-user software markets, any government service based on proprietary or ("semi-open") standards furthers this anti-competitive effect.

The second point implies that for procurement of software *in general*, public authorities should preferentially implement software based on open standards, as defined by their economic effect of fostering a fully competitive market. Supporting ("semi-open") standards alone without fostering a fully competitive market is harmful to competition and net welfare, and thus expensive by definition over the long term. While software based on open standards may not always be available, public agencies should encourage its development, and indicate their preference for open standards to vendors though preferential procurement of software based on open standards wherever it *is* available. Similarly, public agencies should use open standards wherever supported by the software they implement, in preference to any other technologies supported by such software.

Empirical evidence from the FLOSSPOLS survey of 955 public authorities across 13 EU countries shows that public authorities are not generally aware of the economic effect of their own procurement choices. In particular, while expressing support in general terms for open standards and interoperability, they are unclear about what these terms mean (or should mean, for any meaningful economic effect). This is best illustrated through the response public authorities give when asked to rank the importance to a procurement decision for new software on compatibility with software that they are already using, in comparison to interoperability with competing software.

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[18]   This was recently replaced by a web-based system which appears to be open standards-compliant

The main advantages of open standards is its capacity to be interoperable with other software systems. This, a software application based on open standards is fully interoperable with any other application using the same standards, and it is possible for any other application to use the same standard. As a result, software buyers often try to achieve "vendor-independence", which is to retain the ability to change software products or producers in future without loss of data or significant loss of functionality.

However, this goal can conflict with implicit or explicit criteria for software purchasing, in particular whether new software is compatible with previously purchased software. Buyers who use the latter criterion rather than a general requirement for open standards or vendor-independent interoperability in effect remain locked in to their previously purchased software. Thus, even if they see the benefits of open standards and believe in interoperability, buyers whose preference for new software is based instead on compatibility with previously installed software are not, in practice, supporting or benefiting from interoperability.

5. Public procurement and competition: empirical evidence

To examine relationship between compatibility and interoperability, FLOSSPOLS survey respondents were asked whether they find it more important that new software they buy is compatible with other software from the same product family they already use ("compatibility", i.e. preferring previous suppliers) or that new software is compatible with software from other producers and product families ("interoperability", i.e. no anti-competitive preference in procurement). It turned out, as shown in Figure 1 below, that 59% of the respondents favoured interoperability and 33% favoured compatibility (8% said they did not know)[19]. This shows that a significant share of public administrations in practice lock themselves into proprietary technologies. While this may have long-term costs for these public administrations, it also has long-term costs for net welfare.

Figure 1: Selection criteria for new software purchases: FLOSSPOLS survey

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[19] This and other responses from the survey are analysed in detail in the separate report on the survey, Glott and Ghosh 2005. The present document only draws conclusions specifically related to open standards and interoperability.
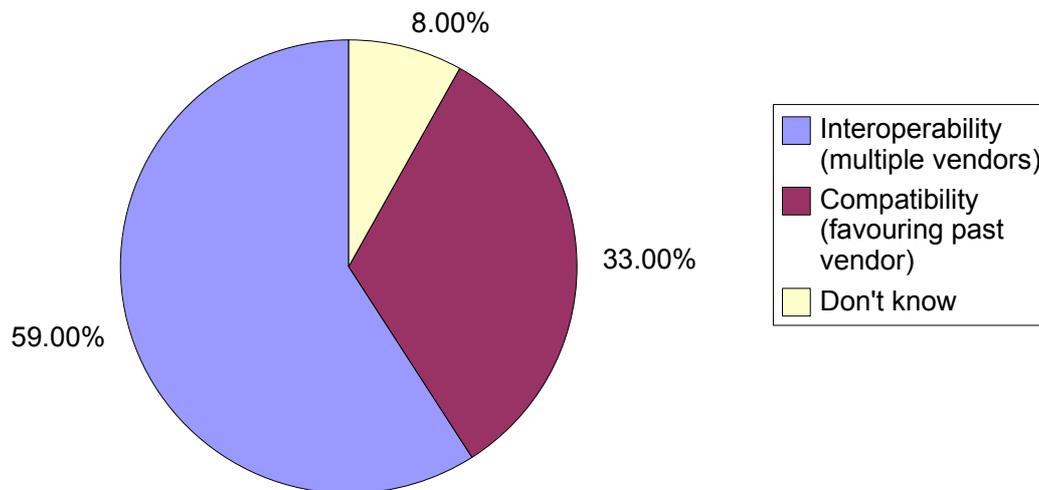
Preferring "compatibility" may even violate public procurement principles, since a preference – explicit or implicit – for "compatibility with previously installed software" favours the single supplier of that software, if it is based on proprietary or semi-open standards. An explicit preference, instead, for interoperability with open standards as defined in this paper does *not* favour a single supplier of technology and is therefore far more in keeping with public procurement principles. This may also be more in keeping with public procurement *law*. The European Commission found in 2004[20] that public procurement requirements to supply hardware based on "Intel or equivalent" microprocessors, or even requiring clock-rates specific to Intel processors without mentioning Intel was not compatible with EU law[21]. This has not yet resulted in formal legal action, as Italy and Germany changed their procurement policies in response to the EC's prior warning[22], but the EC has sent formal notices to France, Netherlands, Finland and Sweden regarding their procurement policies[23]. What applies to public procurement of hardware could reasonably be thought to apply to software procurement too, especially as the use of tenders with explicit requirements for compatibility with proprietary software standards appears to be quite common.

While this subject clearly needs empirical research beyond the scope of this paper, a quick keyword search for tenders on TED, the EU's public procurement portal[24] identified 149 recent tenders including the term "Microsoft". A brief analysis below, of six calls for tender, identifies the strong anti-competitive effects of public procurement that favours "compatibility" with proprietary standards over "interoperability" with open standards.

1. The anti-competitive effect starts with the procurement process itself, which may require bidders to purchase software from specific vendors. For instance, a tender from Scottish Enterprise, 2005, states that "All expressions of interest shall be provided either on paper

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[20] European Commission, 2004.
[21] Specifically, "Intel or equivalent" was found to be "a violation of Directive 93/36/EEC on public supply contracts, and specifying clock rates was found "contrary to Article 28 of the EC Treaty, which prohibits any barriers to intra-Community trade".
[22] http://www.channelregister.co.uk/2004/12/21/german_it_tenders/
[23] http://www.channelregister.co.uk/2004/10/13/ec_probe_widens/
[24] Http://ted.publications.eu.int

or both on paper and in electronic format (via floppy disk using Microsoft Office compatible products)"[25]. While not as bad as requiring citizens to purchase software from a single vendor for access to essential government services, such procurement procedure requirements are clearly detrimental to competition in the market for software even among *private* consumers.

2. A typical case of explicit preference to bidders using technologies from favoured providers is a tender from Fife Council, 2005, which is for additional services to be built around "an interactive site provisioned through the use of Macromedia Cold Fusion and Microsoft SQL"[26]. Such anti-competitive preferences are quite common even when they are not explicitly stated – tenders for the provision of websites for the European Commission, for instance, may require compatibility with the europa.eu.int EU portal. As Europa is based on proprietary technologies (including ColdFusion), a specific vendor preference is introduced into the market even without mentioning brand names. This perfectly illustrates vendor lock-in, and how the anti-competitive effect goes beyond the public sector alone when public bodies are locked in. The original procurement of technology for Europa may have indeed been truly competitive in nature. Since it obviously did not require the use of open standards, *all future procurement related to Europa* is anti-competitive in nature and favours the single vendor owning rights to the original technology chosen, directly (through purchase of the same vendors' software) and indirectly (through the requirement that suppliers of additional websites compatible with Europa purchase these vendors' software).

3. An example of how past purchase of software based on proprietary technology ensures a preference for the same proprietary technology (and thus favouring its sole vendor directly, or bidders who are customers of that sole vendor) is in this tender from Eurojust, 2005, a European international organisation, for a library automation system[27]. In this tender, the preference for compatibility with previously purchased proprietary technology is explicitly stated: "Eurojust employs Intel-based servers running Windows 2003 and workstations running Windows XP . The network protocol in use is TCP/IP. Any proposed software must be able to function efficiently in this environment. Eurojust has a strong preference for Microsoft SQL as the database to minimise the variety of software to be supported in-house. It must be possible to integrate the system with Microsoft's Active Directory for user information and access control." Clearly, Microsoft and its customers are favoured in this tender. If the previously purchased software was based on open standards, the new system could have been required to be interoperable with those open standards, thus giving no preference to individual vendors.

4. Preference for individual vendors can get explicit: a tender from Consip, Ministry of Economy and Finance, Italy, 2005[28] is representative of the several tenders found for "software licences". It requires "licenze d'uso di programmi software Microsoft Office" (i.e. usage licences for Microsoft Office). It is supposedly a competitive tender, yet the only competition possible is among resellers of Microsoft.

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[25] http://ted.publications.eu.int/udl?REQUEST=Seek-Deliver&LANGUAGE=EN&DOCID=189553-2005
[26] http://ted.publications.eu.int/udl?REQUEST=Seek-Deliver&LANGUAGE=EN&DOCID=189364-2005
[27] http://ted.publications.eu.int/udl?REQUEST=Seek-Deliver&LANGUAGE=EN&DOCID=59337-2005
[28] http://ted.publications.eu.int/udl?REQUEST=Seek-Deliver&LANGUAGE=IT&DOCID=181643-2005

5. Explicit preference for individual vendors can be extreme. In a procurement process that was "negotiated without a call for competition" (i.e. explicitly without competitive bidding but an offer invited from a single vendor), Hessische Zentrale für Datenverarbeitung, 2005[29], signed a contract with Microsoft Ireland for "software licences" worth Euro 2.69 million over three years. The justification provided for this negotiated procedure is a concise statement of the argument presented previously in this document: "The works/goods/services can be provided only by a particular tenderer for reasons that are: Connected with protection of exclusive rights." Clearly, if proprietary technology is specified as part of the requirements, as explained in section 2 above, only the rights holder can provide the technology, due to the "protection of exclusive rights" around the technology.

According to the European Commission, "Under European law on public procurement, a brand may be specified only if it is otherwise impossible to describe the product sufficiently precisely and intelligibly" (European Commission, 2004). True, the only way to describe proprietary software products such as Microsoft Office or Macromedia ColdFusion is through their brand names. But specifying these products in public procurement, rather than product-independent technical requirements, is surely anti-competitive. Just as the EC argued that microprocessors can be selected on performance criteria rather than specific clock rates (which favour a single vendor), software and software services should be selected on the basis of technology rather than products.

In order to ensure that this is done continuously it is essential to avoid the progression described in the examples above, from one original purchase that was perhaps competitive, to implicitly or explicitly favouring the same vendor (or resellers) repeatedly in all further purchases. As the examples show, this leads eventually to favouring or even requiring private sector bidders to purchase software from the same preferred vendors, cementing their position in the market place beyond the public sector.

For the reasons presented previously in section 2, on the lock-in effect of proprietary standards, and section 4, on the effect of relationship between public procurement and standards in the software market, the only way such sustained competitive public procurement can be achieved is through:

1. defining procurement requirement by technology rather than individual (named) products

2. explicitly excluding compatibility with proprietary technologies as a selection criterion

3. requiring (or at least preferring) interoperability with open standards

6. Empirical evidence from the FLOSSPOLS survey

In addition to the widespread prevalence of compatibility as a selection criterion above interoperability, the FLOSSPOLS survey also provides an empirical association between open standards and FLOSS. Local governments that consciously using FLOSS are much stronger supporters of interoperability (67%) compared to only 50% of non-users. We see from the survey results that limitations to interoperability set by proprietary software vendors help to

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[29] http://ted.publications.eu.int/udl?REQUEST=Seek-Deliver&LANGUAGE=EN&DOCID=172383-2005

increase a demand for FLOSS in an organisation. This is of course only when the IT department of that organisation truly wants interoperability, and is aware of the conflict between interoperability and proprietary software applications that promote lock-in ("compatibility") with their own proprietary standards. In contrast, organisations that do not prefer interoperability with open standards in their purchasing decisions are more likely to remain locked in to proprietary vendors providing compatibility with previously purchased software.

The association between open standards, inter-vendor interoperability, FLOSS usage and vendor lock-in is highlighted in two further findings from the FLOSSPOLS survey. First, FLOSS users – who, as we have seen, are likelier to favour open standards and interoperability – rely on more vendors on average than non-users (who, as we have seen, are likelier to favour compatibility with previously purchased software and thus get locked in to past vendors). 41% of FLOSS users have 1 to 4 regular vendors for their IT software and services; 59% have more than 4 vendors. For non-users of FLOSS this ratio is reversed – 61% have 1 to 4 vendors and only 39% have more than 4 vendors. This indicates a higher degree of concentration and possibly lower competition among suppliers of non-users of FLOSS in comparison to organisations with some FLOSS use. While the survey did not show a clear causal relationship between FLOSS use and number of vendors (which could be influenced by external factors), increasing competition is frequently cited by IT managers as a reasons to use FLOSS[30].

Indeed, the survey showed a clear relationship between perceived over-dependence on vendors and a desire to increase FLOSS use. As shown in Figure 2 below, 53% of those who would like to increase their FLOSS use felt too dependent on vendors, compared to only 30% of those who do not want to increase FLOSS use. A closer look at *current* FLOSS non-users clarifies the link between FLOSS use and vendor independence. We defined two sub-groups of these non-users - those who would value increased FLOSS use, "future adopters", and those who would not, "persistent non-users". 58% of the "future adopters" say they are too dependent on vendors, while only 32% of the "persistent non-users" feel too dependent. Similarly, only 39% of "future adopters", compared to 64% of "persistent non-users" feel *not* too dependent on vendors. These differences indicate that for even for those who do not already use FLOSS (consciously), vendor dependency is indeed a strong driving force towards FLOSS use in the future.

Figure 2: Over-dependence on vendors drives FLOSS use: FLOSSPOLS survey

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[30]   e.g. See Ghosh, R.A., 2005: "according to Mauro Solari, Deputy President of the Province of Genova [...] "it important not to have only one supplier" [...]Reduced vendor dependence is expected to lead to increased market competition and weakening existing monopolies of certain proprietary software vendors."
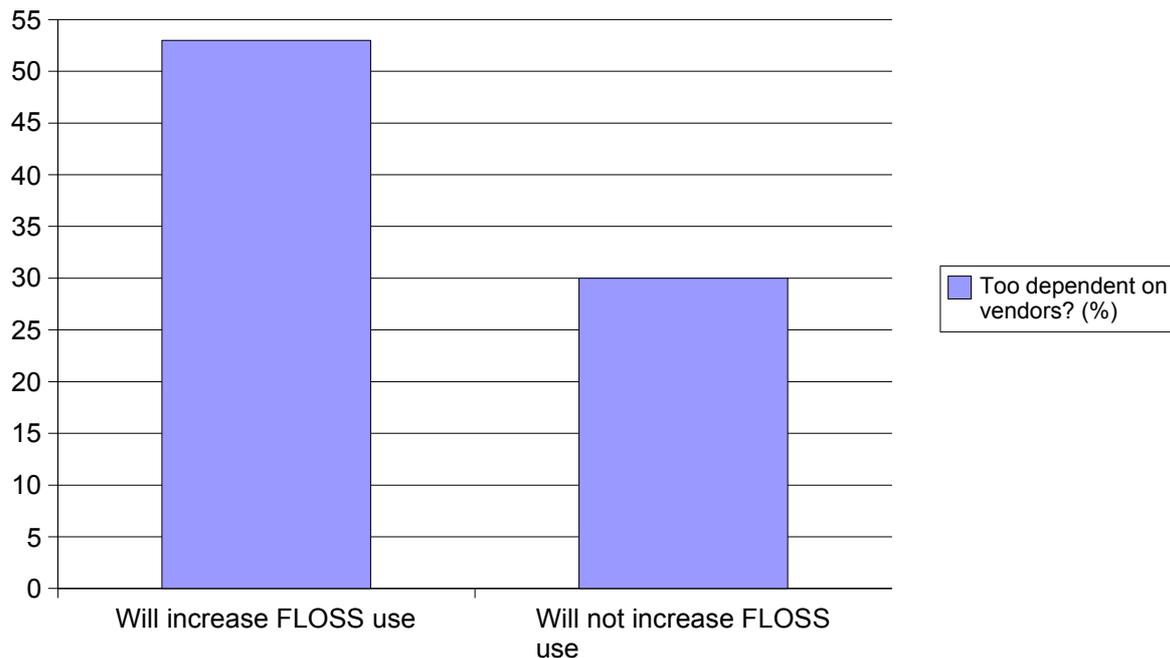
7.Policy strategies for public procurement

Section 4 describes possible policy goals for public procurement in order to support – or at least, not undermine – the economic effects that can be achieved by the use of open standards as defined in this paper. Section 5 shows that public authorities in practice fail to achieve these goals, as they support strongly anti-competitive behaviour through their procurement policies favouring compatibility with proprietary technologies. Section 6 suggests that some public authorities attempt to reach some of these goals – increased competition, reduced vendor lock-in – through the use of FLOSS.

Open standards are not the same as FLOSS, and public administrations generally support the principle of open standards even when they are reluctant to support any policy with regards to FLOSS. However, support for open standards is in practice not meaningful unless it is strong support – mandatory, where possible – and using a clear definition of open standards based on an understanding of their effects. Empirical evidence (e.g. Ghosh and Glott 2003) has shown that "most ICT managers do not know for sure which standards are open and which are closed", with surprisingly high shares of survey respondents presuming that standards they use (e.g. Microsoft Word DOC) must be open while others that they use rarely must be closed. As Section 5 shows, the result is that a general stated principle in favour of interoperability is often replaced in practice with policies that favour compatibility with the proprietary standards of previously purchased software. Not only does this result in vendor lock-in for buyers, it also reinforces the market position of dominant players, with broadly negative effects for competition. Moreover, public authorities that favour interoperability *in practice* seem to implicitly or explicitly encourage FLOSS use.

A recommendation for public policy for effective support for interoperability, therefore, must start with a mandatory requirement not to include compatibility with previously purchased

software as a selection criterion for new software. Rather, interoperability with software from multiple vendors must be the sole "compatibility" criterion for new software.

Beyond this, similar effects with respect to interoperability may be achieved by the support of FLOSS, or the support of open standards. In the latter case, however, policy would need to be strong (if not mandatory) in order to be effective at all, with a clear definition of open standards following the framework provided previously in Section 2 and Section 3 of this paper.

This may require that the definition of open standards be tailored to specific software domains, and perhaps the classification of individual standards as open or not. An indication of how this approach may work is provided by the Dutch CANOS classification table and the Government's OSOSS Programme[31], although the criteria used by them differ from ours, which are based on the economic effect of the standard.

For several software domains, FLOSS developers provide viable competitive products and therefore the definition of "open standards" must be compatible with FLOSS development and licensing models. As described in section 3, this typically means that licences on rights over the standard must be made available to FLOSS developers on a royalty-free, audit-free, sublicensable and irrevocable basis.

A recent practical demonstration of an open standards policy is the decision of the Commonwealth of Massachusetts, USA, of mandating open formats for office documents from 2007. This mandatory specification lists the OASIS OpenDocument and Adobe's PDF[32] formats as the only ones in which public sector documents can be published. In effect, this may rule out the use of Microsoft Office in Massachusetts, since Microsoft has publicly refused to support the OpenDocument format in its products, which is an open standard[33].

Some commentators have pointed out that according to European law "only specifications that are issued by public standardisation bodies are considered standards"[34] and only such standards can be specified in calls for tender. This is a result of European Directive 98/34/EC (EU 1998), which listing national standards bodies as well as recognised European standards bodies[35]. The Directive is designed to "create an environment that is conducive to the competitiveness of undertakings"[36]. In practice, as in the example calls for tender in section 5, procurement processes are often anti-competitive. The present argument has shown that the legalistic definition of standards used by the Directive (as approved by recognised public standards bodies, with no concern for their licensing methods) is no guarantor of competition in public procurement or in the economy at large.

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[31] Www.canos.nl

[32] Although PDF is not an open standard under our definition – see the discussion of PDF in section 3.

[33] See news item on the *IDABC Open Source Observatory* at: http://europa.eu.int/idabc/en/document/4678/469 – note that following the Massachusetts decision, Microsoft has announced that it will support Adobe PDF: see e.g. news item at http://news.zdnet.com/2100-3513_22-5887532.html and the Massachussetts decision seems now mired in political debate.

[34] E.g. IDABC's Barbara Held, quoted by ZDNet UK News at http://news.zdnet.co.uk/software/applications/0,39020384,39231581,00.htm

[35] International bodies include the ISO; European bodies listed by the Directive include ETSI, which maintains the GSM mobile telephony standard, but not ECMA, to which Microsoft's document format has been submitted for approval.

[36] EU 1998, Preamble clause 7.

A definition of open standards based on the positive effect of the standard on competition is more likely to produce procurement processes "conducive to competitiveness". The spirit and the letter of the law is seemingly ignored by public bodies issuing calls for tender that require suppliers to use proprietary standards. The letter, but not the spirit of the law will be ignored by public tenders specifying named open standards. And tenders requiring open standards, not named but clearly defined based on their economic effect on competition, will follow both the letter and the spirit of such laws.

We summarise the above guidelines in the following four recommendations:

1. open standards should be defined in terms of a desired economic effect: supporting full competition in the market for suppliers of a technology and related products and services, even when a natural monopoly arises in the technology itself.

2. open standards for software markets should be defined in order to be compatible with FLOSS licenses, to achieve this economic effect

3. compatibility with proprietary technologies should be explicitly excluded from public procurement criteria and replaced by interoperability with products from multiple vendors;

4. open standards should be mandatory for eGovernment services and preferred for all other public procurement of software and software services.

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