LEGAL ASPECTS OF EMULATION

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ABSTRACT

Apart from technical, organisational and economical challenges of long-term access to digital objects, legal implications arise as well. The KEEP project, co-funded by the European Commission under the Seventh Framework Programme (FP7), researched the legal aspects of emulation as part of their research to create a preservation strategy based on emulation. It addresses the legal implications in France, Germany and The Netherlands as well as on European level. Insights have been gained into the legality of transferring content from old media carriers to newer ones and the reproduction of hardware into software emulators. This paper presents the results of the study, conducted by the Bibliothèque nationale de France (BnF), Deutsche Nationalbibliothek (DNB) and the Koninklijke Bibliotheek (KB, the National Library of the Netherlands).

1. INTRODUCTION

Long-term preservation of digital objects not only implies looking after their conservation, but also necessitates the development and execution of strategies to ensure these objects remain accessible and understandable in the future. Apart from the technical challenges this touches upon some legal implications which have been investigated within the KEEP project.

KEEP is a research project co-funded by the European Union under the Seventh Framework Programme (FP7) and stands for *Keeping Emulation Environments Portable* [1]. The project extends on previous work done on emulation such as the Dioscuri project [2] that developed the Dioscuri emulator and the Planets project [16] which amongst others created emulation and migration services. Furthermore, KEEP follows on the recommendations given by the Emulation Expert Meeting held in The Hague in 2006 [3] which stated that emulation is a vital strategy for permanent access but it requires several next steps to become mature. KEEP aims to deliver a strategy that gives permanent access to multimedia content (such as computer applications and console games), not only now but also over the long term. Therefore, it does research into media transfer, emulation and portability of software. In addition to this research a prototype will be developed that can capture data from old physical carriers and render it via emulation. To avoid having the prototype itself becoming obsolete a virtual layer is created that guarantees portability to any computer environment.

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2. EMULATION AS A PRESERVATION STRATEGY

Emulation is a proven technology that can be used to cope with obsolescence of hardware and software. It is a technique that supports the recreation of a computer environment (target) on top of another computer environment (host) [4]. Such adaptation is done by an emulator (often a software application but it could also be embedded in hardware). The emulator mimics the functionality of hardware or software, depending on the kind of emulation level is chosen. Each level of a computer environment can be emulated, that is: hardware, operating system or application. The KEEP project focuses on the level of hardware which entails creating virtual representations of real hardware such as a CPU, memory and graphics card. Altogether it forms a virtual computer that is capable of executing native software (e.g. operating system, drivers, applications). Hardware is often well specified and documented in comparison with other levels (e.g. a closed-source operating system such as Microsoft Windows is very hard to emulate accurately). Moreover, an almost unlimited list of emulators and virtualisation software exist mimicking hardware going back as far as the IBM CP-40 in 1966 [21]. This makes it easier to understand the inner workings of hardware components as this software can be examined and re-used.

In the context of preservation, emulation is an attractive solution. By rendering a digital object with an emulator and original software an authentic recreation of that object in its native computer environment can be given, such as WordPerfect 5.1 on MS DOS 5.0 (see figure 1). The advantage of such a strategy is that no changes to the digital object is required which offers better conditions to its authenticity. Apart from a computer museum, in some cases emulation is even the only possible way to gain long-term access to digital information as migration does not work for complex digital objects such as software applications (e.g. games), websites or visualisations of data sets.

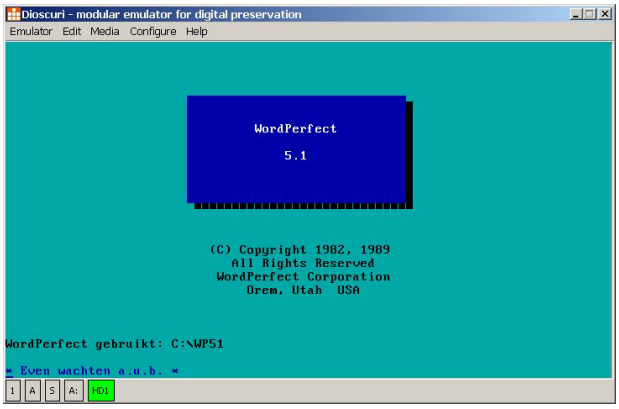

Figure 1: emulator Dioscuri rendering WordPerfect 5.1 on MS DOS 5.0

3. EMULATION ACCESS PLATFORM

KEEP extends on the idea of applying emulation as long-term access strategy in an organisation (e.g. library, museum, company) for its digital collection. To move the emulation strategy from the arena of theoretical discussions into the field of practical solutions some implications have to be solved first. During the first year of the project, the BnF, DNB and KB conducted a survey amongst users of their library. They were asked about their current practices, preferences and desires regarding access to digital information. In total, 644 people responded of which 588 completed the survey. One of the outcomes regarding emulation (figure 2) was that more than half of the respondents (285) noted to have experienced problems accessing old computer files or programs. The technical reasons mentioned were that their current computer could not operate with the old digital file or program (31%). Even so, appropriate media drives seem to be missing (29%) or the media carrier was damaged (17%). Lack of original software is also a significant issue (15%).

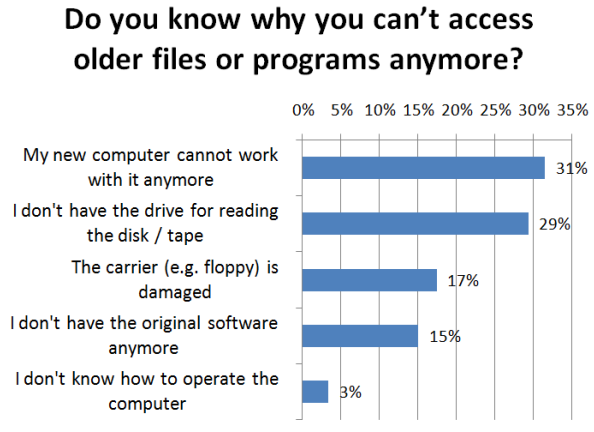

Figure 2: Results on question: do you know why you can't access older files or programs anymore? n = 285 (multiple answers allowed)

This insight is supported by a recent study conducted by the European project PARSE.Insight [23]. Focusing on researchers, 1,209 of almost 1,400 the responding researchers stated that "lack of sustainable hardware, software or support of computer environments may make the information inaccessible" is the most important threat to digital information. However, 81% of the same researchers still preserve their own research data on their local computer.

Based on this input and on experience with emulation strategies, the following issues require attention:

- Data often resides on obsolete data carriers;
- Original software is required;
- Installing an old computer environment is difficult if not impossible;
- Insufficient descriptive and technical information is available (e.g. manuals, tutorials and other supporting documents).

The KEEP project recognises these technical issues and has envisioned a solution that should help organisations to adopt emulation within their business. The solution is called the Emulation Access Platform (EAP) and will support organisations to:

- Migrate data from old carriers onto newer media carriers;
- Access digital objects in its authentic computer environment using emulators;
- Keep track of sufficient contextual information regarding object and its environment;
- Become independent from current and future computer platforms.

The EAP will consist of three components: Transfer Tools Framework (TTF), Emulation Framework (EF) and the KEEP Virtual Machine (KEEP VM). Figure 3 gives an overview of these components and how they interact with each other and the environment.

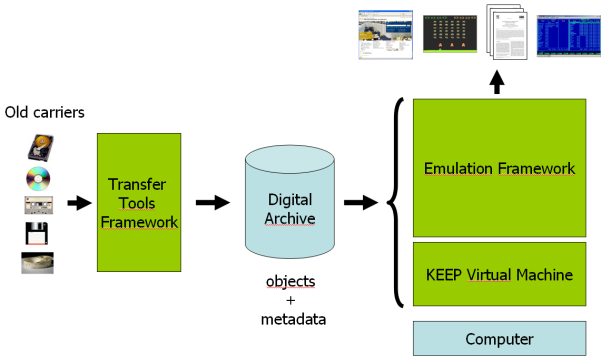

Figure 3: Emulation Access Platform

The first step is to capture the bit stream from old media carriers. This will be done by the TTF integrating

already available or new tools to extract raw data from physical media. The data stream (raw bit stream) will then be captured in a container format (disk image) enriched with metadata. After that, the newly created container and metadata can be ingested in the organisation's digital archive via the normal ingest procedures in terms of the OAIS reference model (ISO 14721:2003) [5].

At retrieval time, the object and metadata are disseminated from the digital archive and handed over to the EF. The EF identifies and characterises the digital object using external services such as DROID, PRONOM or another service (e.g. Planets suite [17]). The connection to these services can be customized depending on which services are available and denoted as trustworthy by the organisation's policy. Based on the object's characteristics the emulation environment is constructed automatically. This consists of the appropriate operating system, application software and drivers together with an emulator capable of accurately rendering the object and environment. When preparation is done the EF facilitates a Graphical User Interface (GUI) to the user showing the rendered object in its authentic environment. Additional services such as copying text, making screenshots or recording a video of the rendering process will be supported.

Currently, several prototypes of the EF have been created already based on a set of requirements and a design [18]. The KEEP VM has been specified as well [19] and the requirements for the TTF are almost finalised.

4. LEGAL CHALLENGES

Although emulation is denoted as technically challenging, it has become a more accepted strategy over recent years. The big advantage of not having to migrate all digital objects over time (periodically) saves storage space, time, money and effort and therefore has made this strategy an attractive alternative to migration. However, apart from this technical and economical perspective, the legal conditions should researched as well [6].

Within the KEEP project a study has been carried out to research the legality of various aspects of emulation [22]. The legal departments of the Bibliothèque nationale de France (BnF), Deutsche Nationalbibliothek (DNB) and the National Library of the Netherlands (KB) worked together with the international law firm Bird&Bird to research the legislation within their own countries as well as European regulations. The legal teams at the libraries are experts in copyright and privacy and find KEEP's research a welcome addition to their journey for better legislation regarding long-term access to cultural and scientific information. The study has been conducted from February 2009 until March 2010 and covers two main topics which are explained in detail in the following sections.

4.1. Media transfer

To ensure that a digital object will last longer than its media carrier, it has to be transferred to subsequent carriers over time. This process raises some legal issues as reproduction of content is restricted by law. Moreover, various protection mechanisms have been put in place by vendors to prevent users to copy the information stored on the original data carrier. Matters get even more complicated when manufacturers have stopped their businesses or gone bankrupt, leaving their products as 'orphan works' or abandon ware [20]. This leads to a very challenging situation within cultural heritage. On the one hand memory institutions are given the responsibility to preserve the cultural heritage which includes increasing amounts of digital media carriers. On the other hand, most of the digital carriers received are protected against copying and require special treatment to sustain access to the objects contained therein while the legal framework seems very restrictive.

4.2. Emulation of software and hardware

For emulation purposes, hardware and their embedded software or semi-conductor products (e.g. chip masks), have to be mimicked. Their inner workings can be understood by reading technical manuals, but in some cases this is not sufficient. Reverse engineering of hardware and software could then be the only way, for example by performing specific tests on original hardware using an oscilloscope or decompiling software.

The issues raised here are whether or not reverse-engineering is lawful where software, hardware or semiconductors are concerned. In addition, as certain hardware may have already been emulated by proprietary or Open Source Software it is therefore worth assessing to which extent these existing emulators could be used by KEEP.

5. CONTEXT & DIRECTIVES

To find out if transferring digital information and using emulation for rendering digital objects is legally possible, the appropriate European and national regulations have to be investigated. The legal study uses the container term 'Multimedia Works' to cover all possible types of content, such as audiovisual content, software and database elements along with off-the-shelf software programs considered on a standalone basis. The legal qualifications of these digital objects differ: they may qualify as computer programs, audiovisual works and/or databases. Moreover, video games are sometimes treated as a special legal category, within national law, as well.

Examining the set of rules and regulations defined by the European Union (also known as the *Community Framework*) learns that various directives are involved that cover (parts of) the digital objects concerned:

- Directive 2001/29/EC of 22 May 2001 on the harmonization of certain aspects of copyright and related rights in the information society, known as the *Information Society Directive* [7];

- Directive 2009/24/EC of 23 April 2009 on the legal protection of computer programs, known as the *Computer Programs Directive* [8] (replacing the older Directive 91/250/EEC of 14 May 1991) [9];

- Directive 96/9/EC of 11 March 1996 on the legal protection of databases, known as the *Database Directive* [10].

These directives have been researched together with the national laws applicable in France, Germany and the Netherlands.

6. LEGAL IMPACT ON MEDIA TRANSFER

In case of transferring data from media carriers, the study identified various areas of impact outlined in the following sections.

6.1. Intellectual property rights

Following the *Information Society Directive* from the EC Multimedia Works are protected by intellectual property rights. This means that reproduction and representation of a protected work must be authorized. Intellectual property rights apply to the work itself rather than to the physical storage media. Therefore, the rules regarding copyright protect the content, whatever the physical medium may be (e.g. floppy disk, optical disk, cartridge). The protection lasts seventy years after the author's death (when the publication is done by an individual) or seventy years after publishing (when the publication is done by a company, or (in the Netherlands) when an employee created the work in the service of an employer).

A special exception exists in the three countries covered by this research (France, Germany and The Netherlands). This exception authorizes reproduction and representation of protected works by institutions responsible for legal deposit (e.g. national libraries), or cultural heritage institutions in general (in the Netherlands no legal obligation exists for preservation publications). This allows them to take appropriate actions such as format migration or media refreshment (transfer of content) to ensure that the digital object in question will not be lost over time.

6.2. Copy protection techniques

To protect the duplication of multimedia works and computer programs publishers often use technical measures of protection (TMP). In France, the law dictates that Multimedia Works must be deposited at the BnF with appropriate access codes (software keys) [11]. In Germany, circumvention of TMP is prohibited by the German Copyright Act. However, according to the Code of the German National Library legal deposits shall be done without TMP. If not, the access codes should be given or the TMP must be removed. This applies to multimedia works except for games which are excluded from the legal deposit requirement. Circumvention of technical protection measures is not allowed for these computer programs.
In the Netherlands, technological protection measures on multimedia works and computer programs prevail over the exceptions, unless this is remedied by secondary legislation [12]. As yet, such legislation has not been issued and as a consequence, circumvention of these protection measures is legally not possible.

When circumvention of TMP by the legal deposit institutions is permitted, they are only allowed to do so within their premises. Circumvention by private companies is possible only when they act for these institutions as service providers.

7. LEGAL IMPACT ON EMULATION SOFTWARE

The lawfulness of decompiling computer program environments consisting of operating systems, firmware (e.g. BIOS) and applications should be assessed in line with Article 6 of the *Computer Programs Directive*. This article states that reproduction and translation of source code for the purposes of decompiling are not subject to prior authorisation, provided that (i) these acts are intended to create interoperability between an 'independently created program' and other programs; (ii) these actions are performed by a licensee or lawful user; (iii) the necessary information to obtain such interoperability is not quickly and easily accessible, and (iv) the acts are limited to the portions of the code required for the aim pursued.

Following the line of thought that cultural heritage institutions are lawful users and that they try to create interoperability between old Multimedia Works and current computer environments while no other information is easily at hand, they seem to meet all the predefined conditions. Therefore, decompilation of certain parts of software code is allowed. It would therefore not be necessary to obtain permission in advance from the rights holder.

That said, these conclusions are subject to the development of the emulation platform not requiring the reproduction of a substantial quantity of code from the decompiled computer program, in which case the offence of copyright infringement could be incurred. Likewise, decompiling merely for the purpose of research and analysis without attempting to achieve interoperability could constitute the offence of copyright infringement.

The French, German and Dutch laws have incorporated the provisions of Article 6 of the *Computer Program Directive* in an almost literal manner and thus national interpretations do not diverge from the European orientations defined here.

Therefore, emulating software is in principle permitted under the relevant national laws and subject to the limitation to research, to achieve interoperability between the emulation platform and the Multimedia Work. However, reproduction of a substantial quantity of lines of code or of the structure of decompiled computer programs is not allowed.

8. LEGAL IMPACT ON EMULATION OF HARDWARE

Within the context of emulating hardware several areas were investigated. Each of these are explained in the following sections.

8.1. Patent protection

In general, hardware components are often patented. A patent is (a set of) exclusive rights granted by a patent office to an inventor for a limited period of time. In turn, a public disclosure of an invention is given which allows the rights holder to gain a benefit from the invention in competition with other vendors on the market. As far as patent rights are concerned, it is necessary to distinguish the following situations:

- If hardware is not protected by any patent rights, there are no restrictions to undertake reverse engineering necessary to emulate the applicable hardware and use the resulting emulation program;

- If hardware is protected by patent rights which are still in force, it is not allowed to carry out the activities described above, depending on what is specifically claimed in the patent. This needs to be assessed on a case-by-case basis;

- If hardware was protected by patent rights which are no longer in force, there are no restrictions.

French, German and, to some extent, Dutch law limit patent protection as it does not extend to private or non-commercial purposes (private use exception) and does not extend to acts solely intended for research or testing on the patented subject matter (experimentation exception). However, if emulation is meant for giving access to digital objects to the public, none of these exceptions are applicable. So, KEEP cannot make use of emulators that mimic hardware still protected by a patent without asking permission of the rights holders beforehand.

All European countries' domestic laws and regulations protect national patents for twenty years (maximum) from the filing date. The filing of a patent often occurs several years before the marketing of the related invention. In addition, to keep the patent in force, annual renewal fees must be paid to the different national intellectual property's Offices where patents have been filed.

Consequently, in most cases, the patented product or process will become public domain before the term of the twenty years protection. It is however necessary to verify, on a case-by-case basis, for each invention identified, whether the patent rights are still in force.

Once the hardware protected by patent rights falls in the public domain, the related invention is free for exploitation. Therefore, emulation of older computer hardware (older than twenty years) is likely to be permitted.

8.2. Emulation of semi-conductors (computer chips)

Semi-conductors can be protected by patents in relation to their hardware layer and by copyright when it relates to the firmware (software) layer they may embed. In addition, semi-conductors enjoy a special protection as far as their topography or mapping is concerned. In this case, the rules deriving from Council Directive of 16 December 1986 *on the legal protection of topographies of semiconductor products* (87/54/EEC) [13] should be considered.

The directive provides protection to the 'topography of a semi-conductor product' in so far as it satisfies the conditions "that it is the result of its creator's own intellectual effort and is not commonplace in the semi-conductor industry" (article 2.2). In such a case, the rights holder can forbid the reproduction of the topography by others. This rule, however, carries exceptions that seem relevant to emulation research:

- a Member State may permit the reproduction of a topography privately for non-commercial aims (article 5.2);

- The exclusive rights granted to the rights holder shall not apply to the sole reproduction for the purpose of analyzing, evaluating or teaching the concepts, processes, systems or techniques embodied in the topography or the topography itself (article 5.3);

- The exclusive rights referred to in the first paragraph shall not extend to any such act in relation to a topography created on the basis of an analysis and evaluation of another topography, carried out in accordance with Article 5.3 (article 5.4).

It is quite likely that activities regarding emulation with respect to the reproduction of semi-conductor chip masks, if any, would fall within the scope of those exceptions.

8.3. The use of emulated hardware from third parties

Within the emulation community a lot of third party emulation software is already available under either an open source or a proprietary license. After verifying whether such third party emulators are not infringing the rights of the emulated environment right holder, such software may be used within the limits of their licenses (irrespective of their Open Source or proprietary character) and of the applicable law. With respect to Open Source licenses most of them indeed allow the use and modification of source code, and permit further distribution of the resulting product, even as commercial distribution. As such, emulator developers could use existing Open Source licensed code in their own emulator. Most Open Source software licenses require that the recipient of each resulting product must be given (a) access to the source code and (b) a license to the product which is in line with the initial Open Source license. In other words, the company or heritage institution/KEEP partner that incorporates the Open Source licensed code into its own software cannot distribute it more restrictively than the initial Open Source license. As a result, the licensed code remains 'free', even when embedded into future derivative works.

9. RECOMMENDATIONS & FUTURE WORK

Based on the analysis presented in the previous sections a couple of recommendations can be drawn.

9.1. Regarding media transfer

It is reasonable to consider that the legal risk of transferring data from old carriers is relatively limited as long as conservation is only done at cultural heritage organisations and access is only granted on small scale to individual researchers. However, none of the research exceptions are applicable if the emulation platform is meant to be made available to the public at large to give them access to the digital objects, as is KEEP's goal.

Therefore, it is strongly recommended that copyright law is adapted to fit the Information Technology age in which we live in. Today, several Digital Rights Management (DRM) mechanisms have been developed and applied to regulate the usage of digital content. For such content it is common practice that the use restrictions are transferred together with the object itself or that restrictions in usage and/or transfer of the Multimedia Works are encoded within the digital object. Therefore, copyright law needs to be adapted to focus more on protecting against the unauthorized usage of Multimedia Works rather than just simply prohibit to transfer Multimedia Works.

Especially for those media types which are already obsolete or becoming so, a general exception for cultural heritage institutions to transfer digital media carrier for archival and access purposes without any technical restrictions is urgently needed on both national and European levels.

Two possible solutions called *the legislative path (9.2.1)* and *the negotiation path (9.2.2)*.

9.2. Regarding emulation of (embedded) software

As explained before, the EU only allows reproduction to carry out decompilation (reverse engineering) for interoperability purposes provided that the resulting program does not incorporate portions of the code that is subject of decompilation. The practical steps that should be taken to mitigate the risks of copyright infringement are twofold:

9.2.1. The legislative path

A consortium of stakeholders could launch an initiative aiming at modifying the current *Community Framework* of the EU and more specifically the *Computer Programs Directive* to include a new exception. Such an exception should allow cultural or legacy institutions such as national libraries, archives and museums to perform the necessary steps for reproduction in order to preserve Multimedia Works running on proprietary programs, through emulation or any other relevant technique. As a condition to this exception, it could be envisaged that the institutions would only be allowed to do so when such proprietary programs are no longer on the market or supported by the relevant manufacturers.

This approach is obviously the most effective one in terms of result and legal security. However, it is likely that software companies will launch a strong lobby to hamper the achievement of such an initiative as they did in the past in respect of the *European Computer Programs Directive* [14] and, especially, against the decompilation exception. As a result, even in the event that the stakeholders would be able to find heavy political support to endorse the initiative, the timeframe necessary to reach the final objective will be long and even longer considering the implementation required at national level.

9.2.2. The negotiation path

An alternative solution would be to approach the right holders in order to obtain the required authorisation to proceed with the activities of emulating software. This would require the stakeholders to disclose the existence and purpose of the research to such right holders which may eventually perceive it as a potential threat for their proprietary rights. They may fear the dissemination of a groundbreaking and far-reaching emulation technology. Negotiations are therefore likely to be difficult and, in

any event, lengthy, as the rights holders will thoroughly assess the risks and proceed very carefully. Moreover, not all the rights holders will be found as some will have gone out of business.

A possible approach would be to involve those manufacturers as sponsors within the group of emulation stakeholders, by associating their names with the research and enabling them to communicate about their participation in a project of public interest. For instance, Microsoft could see a PR benefit from showing that it is collaborating with national libraries for non-profit purposes. However, it may be difficult to attract the most important software manufacturers within an enlarged emulation community.

It is also highly probable that those manufacturers would require an insight into the emulation technology which may raise concerns in terms of protection of intellectual property rights developed as part of the emulation research.

9.3. Regarding emulation of hardware

The first practical step that should be taken with respect to emulating hardware would be to verify whether the processes or products to be reverse engineered and emulated are protected by patent claims still in force. This should be done on a case-by-case basis with support from patent agents.

If the conclusion is that the processes or products are not, or not any longer, protected then no obstruction exists to undertake the emulation operations and develop the corresponding emulator. However, if the processes or products are still protected by patent claims, then the two options described in the previous section (*legislative* or *negotiation path*) seem the only two options.

In this regard, the legislative path is probably a more difficult option than for software as there is no unified European framework governing patent protection that could be amended. Furthermore, any national or European initiative would probably violate the provisions of the TRIPS agreement [15] which is signed on international level. One can imagine that the United States or East Asian countries would probably strongly disapprove in protection of the interests of their national manufacturers.

Concerning the *negotiation path*, the obstacles mentioned in respect of software are relevant here as well, unless the research community would specifically target their interests in technology that is economically outdated as manufacturers probably do not see any commercial or technological value anymore.

9.4. Future work

Clearly, work has to be done in the field of legislation for preservation and use of digital objects. The current *Community Framework* and national laws do provide some structure but legislation is scattered over many domains and different national interpretations exist. Major legal obstacles still exist regarding copyright protection, software re-use and recreation of computer environments based on patented hardware. National libraries, archives and museums try to fulfil their task in offering long-term access to authentic digital material, but they cannot violate the law.

Therefore, a strong group of stakeholders should be formed representing a variety of cultural heritage organisations such as libraries, archives and museums. Moreover, research organisations and companies could join as each organisation will face severe loss of access to old media and information as long as regulations will not change. A two-fold initiative could be deployed:

- focus on a long-term approach of lobbying for better legislation regarding preservation and use of software, media migration and emulation of hardware;
- focus on negotiations with software manufacturer and hardware manufacturers to find solutions on the mid-term, enabling the emulation of their software and hardware for access to digital information.

Only this way, alignment can be reached between what technically is possible and legally allowed to enable preservation and access of digital information in Europe and beyond. The three national libraries involved in this research are now considering the above- mentioned strategy and invite others to join forces.

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