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Heterogeneously-Licensed System Requirements, Acquisition, and Governance

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Abstract

Increasingly, software-intensive systems are being constructed from components subject to different licenses. As software reuse, component-based software development, and open source software components come into more widespread use during system development, developers and consumers are faced with a complex array of legal rights and obligations that they have difficulty tracking, yet alone comprehending. We outline aspects of this problem and an approach for managing it from the points of view of architects, analysts, acquisition managers, and regulators.

1. Introduction

It has been typical until recently that each software system is used and distributed under the terms of a single proprietary or open-source software (OSS) license, with all its components homogeneously covered by that same license. The system sources and executables bear copyright and license notices, and the license gives specific rights while imposing corresponding obligations that consumers of the software (whether developers or users) must honor, subject to the provisions of contract and commercial law.

But it is increasingly common to see *heterogeneously-licensed (HtL) systems*, whose software components are not under a single license [2, 4]. Such systems are produced in software ecosystems in which software producers and consumers are related through the integration of software components that may each have a different license. As a rule the resulting system will not have a single recognized license. Instead its consumers are given one or more rights that are the intersection of the rights given by the components' licenses, on the condition of meeting a list of obligations, given by the union of those imposed by the components' licenses. The licenses may conflict, so that not all obligations can be met simultaneously and the intersection of the rights will be empty; for example, in a system combining proprietary components with components under the General Public License (GPL) unless careful measures are taken [1]. Understanding which rights are ultimately available and which obligations are imposed, determining whether any subsume or conflict, and foreseeing how they may change as a result of software evolution practices is therefore a core problem of considerable interest. Our approach to understanding and analyzing these challenges is presented in detail elsewhere [1]. There we focus on license provisions that are enactable by a licensee, testable, and computational, so that we can provide effective tool support for addressing licensing challenges, and support the point of view of a system designer or architect. As a result, we can calculate rights and corresponding obligations for a particular system architecture, and examine the consequences of specific architectural and component choices.

A necessary next step is to formulate nonfunctional requirements (NFRs) for the Intellectual Property (IP) rights and obligations of a system. This step adds the point of view of a requirements analyst and a consumer. Our position here is that *licensing NFRs cannot be effectively stated in terms of licenses; they can only be stated in terms of individual rights and obligations.* The rights (positive "may" and negative "need not") are those defined in copyright, patent, and other IP law, or subdivided into smaller rights defined in specific licenses, and those disclaiming what would otherwise be obligations for warranty, liability, etc.; the obligations are those defined in licenses. If these rights and obligations are stated in the same form and terms in which we represent licenses [1], then our approach can analyze the requirements for potential conflicts, and provide guidance for the architectural patterns and component selection policies that can implement them.

Finally, a third step is to formulate policies, regulations, and principles of governance for HtL system development and acquisition in the context of ecosystems. With this step our point of view is extended to include that of an acquisition manager or officer responsible for seeing that an appropriate system is brought into existence and distributed to its

consumers. For example, the U.S. Federal Government (as well as other national and regional governments) routinely engages in software procurements (purchases of standard goods) and acquisitions (contracts to develop or customize specialized goods), guided and constrained by Federal regulations designed for those processes. Parts of the Federal Government are already shifting to HtL system acquisition. But to our knowledge, these regulations have not yet addressed the new concerns raised by HtL system acquisition.

2. Discussion

We and others have shown that licenses are too large a unit for describing IP requirements of HtL systems, as such systems often do not have a recognized license but only individual rights and obligations [2, 4]. We argue that individual rights and obligations are at the scale appropriate for use as the elements of IP requirements.

The rights that appear in the corpus of licenses plus those defined in copyright and other IP law form the basis for IP rights requirements, as these are the only ones that are available for an HtL system. Our initial studies of 15 licenses show that the copyright rights of use, distribution, and modification express the most-desired rights, generally addressing the common lifecycle contexts of use of a single system version, distribution of a version to additional consumers, and system evolution from version to version.

A second set of IP rights address the legal domain rather than that of system development and operation. These "need not" rights disclaim default obligations ordinarily imposed by the legal system for warranty, mechantability, liability, etc., and again the rights of this kind that appear in the corpus of licenses are the appropriate ones.

IP requirements for obligations appear to be intrinsically more challenging, for several reasons. The first is scale: our analysis of licenses revealed a greater variety of obligations than of rights, with fewer inference relations among the obligations than among the rights. Thus there are fewer opportunities for generality and concision in expressing the requirements. While we cannot know whether this trend will continue as we extend our license analyses, it is a notable phenomenon in our results to date. Secondly, each license conflict we identified involves at least one obligation (many involve two), so that more care may be needed to express useful obligation requirements. The third reason is that each obligation is related to a specific right, so that tradeoffs are possible and desirable. Obligation requirements must address relationships among obligations (and rights), rather than individuals as can be the case for many IP rights requirements, in order to delineate the permitted tradeoffs. We foresee that most such IP requirements will be patterns relating several obligations and rights.

At this point we pause to note that this point of view, the analyst's, would appear in combination with our approach to offer guidance to authors of new licenses and revisers of existing ones. We envision future work along these lines.

Taking our further step involves not only a change to the acquisition viewpoint, but also a change of concerns. Working with IP requirements involves specifying patterns of "at least these rights" coupled with "no more than those obligations," seeking requirements that can be enacted and tested for compliance, but IP governance raises the level of abstraction to acceptable *patterns of IP requirements*.

Policies, regulations, and governance are concerned with system instances meeting specific IP requirements, but also with evolution from one version to another, both of systems and of IP requirements. At this level we must not only allow evolution, but if possible direct it in desirable paths. For example, it is unlikely to be desirable for a HtL system to be "captured" by a proprietary component vendor, to go from an open architecture with open interfaces to a traditional closed system that can only be delivered from a single producer, or to restrict HtL components to non-GPL licenses as is the practice for some parts of the U.S. Federal Government; and it is desirable to allow end users to participate in some role in system evolution, in order to obtain some of the OSS advantages of quick response to changing requirements and better fit to contexts of actual use, and to require systems that must interoperate to have non-conflicting IP regimes. Substantive progress at this level may have to wait until we have a better understanding of their software ecosystems, what push-pull relations operate there, and how the systems and their ecosystems should and should not evolve. We hypothesize that effective policies and regulations may turn out to be analogous to process workflows rather than individual requirements [3].

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