Developing An Open Source Option for NASA Software

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Abstract

We present arguments in favor of developing an Open Source option for NASA software; in particular we discuss how Open Source is compatible with NASA's mission. We compare and contrast several of the leading Open Source licenses, and propose one – the Mozilla license – for use by NASA. We also address some of the related issues for NASA with respect to Open Source. In particular, we discuss some of the elements in the "External Release of NASA Software" document (NPG 2210.1A) that will likely have to be changed in order to make Open Source a reality within the agency.

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1 Introduction

In the past decade the rapid growth of the Internet has changed how we use computers. For software developers, the widespread network availability and growth of network-aware tools have led to new forms of distributed development and collaboration. Software distribution has also changed. Distributions in the past, requiring sending disks and tapes through the postal service, have in many cases been superseded by the simpler and more rapid distributions enabled by the network.

One of the more exciting developments has been the growth in what is known as Open Source software. From the name alone it might seem that Open Source simply means that when software is distributed, source code is included. But Open Source is more than that. Open Source is about enhanced software quality, more efficient software development, and increased collaboration. An organization known as the Open Source Initiative (OSI) [21] provides the most widely recognized guidelines as to what constitutes Open Source; in particular the OSI provides guidance with respect to how to balance the intellectual property rights concerns of developers with openness. The OSI's contribution is particularly important because there is the temptation by many to use the terms "open" and "open source" rather loosely, and in particular to apply the adjectives to software that in reality is not particularly open. An article by Tim O'Reilly (of O'Reilly & Associates, one of the most prolific computer science book publishers) also provides help with clarifying what Open Source is about [34]. Currently, the largest Open Source software hosting site, SourceForge, provides the home to over 36,000 Open Source projects.

For NASA, the adoption of an Open Source option for software distribution would lead to three main benefits:

1. improved software development;
2. enhanced collaboration, in particular across organizational boundaries;
3. more efficient and effective dissemination.

The first benefit is described by the OSI as "when programmers can read, redistribute, and modify the source code for a piece of software, the software evolves. People improve it, people adapt it, people fix bugs. And this can happen at a speed that, if one is used to the slow pace of conventional software development, seems astonishing" [21]. In one sense, Open Source enables a type of peer review for software. The second benefit is important because NASA's overall mission to "understand and protect our home planet, to explore the universe and to search for life" [32] is not one that NASA can effectively achieve alone. To be successful, NASA will need to work with other government agencies, academia and industry. Open Source makes those types of collaborations easier. Finally, from the beginning NASA has been directed to "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof" [8]. An Open Source distribution, coupled with the opportunities provided by the Internet, would enable far greater dissemination than has ever been achieved before.

In this report we propose that NASA develop an Open Source option for software developed within the agency. We say *option* because we are not proposing that *all*

NASA software be released Open Source. We recognize that some software, because of export control, ownership or commercialization concerns, may not be suitable for Open Source. Nevertheless, we expect that many NASA projects would be appropriate for, and would benefit greatly from, an Open Source distribution. In the following sections we begin with some of the rationale behind Open Source. Next we consider some of the leading Open Source licenses and their properties. We also address some associated issues that impact potential Open Source distribution for NASA software, in particular issues related to NPG 2210.1A, the "External Release of NASA Software" guideline. We propose one particular license, the Mozilla public license, for consideration. And finally, we conclude with some proposed next steps.

2 Why Open Source Software?

There are many arguments in favor of Open Source software. Which argument resonates with the listener depends on ones viewpoint. Here we discuss some of the key perspectives.

2.1 NASA Perspective

The functions of NASA were prescribed in the "National Aeronautics and Space Act of 1958", NASA's charter [8]. The charter states that NASA shall:

1. plan, direct, and conduct aeronautical and space activities;
2. arrange for participation by the scientific community in planning scientific measurements and observations to be made through use of aeronautical and space vehicles, and conduct or arrange for the conduct of such measurements and observations;
3. *provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof;*
4. seek and encourage, to the maximum extent possible, the fullest commercial use of space; and
5. encourage and provide for Federal Government use of commercially provided space services and hardware, consistent with the requirements of the Federal Government.

(*Emphasis added*). An Open Source distribution option for NASA software would provide for the widest dissemination of the work, with minimal overhead.

A more recent expression of NASA's priorities comes in the form of the NASA Mission Statement (found for example in the NASA 2003 Strategic Plan [32]):

- To understand and protect our home planet,
- To explore the universe and search for life,
- To inspire the next generation of explorers ... as only NASA can.

To most effectively achieve the first two goals NASA will need to work closely with other government laboratories, universities, and industry. Open Source software lowers the barriers to collaboration and enables sharing with minimal overhead. The third goal would also benefit if NASA were to adopt an Open Source option. NASA produces software specifically intended for teachers and children; for example, see the applications sponsored by the NASA Learning Technologies Project [30]. Schools, especially K-12, tend to be especially sensitive to software cost. Open Source would enable easier transfer of software from NASA to teachers and students with little or no cost to the recipients. Open Source would also make it easier for more advanced students and teachers to add new features to the software and contribute those features back to NASA, so that they may be shared by other schools. Imagine the excitement and pride fostered in a student when his or her work was appreciated not only by classmates but by peers worldwide.

2.2 Software Users' Perspective

The appeal of Open Source software for users is based on more than simply the desire to avoid paying money or to make a political statement. The decision to utilize a particular software library or application has serious implications because most non-trivial software requires a significant amount of time and effort to master and use effectively. Software that is available Open Source is easier to evaluate before making a deeper commitment. Furthermore, software used by NASA researchers tends to come from other NASA researchers, other government laboratories, university researchers, or small companies. Not all software comes from multi-billion-dollar giants. A significant consideration when deciding whether to adopt a software package is the expected longevity of the source. Budget cuts, personnel changes, rearranged priorities or bad business decisions may all lead to software that goes from reasonably supported to unsupported. In cases of closed or proprietary software, there may be no recourse for the user. Open Source software, on the other hand, leaves open the option of stepping in to keep the software alive. For example, the software underlying the Apache web server was initially developed and distributed Open Source by NCSA. When development and support from NCSA slowed, users stepped up to keep the project active. This is not to say releasing software Open Source magically means that programmers will step in when needed – many Open Source projects die in obscurity – but when the technology is important enough (the Apache server continues to play an important role in the infrastructure of the Internet) then the motivation will be there.

2.3 Software Developers' Perspective

Software developers are necessarily software users. They understand first hand why potential users of their own software prefer Open Source. Software developers also appreciate the potential value that users can provide in terms of testing, bug fixes, extensions and new ideas.

Researchers also understand that software frequently functions as a common platform for collaboration. Open Source encourages such collaborations by minimizing

unnecessary and unwarranted restrictions on transfer, in particular when those collaborations cross boundaries between government laboratories, academic laboratories, and industry.

2.4 PITAC Perspective

In 2000 a President's Information Technology Advisory Committee (PITAC) was convened to address the subject of "Developing Open Source Software to Advance High End Computing" [15]. The committee included participants from industry, academia and government laboratories. Bill Feiereisen, the former chief of the NAS division, was one of the NASA representatives. The committee produced three recommendations [15]:

> 1. The Federal Government should encourage the development of Open Source Software as an alternate path for software development for High End Computing.
>
> 2. The Federal Government should allow open source development efforts to compete on a "level playing field" with proprietary solutions in government procurement of high end computing software. Requests for Proposals (RFPs) from Federal agencies for high end computing software, tools, and libraries should include provisions allowing these efforts to be carried out using open source.
>
> 3. An analysis of existing open source licensing agreements should be undertaken, and the results should be distributed to all agencies funding high end computing. The analysis should describe characteristics of each license and give specific examples of situations in which it may be preferable to use one type over another. The use of common licensing agreements should be encouraged.

While the committee's focus was on high-end computing, much of the rationale behind their findings could be applied to the broader information technology arena.

2.5 Academia Perspective

In the past decade within universities there has been a trend towards the commercialization of software. More recently some notable voices have pointed out that commercialization may not be the best choice in all cases. Larry Smarr, founder of the National Center for Supercomputing Applications (NCSA) and generally acknowledged as a leading visionary in information technology, has stated:

> Some universities are dead set against giving [software code] away. But I don't think universities should be in the moneymaking business. They ought to be in the changing-the-world business, and open source is a great vehicle for changing the world [14].

While "changing the world" is a lofty goal, it is an appropriate one. Replace "universities" with "NASA centers" in Smarr's statement and you would be echoing the

sentiments of many in NASA, in particular those who are actually developing the software that would be eligible for an Open Source distribution.

NCSA, it should be noted, is the birthplace to several key information technologies, including HDF [17] and the Mosaic web browser. Those technologies were effectively distributed open source; their open distribution was key to their widespread adoption. HDF is used extensively by NASA, in particular for Earth science data [33]; successors to Mosaic are used by virtually anyone who uses a computer.

2.6 Department of Energy Perspective

The Department of Energy (DOE) is similar to NASA in many respects. Like NASA, DOE is responsible for research laboratories, and like NASA DOE produces software in pursuit of its mission. Also, like NASA DOE is grappling with how best to disseminate that technology, given intellectual property and export control concerns. One difference though between DOE and NASA is that DOE national laboratories are staffed by management and operating contractors, not civil servants. In recent years the trend at DOE has been towards Open Source. Appendix H provides a partial list of DOE-related projects that are available Open Source. Both Chromium [1] and Globus [18] are used at Ames, some of the other packages may be as well.

3 The Leading Open Source Licenses

The following sections provide brief descriptions of some of the leading Open Source licenses. There are currently over 30 licenses recognized by the Open Source Initiative [21], but the majority of Open Source projects are covered by a relatively small set of the licenses. See Appendix I. There are also numerous semi-open-source licenses that do not qualify fully as Open Source as defined by the OSI [21]. Since the focus of this report is Open Source we do not include evaluations of those licenses here. If there is enough interest – and resources – we can add licenses to this evaluation if necessary.

Two of the more helpful sources providing an overview of these licenses and others are the Mozilla "Frequently Asked Questions" file [29] and an "Evaluation of Public Software Licenses" by Rosenberg [36].

Finally, it should be noted that there have been very few court cases where the validity of software licenses in general has been put to the test.

3.1 GNU General Public License

The GNU General Public License (or GPL) was developed by the Free Software Foundation [6]. Unlike the BSD License [13] (see below), it maintains free source code by a fairly complex set of rules. It requires that any "derivative works" based on software covered by the GPL also be covered by the GPL, and that source code to these works be made publicly available. This means than any development that anyone does that is derived from GPL code (derivative works) must also be made free. This ensures that the resource of free source code will not be diminished by someone taking the

code, modifying it slightly, and keeping it to themselves, but it also tends to discourage the use of GPL derivative work in commercial development by traditional software companies and other for-profit organizations [29]. Maxwell [28] provides a relatively critical evaluation of the GPL. The full text for the GPL can be found at [19] and also in Appendix C of this report.

3.2 GNU Lesser General Public License

The GNU Library General Public License was also developed by the Free Software Foundation [6]. It is similar to the GPL, but it introduces the idea that a library of functions covered by the LGPL may be used by a program without the program being a derivative work of the library. This allows the program to be issued under different terms than the LGPL. This makes the LGPL less restrictive (the developer is compelled to release the source code to less of his or her work) than the GPL. (Only changes to the library itself would have to be made public.) [29]. The full text for the LGPL can be found at [20] and also in Appendix D of this report.

3.3 Mozilla Public License

The Mozilla Public License (MPL) attempts to strike a middle ground between promoting free source development by commercial enterprises and protecting free source developers. Like the GPL, it requires that any and all changes to code (derivative works) covered by the license must be made publicly available. However, it also allows you to combine covered code with other code to create a larger work without requiring that other code to be covered by the license. This is similar to, but even less restrictive, than the LGPL [29]. There is also a "Netscape Public License" (NPL) which adds amendments to the MPL granting Netscape certain additional rights that allow the company to make its client source code free while still attending to business needs such as the development of other products (e.g. servers) and the fulfillment of previously existing contracts [29]. We do not further consider the NPL here. The full text for the MPL can be found at [7] and also in Appendix E of this report.

3.4 BSD License

The Berkeley Systems Distribution (BSD) license is another free software license that was developed by the University of California at Berkeley. It is very non-restrictive in its terms, basically allowing anyone to do anything with code covered by the license, but requiring a reference to the copyright holder in accompanying documentation – essentially requiring only credit where credit is due. This makes the license acceptable to commercial developers, but opens others to the possibility that their work may be incorporated into products that may be proprietary to someone else [29]. The full text for the BSD license can be found at [13] and also in Appendix F.

Property	GPL	LGPL	MPL	BSD	PD
(4.1) Recognized by the OSI	Y	Y	Y	Y	N
(4.2) Attribution Required	Y	Y	N	N	N
(4.3) Redistribution Allowed	Y	Y	Y	Y	Y
(4.4) License Trumps in Derivative Works	Y	N	N	N	N
(4.5) Derivatives Must Be OSS	Y	Y	Y	N	N
(4.6) Commercialization Allowed	Y	Y	Y	Y	Y

Table 1: A summary of properties for some of the leading Open Source licenses, inspired by [11]. Y indicates that the property does apply to the license, N indicates that the property does not apply. The headings **GPL**, **LGPL**, **MPL**, **BSD** and **PD** stand for GNU General Public License (Appendix C), GNU Lesser General Public License (Appendix D), Mozilla 1.1 Public License (Appendix E), Berkeley Software Distribution License (Appendix F), and Public Domain, respectively. Public Domain is not a license, but it is included for comparison purposes. "Public Domain" essentially means "all rights waived" by the author.

4 License Properties

As should be apparent from the previous section, not all Open Source licenses are the same. Table 1 lists some of the key properties for various leading licenses, plus public domain. Public domain is not a license, but is included for comparison. *Caveat: The following analysis is not written by a law professional – seek the advice of such a professional before making legal decisions.*

4.1 Recognized by the Open Source Initiative

The terms "open" and "open source" get used frequently these days, not always with the same meaning. The Open Source Initiative (OSI) [21] provides the most widely agreed upon criteria for deciding whether a license should be considered open source. Currently there are over 30 OSI-recognized licenses (see Appendix I, Table 3), including those submitted by GNU, IBM, Sun and Apple. Knowing that a license is OSI approved gives a potential software user some assurance about what to expect from the license. Without some type of assurance, a potential user may feel obligated to get a legal analysis of the license before proceeding – potentially a significant inhibitor to a wider distribution.

4.2 Attribution Required

By "attribution" we mean that the licensee must give the author credit. For Open Source software, this typically means recognition beyond what is buried in the source code files. For example, the GPL license requires that applications that are executed from a command line print an announcement listing the copyright notice, warranty, and redistribution conditions. Among the over 30 licenses recognized by the Open Source Initiative is in fact an "Attribution Assurance License" [21] whose focus is attribution.

Other examples of licenses designed to ensure attribution – though focused on other types of creative works such as images and audio – can be found at Creative Commons [3].

4.3 Redistribution Allowed

No restrictions on redistribution is one requirement for OSI approved licenses. See the first criterion in the Open Source Definition (Appendix B). All the licenses considered here require that they remain with the software if it is redistributed, whether or not the redistributed work is a derivative.

4.4 License Trumps in Derivative Works

Most licenses allow for derivative works where there is more than one license that applies. The exception is the GNU General Public License (GPL). The GPL requires that any derivative work be licensed solely under the GPL. This the the so-called "license capture" or "viral" property.

4.5 Derivatives Must Be Open Source Software

The GNU and Mozilla licenses require that derivative works be Open Source. This is potentially a valuable requirement for NASA, since it provides some assurance that the agency will have access to enhancements. This requirement also prevents certain types of "forking", where a user branches off from the NASA development in a closed way. In particular, this requirement would rule out cases where the branch goes proprietary. Weaker licenses, such as the BSD license, do not have this protection.

4.6 Commercialization Allowed

It is a common misunderstanding that open source licenses prohibit commercialization. In particular, some assume that the GPL does not allow commercialization. This is not the case – Linux is one of the most prominent examples where software with the GPL is sold for a profit. On the other hand, some open source licenses may prohibit use in certain business models. For example, one could not use a business model depending on closed, proprietary software with GPL code. Other licenses, such as the BSD license, do allow redistribution in a closed, proprietary form.

5 Associated Issues

Getting to Open Source depends on more than simply choosing the appropriate license. Here we point out some of the associated issues. Note, all these issues are potential "show stoppers". It is important to consider these issues carefully before proceeding.

5.1 Export Control

Before releasing scientific and technical information (STI) NASA requires that one submit a "NASA Scientific and Technical Document Availability Authorization" (NF1676). NASA Ames also requires an "Export Control Public Domain Declaration" (ARC1676A). We assume that software considered eligible for open source distribution is declared "Publically Available" on NF1676. Copyright, patents and licensing enable NASA to openly distribute STI while still having control over intellectual property. Export control for STI not "Publically Available" means preventing access to the STI by some foreign citizens or entities. This is fundamentally not compatible with an open distribution.

5.2 "External Release of NASA Software" (NPG2210.1A)

The primary document governing the release of NASA software is the "External Release of NASA Software", NPG 2210.1A [31]. The NPG mentions Open Source in one place, Section 2.2.2:

> "Approved for Public Domain Release" - This release category is the broadest release category possible and may be approved only if Software Accepted (As-Built) Baseline has been categorized as Public Domain Software as defined in paragraph 2.1.7. This release category indicates there are no export restrictions on the software and should be approved with great care and requires concurrence by Agency Export Control officials. Once software has been Approved for Public Domain Release, all other release types could be allowed; however some may be inappropriate, e.g., if no further development is envisioned, then a Beta Release would be inappropriate. This type of release also meets the requirements of open source software as defined by the Open Source Initiative. Either an SUA or an Open Source license is required.

There are problems with how NPG 2210.1A handles Open Source. First, the NPG lumps Open Source with Public Domain, but as should be clear from this report (especially for those readers dedicated enough to read through all the appendices), Open Source and Public Domain are not the same thing. We want the protections that an Open Source license can give us. Second, the guideline misses the point of Open Source. The NPG envisions Open Source for projects for which there is "no plan for further development or beta testing" (NPG Section 2.1.7). The NPG sees Open Source for essentially completed projects, whereas most software developers expect that placing software into Open Source means the beginning of new development activity, not the end. The interactions enabled by Open Source software are a significant part of the value of OSS to NASA and software developers. The NPG implies that software release is an infrequent, major occurrence. Open Source developers expect changes to be small, incremental and relatively frequent.

Finally, there is the issue of tracking. Section 3.9, "Release Records and Metrics Reporting" states that every software release must have a software release record, and that every record must include "the recipient's name, address, phone number, e-mail

address, date of transfer, and version of software transferred." (Section 2.1.14). This type of tracking is not appropriate for Open Source, for several reasons:

Breaks Down With Redistribution The first criterion of the Open Source definition [16] is that redistribution must be allowed. All it would take is for one recipient to post the software to a site such as SourceForge, and the tracking would become essentially meaningless. NASA would likely be significantly undercounting the number of users. The same problem would apply to Public Domain software, since placing software in the Public Domain would mean among other things that NASA would be waiving the right to prohibit redistribution.

Burdensome Requiring that a potential user fill out forms with personal information will deter a significant number of people. It's a bit like requiring a prenuptial agreement before a first (and possibly somewhat blind) date. Requirements that the user fill out some sort of web form also would be contrary to the "License must be technology-neutral" criterion in the Open Source definition. See Appendix B.

Arbitrary NASA disseminates a great deal of scientific and technical information (STI), including – but not limited to – journal publications, technical reports, and images. The various types of STI have far more in common with software than difference. Like software, the other types of STI have to be evaluated with respect to export control criteria. Like software, they also have be evaluated with respect to intellectual property, and the standard legal protections of copyright, patents and licenses can apply to all the above. Insisting on the types of tracking NPG 2210.1A imposes for software for other types of STI would likely be treated as a bad joke. For example, would NASA demand the mailing list from a journal publisher before allowing it to publish an article authored by a NASA researcher? Clearly, NASA is making a trade-off: the value of NASA scientists participating effectively in the community outweighs attempting to track every recipient of the STI. More data is usually a good thing, but it must always be balanced against the acquisition cost. The Department of Energy laboratories are facing essentially the same trade-off. As we can infer from recent releases (see Appendix H), DOE is coming to the realization that the value of genuine Open Source with unencumbered distribution outweighs the bureaucratic instinct towards additional control and protectiveness.

5.3 Contractor Rights

Much of the software authored within NASA is written by contractors. Rights to software authored by contractors varies depending on the contract that they are working under. Thus to a certain extent contractor software rights have to be handled on a case-by-case basis based on the type of contract or other agreement. Under standard procurement contracts (excluding SBIR), contractors must request and receive permission to assert copyright from the contracting officer before copyright ownership can be established by the contractor entity in software produced under the contract. NPG

2210.1A states that the contracting officer will require an acceptable commercialization plan. The official text (Section 3.4.3.2.1) [31] reads:

> NASA can direct its contractors to assert their copyright and assign it to the U.S. Government when software is created under a NASA contract. If the contractor provides an acceptable plan to commercialize the software and the Contracting Officer, in consultation with the Center Patent or Intellectual Property Counsel, provides the contractor written permission to assert copyright in the software code, the contractor may retain the copyright with the Government retaining a license for use by and for the Government. This license does not, however, include the right to distribute the software to the public.

Clarification from the Ames Patent Counsel indicates that the final sentence of the quote above is referring specifically to a "Government purpose" license. Furthermore, guidance from the Ames Patent Counsel indicates that Section 3.4.3.2.1 does not preclude an Open Source distribution by the contractor. Thus, for work with contractor involvement, one path to Open Source mode may possibly be through the commercialization avenue.

As discussed earlier in this report, there are many advantages to adopting an Open Source distribution, most notably: improved software development, enhanced collaboration, and more effective dissemination. Commercialization is not necessary to realize these advantages, thus requiring that the contractor produce a "plan to commercialize" may not always be appropriate. On the other hand, it should be noted that commercialization is not incompatible with these advantages. Improving software quality certainly would lead towards code that would have higher value and commercial potential in the long term. Enhanced collaboration would tend to produce software with more users, and in particular users who have a vested interest in seeing the software continue to thrive. In the long term those users may see value added in a commercialization that provides systems integration and support (think, for example, Linux). Enhanced dissemination would also tend to create a larger user base, and a large user base would enable more commercial opportunities.

In the long term it may be worthwhile for the government to address software distribution, and in particular Open Source, in the initial request for proposals and statement of work.

5.4 Copyright for Government-Employee-Authored Work

NPG 2210.1A [31], Section 3.4.3.2, states:

> Software created solely by an officer or employee of the U. S. Government as part of that person's official duties is a work of the U. S. Government. Copyright protection is not currently available in the United States for a work of the U. S. Government. However, the Government can claim foreign copyrights for software created by its employees and can receive and hold copyrights transferred to it by assignment.

In cases where a work is a joint effort between civil servant and contractor, the options look better. Section 3.4.3.2.2 of the NPG states [31]:

> Software that is a joint work between NASA employees and NASA contractors is protected under copyright and, absent an agreement to the contrary, is co-owned by the U.S. Government and the contractor, with each having an independent right to use or license the use of the work with an obligation to account for royalties.

How much contractor involvement is required in order to be considered "joint work" is unclear.

6 Proposed NASA Open Source License

As described in the previous sections, there are many licenses to choose from for distributing software, even if we limit ourselves to those licenses recognized by the Open Source Initiative [21]. We propose that version 1.1 of the Mozilla Public License (MPL, see Appendix E) be considered for use with NASA Open Source Software, for the following reasons:

- the license is recognized by the Open Source Initiative [21], there would be no need to develop yet another license and submit it to the OSI for approval;
- by requiring that derived work also be Open Source, NASA has some assurance that derivative works will be available to the agency;
- the license was developed with input from legal and technical experts and subjected to public review, it appears to be one of the more carefully written licenses available;
- the license does not have the GPL "license capture" feature, in general it does not have the political baggage of the GNU licenses.

From the SourceForge statistics (see Appendix I, Table 3), there are currently 294 projects using the MPL 1.1, and an additional 240 using the 1.0 version of the MPL. These counts are far less than the GNU and BSD license totals, but still significant.

7 Conclusion

We have presented arguments in favor of an Open Source distribution option for NASA software. We have discussed how Open Source is compatible with the mission of NASA, in particular in terms of software creation, collaboration and dissemination. Also, we have reviewed several of the leading Open Source licenses and proposed one – the Mozilla Public License – as a template for a NASA. Finally, we have pointed out some of the sections within NPG 2210.1A, the "External Release of NASA Software" document, that may not be compatible with an Open Source distribution option.

We propose two next steps. First, we should work to develop consensus on a license that would be appropriate for NASA Open Source release. This report is intended to move that discussion forward. Second, we need to address the issues highlighted in Section 5. Most of these issues stem from problems with NPG 2210.1A [31]. Some issues, such as how much contractor participation is necessary in order to make a civil-servant/contractor work "joint" probably only require clarification from a more authoritative source. Other issues, such as the NPG sections that are contrary to Open Source, will likely require amendments to the guidelines.

A Acronyms

AFPL Aladdin Free Public License.

BSD Berkeley Software Distribution.

CFR Code of Federal Regulations.

COSMIC COmputer Software Management and Information Center.

CTO Commercial Technology Office.

DAA Document Availability Authorization.

DNS Domain Name System.

DOD Department of Defense.

DOE Department of Energy.

DRM Digital Rights Management.

EAR Export Administration Regulations.

EULA End-User License Agreement.

FSF Free Software Foundation.

FTP File Transfer Protocol.

GNU “What’s GNU? GNU’s not Unix!”.

GPL GNU General Public License.

GUI Graphical User Interface.

HDF Hierarchical Data Format.

HEC High-End Computing.

IETF Internet Engineering Task Force.

IP Intellectual Property.

IPG Information Power Grid.

ITAR International Traffic in Arms Regulations.

LGPL GNU Lesser General Public License.

MPL Mozilla Public License.

NDA Non-Disclosure Agreement.

NSF National Science Foundation.

NF NASA Form.

NCAR National Center for Atmospheric Research.

NOAA National Oceanic and Atmospheric Administration.

NODIS NASA Online Directives Information System.

NPD NASA Policy Directive.

NPG NASA Procedures and Guidelines.

NPL Netscape Public License.

OSI Open Source Initiative.

OSS Open Source Software.

OSSD Open Source Software Development.

PD Public Domain.

PDD Public Domain Declaration.

PITAC President's Information Technology Advisory Committee.

SBIR Small Business Innovative Research.

SRA Software Release Authority.

STI Scientific and Technical Information.

SUA Software Usage Agreement.

TRL Technical Readiness Level.

UCITA Uniform Computer Information Transactions Act.

USC United States Code.

B Open Source Definition

This is Version 1.9 of the Open Source Definition [21]. The indented, italicized sections below appear as annotations to the Open Source Definition (OSD) and are not a part of the OSD.

Introduction

Open source doesn't just mean access to the source code. The distribution terms of open-source software must comply with the following criteria:

1. Free Redistribution

The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license shall not require a royalty or other fee for such sale.

> *Rationale: By constraining the license to require free redistribution, we eliminate the temptation to throw away many long-term gains in order to make a few short-term sales dollars. If we didn't do this, there would be lots of pressure for cooperators to defect.*

2. Source Code

The program must include source code, and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well-publicized means of obtaining the source code for no more than a reasonable reproduction cost-preferably, downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.

> *Rationale: We require access to un-obfuscated source code because you can't evolve programs without modifying them. Since our purpose is to make evolution easy, we require that modification be made easy.*

3. Derived Works

The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

> *Rationale: The mere ability to read source isn't enough to support independent peer review and rapid evolutionary selection. For rapid evolution to happen, people need to be able to experiment with and redistribute modifications.*

4. Integrity of The Author's Source Code

The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.

> *Rationale: Encouraging lots of improvement is a good thing, but users have a right to know who is responsible for the software they are using. Authors and maintainers have reciprocal right to know what they're being asked to support and protect their reputations.*

Accordingly, an open-source license must guarantee that source be readily available, but may require that it be distributed as pristine base sources plus patches. In this way, "unofficial" changes can be made available but readily distinguished from the base source.

5. No Discrimination Against Persons or Groups

The license must not discriminate against any person or group of persons.

> *Rationale: In order to get the maximum benefit from the process, the maximum diversity of persons and groups should be equally eligible to contribute to open sources. Therefore we forbid any open-source license from locking anybody out of the process.*

Some countries, including the United States, have export restrictions for certain types of software. An OSD-conformant license may warn licensees of applicable restrictions and remind them that they are obliged to obey the law; however, it may not incorporate such restrictions itself.

6. No Discrimination Against Fields of Endeavor

The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.

> *Rationale: The major intention of this clause is to prohibit license traps that prevent open source from being used commercially. We want commercial users to join our community, not feel excluded from it.*

7. Distribution of License

The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.

> *Rationale: This clause is intended to forbid closing up software by indirect means such as requiring a non-disclosure agreement.*

8. License Must Not Be Specific to a Product

The rights attached to the program must not depend on the program's being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program's license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.

> *Rationale: This clause forecloses yet another class of license traps.*

9. The License Must Not Restrict Other Software

The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.

> *Rationale: Distributors of open-source software have the right to make their own choices about their own software.*

Yes, the GPL is conformant with this requirement. Software linked with GPLed libraries only inherits the GPL if it forms a single work, not any software with which they are merely distributed.

*10. The License must be technology-neutral

No provision of the license may be predicated on any individual technology or style of interface.

> *Rationale: This provision is aimed specifically at licenses which require an explicit gesture of assent in order to establish a contract between licensor and licensee. Provisions mandating so-called "click-wrap" may conflict with important methods of software distribution such as FTP download, CD-ROM anthologies, and web mirroring; such provisions may also hinder code re-use. Conformant licenses must allow for the possibility that (a) redistribution of the software will take place over non-Web channels that do not support click-wrapping of the download, and that (b) the covered code (or re-used portions of covered code) may run in a non-GUI environment that cannot support popup dialogues.*

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Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

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Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what theProgram does.

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c) Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

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We protect your rights with a two-step method: (1) we copyright the library, and (2) we offer you this license, which gives you legal permission to copy, distribute and/or modify the library.

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Finally, software patents pose a constant threat to the existence of any free program. We wish to make sure that a company cannot effectively restrict the users of a free

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When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the ”Lesser” General Public License because it does Less to protect the user’s freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over competing non-free programs. These disadvantages are the reason we use the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

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(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

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This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

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However, linking a ”work that uses the Library” with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a ”work that uses the library”. The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a ”work that uses the Library” uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for

this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also combine or link a ”work that uses the Library” with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer’s own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

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Patent A *patent* protects novel, useful and non-obvious inventions; a U.S. patent provides rights to exclude others from making, using and offering to sell an invention in the U.S. or importing into the U.S.. A patent protects an underlying idea or concept.

Public Domain With *public domain*, the owner of a work assigns all of his or her rights to a work to all.

UCITA The *Uniform Computer Information Transactions Act* (UCITA) is a proposed state contract law developed to regulate transactions in computer information products such as computer software, online databases, software access contracts or e-books.

H DOE-Related Open Source Projects

The following are Open Source projects associated with Department of Energy laboratories. This list is not exhaustive, rather it is provided to give a rough idea of the number and variety of Open Source projects sponsored by the department.

Alexandria Alexandria is a component software repository; a next-generation Netlib that supports fuzzy searches and browsing APIs via dynamically generated Babel language bindings [22]. (Copyright Regents of UC; LGPL; served from LLNL).

Babel Babel is a tool for mixing C, C++, Fortran77, Java, and Python in a single application. Babel is the foundation for a multilanguage scientific component framework [23]. (Copyright Regents of UC; LGPL; served from LLNL).

Chromium Chromium is a flexible framework for scalable real-time rendering on clusters of workstations, based on the Stanford WireGL project code base [1]. (BSD License; SourceForge).

Climate Data Analysis Tools CDAT is an open-source, Python-based environment for scientific calculations and graphics with focus on the needs of climate modelers. It is coordinated by the Program for Climate Model Diagnosis and Intercomparison, LLNL [2]. (cites contract between DOE and UC; custom open source, excludes commercialization without notifying DOE or LLNL; SourceForge).

DMX DMX is a project to develop a complete Distributed Multihead X system, which will enable XFree86 (as well as any system with a standard X server) to distribute the X desktop across large display walls [4]. (SourceForge).

Gauntlet Gauntlet is a multi-language, multi-platform software testing framework. It can harvest results from multiple platforms via XML/email and browse session histories through the web [24]. (Copyright Regents of UC; LGPL, served from LLNL).

Globus The Globus Project is developing fundamental technologies needed to build computational grids. Grids are persistent environments that enable software applications to integrate instruments, displays, computational and information resources that are managed by diverse organizations in widespread locations [18]. Much of the Globus work takes place at Argonne National Laboratories. (Copyright U. of Chicago and U. of Southern California. License “open source” but not in OSI list of approved licenses, served from ANL).

MeshTV MeshTV is an interactive graphical analysis tool for visualizing and analyzing data on two- and three-dimensional (2D, 3D) meshes. It is a general purpose tool that handles many different mesh types, provides different ways of viewing the data, and is virtually hardware/vendor independent while still providing graphics at the speed of the native graphics hardware [25]. (Copyright UC: excludes commercialization; served from LLNL)

Numerical Python Numerical Python adds a fast, compact, multidimensional array language facility to Python [9]. (Copyright Regents of UC; Python License; SourceForge).

Quorum Quorum is an online parliamentary system that enables the proposing, discussion, and voting on motions via the web. This software is used to accelerate standardization efforts for geographically disperse groups [26]. (Copyright Regents of UC, LGPL; served from LLNL).

Silo Silo is a library which implements an application programing interface (API) designed for reading and writing scientific data. It is a high-level, portable interface that was developed at Lawrence Livermore National Laboratory to address difficult database issues, such as different, incompatible file formats and libraries, most of which used non-standard features of the Cray compilers. In addition, none of the previous libraries had portable binary file formats [27]. (Copyright UC: excludes commercialization; served from LLNL)

I Open Source License Usage Statistics

This appendix provides some statistics on Open Source licenses in the form of two tables. The first is from a Department of Defense survey of software that they use that has an Open Source license. The second provides a breakdown of Open Source licenses used by projects in the "Trove" at SourceForge.net, the largest Open Source site.

An accounting of the licenses associated with the Open Source software used within NASA would be likely produce similar totals to that in the DOD survey [11]. The relatively high totals for GPL and LGPL software is probably due to all the GNU-licensed elements in Linux (or, as Richard Stallman would prefer – "GNU/Linux").

Table 3 summarizes current Open Source license usage (February 2003) within the SourceForge Trove, sorted by descending count. The statistics are provided by the site itself [10]. Not all Open Source Software projects are hosted at SourceForge, but many leading ones are. The statistics show the leading license contenders: over 90% of the projects are covered by the top four.

License	DOD Applications
GPL	58
BSD	7
Apache	6
Closed (from open)	4
Community (U.S. government only)	4
LGPL	3
ACE/TAO License	2
Proprietary with source access	2
SATAN License	2
Aladdin Ghostscript Free Public License	1
Artistic	1
C++ Boost License	1
Colt Distribution Licenses	1
Freeware	1
Gnuplot License	1
Government Public Domain	1
IBM Public License	1
ISC License	1
MIT/X11 License	1
MITRE	1
Mozilla	1
OpenMAP	1
OpenSSL	1
Publicly available government software	1
Qmail License	1
RTLinux Open Patent License Version 2	1
Sendmail License	1
VTK License	1
WU-FTPD License	1
Zlib License	1
Zope License	1
Total	110

Table 2: License distribution for Open Source software used by the DOD [11].

License	Count	Percent
GNU General Public License (GPL)	26080	72
GNU Library or Lesser General Public License (LGPL)	3760	10
BSD License	2518	7
Artistic License	945	3
Apache Software License	587	2
MIT License	582	2
Mozilla Public License 1.1 (MPL 1.1)	294	1
Mozilla Public License 1.0 (MPL)	240	1
Qt Public License (QPL)	186	1
zlib/libpng License	178	*
Python License (CNRI Python License)	159	*
Common Public License	136	*
IBM Public License	55	*
Open Software License	50	*
Python Software Foundation License	47	*
Academic Free License (AFL)	41	*
Sun Industry Standards Source License (SISSL)	37	*
Jabber Open Source License	31	*
Apple Public Source License	29	*
Sun Public License	25	*
Nethack General Public License	19	*
Zope Public License	17	*
University of Illinois/NCSA Open Source License	16	*
Intel Open Source License	14	*
W3C License	11	*
Open Group Test Suite License	10	*
Eiffel Forum License	8	*
MITRE Collaborative Virtual Workspace License (CVW)	6	*
wxWindows Library Licence	6	*
Ricoh Source Code Public License	6	*
Sleepycat License	5	*
Attribution Assurance License	4	*
Nokia Open Source License	4	*
Vovida Software License 1.0	2	*
Historical Permission Notice and Disclaimer	1	*
X.Net License	1	*
Total	36110	100

Table 3: A summary of license usage for projects registered with the “Trove” on the SourceForge site. Percentages that would round to 0 are noted by *.

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