Parliamentary Office of Science and Technology

postnote

June 2005 Number 242

OPEN SOURCE SOFTWARE

Open source software (OSS) is computer software that has its underlying 'source-code' made available under a licence. This can allow developers and users to adapt and improve it. Policy on the use of OSS in government was updated in 2004. This briefing explains how OSS works, outlines current and prospective uses and examines recent policy developments. It discusses its advantages and disadvantages and examines factors affecting uptake.

Background

Computer software can be broadly split into two development models (see Box 1 for definitions):

- **Proprietary,** or 'closed' software, owned by a company or individual. Copies of the 'binary' are made public; the 'source-code' is not usually made public[1].
- **Open source software** (OSS), where the source-code is released with the binary. Users and developers can be licenced to use and modify the code, and to distribute any improvements they make[2].

In practice, software companies often develop both types of software. OSS is developed by an on-going, iterative process where people share the ideas expressed in the source-code. The aim is that a large community of developers and users can contribute to the development of the code, check it for errors and bugs, and make the improved version available to others. Project management software is used to allow developers to keep track of the various versions.

Both OSS and proprietary approaches allow companies to make a profit. Companies developing proprietary software make money by developing software and then selling licences to use the software, for example Microsoft receives a payment for every copy of Windows sold with a personal computer. OSS companies make their money by providing services, such as advising clients on the version that best suits their needs, installing and customising software and development and maintenance. The software itself may be made available at no cost. There are two main types of OSS licences:

- Berkeley Software Distribution (BSD) Licence: this permits a licencee to 'close' a version (by withholding the most recent modifications to the source-code) and sell it as a proprietary product;
- GNU General Public Licence (GNU GPL, or GPL, Box 2): under this licence, licencees may not 'close' versions. The licencee may modify, copy and redistribute any derivative version, under the same GPL licence. The licencee can either charge a fee for this service or work free of charge.

Box 1. Some Common Definitions

Software is the name given to the programs that run on a computer, e.g. Microsoft Word. Programs are written as text documents, known as '**source-code**', that contain the readable instructions controlling the program's operation (written in computer code, such as C++). Software must be transformed, or 'compiled', before it can be used by a computer. This is known as the '**binary**'. Once compiled into a binary, a computer application may be used, but cannot be modified and improved unless developers have access to the underlying source-code.

An **operating system** is the basic software required for a computer to work. Usually all other applications require an operating system in order to work. The most widely used proprietary and open source operating systems are Microsoft Windows and GNU/Linux (page 3) respectively. Software is also required for the **desktop** and for **infrastructure**, that is to handle the basic data-processing and connections in a computer network.

Box 2. History of open source and free software
Open source first evolved during the 1970s. Richard Stallman, an American software developer who believes that sharing source-code and ideas is fundamental to freedom of speech, developed a 'free' version of the widely used 'Unix' operating system. The resulting 'GNU' program was released under a specially created General Public Licence ('GNU GPL'). This was designed to ensure that the source-code would remain openly available to all. It was not intended to prevent commercial usage or distribution. This approach was christened 'free software'. In this context 'free' meant that anyone could modify the software. However, the term 'free' was often misunderstood to mean 'no cost'. Hence 'open source software' was coined as a less contentious and more 'business-friendly' term.

Desirable software attributes[3,4]

There is widespread debate over the relative merits of proprietary software and OSS. However, it is difficult to make general comparisons; most analysts say comparisons should be made only on a case-by-case basis. It is generally agreed that whether software is open source or proprietary, the following attributes are of key importance:

- reliability: defined as how long a system can stay in operation without user intervention;
- quality: commonly defined as the number of errors in a fixed number of lines of code;
- security: how resilient the software is to unauthorised actions (e.g. viruses);
- flexibility: how easily the software can be customised to meet specific needs and run on different types of device;
- project management: how well organised the development process is;
- open standards: documents created with one type of software being readable in another. This avoids 'lock-in' to a particular document format (page 4);
- switching costs: the cost of moving from one system to another;
- total cost of ownership (TCO): the full costs incurred over the lifetime of the software;
- user-friendliness: how easy the software is to use.

Advocates of OSS argue that, because it harnesses a large team of developers, bugs and errors can be rapidly spotted and fixed, thus increasing reliability and security. They also say that having a large team means that OSS is by necessity 'modular' (made up of discrete units, each with a specific function). Modularity simplifies software design and can increase the reliability as well as flexibility of software. Advocates also argue that, by making the source-code available with the software, there is no danger of 'lock-in' because document formats are transparent. However, critics point out that proprietary software can also have a high degree of reliability, flexibility and security and can also conform to open standards (discussed further on page 4).

Many commentators argue that OSS projects can suffer from weak project management (because of their complex development structure) and that OSS can be difficult to use. The OSS community point out that new project management tools are being introduced and that efforts are being made to increase the 'user-friendliness' of OSS desktop applications. There are often concerns that OSS is unsupported, and contains unauthorised intellectual property (IP) belonging to third parties. However the OSS community say this can also be the case with proprietary software. Moreover, large firms such as IBM and Hewlett Packard now manage open source projects and indemnify users to give them added insurance.

There is broad acceptance that OSS and proprietary software are comparable in terms of software quality. It is acknowledged that switching costs can be high, whichever software model is used. There are conflicting reports on how total cost of ownership (TCO) varies for the two models. It is widely agreed that TCO should be evaluated only on a case by case basis.

Many analysts believe that there is increasing symbiosis between the two models. For example, modularity is now seen as an important factor in the development of both proprietary and OSS. New project management tools are being used to manage both types of software projects.

Use of open source software

The private sector

There is increasing awareness and uptake of OSS within the private sector, with OSS and proprietary software becoming increasingly interwoven[5]. Major corporations such as IBM believe it enables them to make use of a worldwide community of developers to improve their products and services. Some industry commentators suggest that OSS will lead to a more competitive software industry. Currently over 67% of web-servers run open source software called Apache[6]. The majority of websites and email systems run on OSS. Worldwide, around 30% of infrastructural computers run GNU/Linux, an open source operating system. However, use of OSS on the desktop is more limited: over 96% of desktop computers still use Microsoft Windows. OSS has inspired new portable device projects, such as the 'Simputer'. This is a small, inexpensive, handheld computer, intended to bring computing power to India and other emerging economies.

Open source software in government

Governments' interest in OSS is increasing, due to their reliance on sophisticated software. The UK Office of Government Commerce released a series of case studies in October 2004 outlining how OSS has been used in the public sector (Box 3). However, UK parliamentary responses to questions on the use of OSS in government show that uptake is still limited[7]. The Office of the Deputy Prime Minister is funding the 'Open Source Academy' project. This is intended to overcome barriers to uptake of OSS in local government such as lack of information, skills, confidence and lack of suitable products.

Box 3. Examples of government use of OSS[8]

- Powys County Council, Wales: by replacing existing machines with GNU/Linux servers (a server is a computer that manages network resources), the number of servers has been dramatically reduced. This has led to cost savings on hardware, licensing and support.
- Ministry of Defence (MoD) Defence Academy: OSS was chosen on the basis of functionality (to meet requirements) rather than to reduce costs. However, its use has led to lower licensing costs, lower consultancy rates for developers and faster development times. The software used was security accredited by the MoD.
- Beaumont Hospital, Dublin, Ireland: the hospital has projected savings of €8 million as a result of using OSS. These were mainly due to an elimination of software licensing costs for an x-ray system and the ability to re-use hardware using GNU/Linux.

Policy on use of OSS within government is outlined in the updated e-Government Unit's policy document released in October 2004[9]. Key points are:

- re-affirmation of the UK Government's commitment to 'procurement neutrality': OSS solutions should be considered alongside proprietary ones in IT procurements;
- contracts will be awarded on a case-by-case basis, based on value for money. The UK Government will seek to avoid 'lock-in' to proprietary IT products.

Research licensing

The updated government OSS policy now includes policy on the exploitation of software arising from government funded research projects. There is growing debate over whether such software should be released under open source licences. Government policy states that the 'exploitation route' for such software (that is whether it is released commercially, within the research community, or as OSS) should be chosen to maximise returns on public investment. Decisions should be made at the discretion of the researchers and institutions involved. Some academics and open source groups have proposed dual-licensing as means of getting the benefits of a proprietary and open source licence.

The UK Particle Physics Grid project is an example of a research project using OSS. Grid computing, seen as part of the next-generation Internet, is a massive new area of information systems development. The UK Particle Physics Grid project relies on internationally developed OSS, 'Globus' and 'Condor'. By building on the work of existing international communities, the project has saved significant amounts of development work and money.

Other usage

Advocates of OSS argue that, in principle, the OSS model allows software to be developed for minority markets, that is, product development can be need-driven rather than market-driven. In practice, it is not clear there is such a clear distinction between the two models: for example both GNU/Linux and Windows now have versions in a number of minority languages.

Legal issues

Copyright

Software is protected using the copyright system. Relying on the same protection as on books, music or film, the buyer of software is licensed the use of a copy of the product. Proprietary software is normally distributed under an 'all rights reserved' licence where the rights to exploit the software are held by the copyright owner. Open source relies on copyright law to give legal backing to the licences under which it is released (page 1).

Software patents

Whereas copyright protects software code from being copied, patents can be used to prevent the innovative solution or effects of the software from being copied (what it does and how it does it). Government grants the patent holder rights, in return for sharing the information on how the technical result was achieved. The extent to which software should be patentable is controversial. A key issue is whether the software has a 'technical effect' (for example controls the function of a robot arm) or is used for a 'business process' (no technical effect).

In the US, it is possible to patent software used for business processes. Amazon, for example, has patented the '1-click' process, which gives a monopoly on 'clicking once' using a mouse to buy a product from a website. As all websites are built on the idea of clicking links, patent experts have argued that these broad 'business process' patents can be destructive by granting a monopoly on standard processes. This affects open source developers because, when writing a piece of software, they may not realise that the software technique is patented.

Currently, 'business processes' are not patentable in the EU. There is widespread debate over the 'EU Computer Implemented Inventions Directive', awaiting its second reading in the European Parliament. Under this directive, software will be patentable only if it has a technical effect. However, there are concerns that this may lead to widespread granting of patents, because it is hard to make the distinction between whether software is used for a business process or for a technical effect.

Developers and users of OSS, and some small and medium sized enterprises (SMEs), have voiced concerns over the potential negative impact of the directive on the competitiveness of the software industry. Proponents say software patenting is already possible in the EU; the directive will not allow patents in new areas. The UK Patent Office says the directive aims to 'clarify the situation' and to 'prevent a drift towards the more liberal regime of the US'. Moreover, it is pointed out that business processes cannot be patented under the directive. Proponents (including some SMEs) also argue that patent protection is needed to encourage innovation and investment in research and development.

Document formats

Open standards

A document's 'format' is the structure used to store it and the data it contains. Historically, the formats used for proprietary systems have often been 'closed', so documents created using one piece of proprietary software could not be recognised by another. This made it costly and time consuming to switch to another software product and often resulted in a 'lock-in' to one product. However, there is now a trend towards introducing open standards for document formats that can be used by all software developers. Open standards offer a guarantee that the data will be accessible in the future. Industry is taking measures to increase both document interoperability and digital rights management (DRM) interoperability (see below). Advocates of OSS argue that, by making source-code available with the software, the risk of lock-in is avoided because document formats are transparent.

Digital rights management (DRM) technologies

Concerns over the illegal copying and distribution of digital information (music, video, etc.) have led companies to introduce a range of DRM measures. They allow content vendors to control electronic material and restrict its use. Examples include encryption methods used to prevent DVDs from being copied, or to prevent unauthorised access to data in a database. Such systems prevent infringement of IP. However, there are concerns that DRM technologies can act as another layer of proprietary lock-in. Attempting to break or counter a DRM technology is now a criminal offence under the EC Copyright Directive. Critics argue that this could prevent users from extracting data from one system (even if they own it) in order to transfer it to another, especially if this involves bypassing a DRM technology.

Open source culture

The principle of open source can be applied to a variety of other applications as well as software development. Some commentators believe that several sectors of government and industry could benefit from the open source approach (Box 4). The ideas behind it are spreading into pharmaceutical drug production; music; book and journal publishing; television broadcasting and many other cultural areas. The BBC is planning to make some material available in a 'Creative Archive' for viewing, copying and reuse but with some rights reserved, such as commercial exploitation[10].

Key Points

- Acceptance of open source software is increasing in both the public and private sector. The Office of Government Commerce report states that it is a viable and credible alternative to proprietary software for infrastructure and for most desktop users[8].
- The government's OSS policy promotes a 'level playing field' in which OSS solutions should be considered alongside proprietary ones in IT procurements.
- It is increasingly acknowledged that there is a role for both open source and proprietary approaches and that a combination of both approaches stimulates creativity and innovation.

Box 4. Open Source and Transparency

Some researchers and think tanks, such as Demos, believe that open source can contribute to a more vibrant democratic culture. Just as laws can be scrutinised by the general public, the ability to see the 'code' would mean that governmental processes could be laid open for inspection. Examples include:

- **Tax and benefits**: under the Open Government Code and the Freedom of Information Act, the general public may have the right to know how a particular tax or benefit has been calculated. Open source may help achieve this, as having access to the source-code allows calculations to be read and checked;
- **E-voting**: with the transition to e-voting, political parties or the public might wish to inspect any software used in the process to counter electoral fraud or vote-rigging. Some say that OSS is one possible way of doing this because the source-code is freely available to anyone wishing to scrutinise it.
- **Public participation in Parliament**: some innovative projects have been developed using OSS. Examples include the websites, 'They Work For You', which presents Hansard debates and Written Answers and 'The Public Whip', which details MP voting records. These sites search the contents of Hansard and present it in an easy to read format for the public[11].

Endnotes

1 Some viewing of proprietary source-code takes place, see for example www.microsoft.com/resources/sharedsource
2 www.opensource.org/docs
3 Varian & Shapiro "GNU/Linux Adoption in the Public Sector: An Economic Analysis", December 2003
4 McCormack, Rusnak and Baldwin, "Exploring the structure of complex software designs: An empirical study of Open source and Proprietary Code", October 2004
5 EURIM Modernising Government Working Group status report on open source software, November 2003
6 www.apache.org
7 see for example HC Deb, 17th November 2004, col 1540W; col 1488W
8 Office of Government Commerce, "*Open source software trials in Government, Final Report*", October 2004
9 Cabinet Office, e-Government unit, "*Open source software: use within UK Government*", October 2004
10 creativearchive.bbc.co.uk/
11 www.theyworkforyou.com and www.publicwhip.org.uk

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POST is grateful to David Berry for researching this briefing, to the Economic and Social Research Council for funding his parliamentary fellowship, and to all contributors and reviewers. For further information on this subject, please contact Dr Chandrika Nath at POST.

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