Long-term Business Revolution in the Global Software Sector?

The Emergence of Free/libre and Open Source Software for e-Government

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Abstract

Until recently proprietary software companies have competed and gained market advantage by legally closing access to the source code and exploiting to the full the strategic opportunities implicit in the nature of software technology. In recent years, however, a new market development has begun to disrupt the "stable proprietary order." This is the "free/libre and open source software (FLOSS)" which fundamentally challenges the "exclusion effect" intrinsic to the governance of proprietary (closed) software. The challenge is recent and it is likely to unfold for a decade or more before the real depth and breath of the disruptive impact of FLOSS becomes clear, on both the global software sector and industry in particular and the fabric of society at large. One of the areas where the FLOSS challenge is beginning to make inroads is that of government, particularly in connection with governments' mission for public good. *This paper examines this process by providing a systematic analysis of key issues and trends characterizing the emergence and development of FLOSS in the government sector, with reference to both national and local/regional levels.* It deals with trends and major issues in the rise and development of FLOSS, including the origins of FLOSS, its rise in the software markets and the factors behind this rise. It addresses several themes of importance to understand the evolution of FLOSS in e-government, including arguments against and in favour of FLOSS in public administrations. It contains a selective overview of policy and use of FLOSS in national public administrations, and examines FLOSS use and policy in local/regional public administrations through the analysis of a short web-based survey, a longer postal survey and four selected cases of FLOSS implementation by local/regional authorities.

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1 Introduction

For years the position of proprietary software companies and, particularly, Microsoft's dominance of the operating system and office applications for server and client computing markets have looked unassailable. After all, close to 60% and 95% shares of the respective server and client markets in the hands of an excellent market player such as Microsoft does conjure up the image of strongholds as powerful as Norman castles before the invention of the cannon. Particularly so since software operating systems and applications are technologies that show strong "indirect network externalities"[1] in the sense that their benefits to users "entail the provision of a complementary good."[2] For instance, operating systems and application require each other to fulfil their purpose, just as software requires computer hardware. Under these circumstances, the number of units "consumed" of one proprietary software programme (e.g., an application programme) tends to increase with the spread of "consumption" of the other (e.g., an operating system). And this mutually reinforcing effect travels through the different generations of proprietary products and accumulates given the pervasiveness of client/server computing in today's society. In the market, this tends to support oligopolistic tendencies, especially for proprietary software whose legal distribution denies access to its source code, potentially excluding competition and "locking" users into it.

Until recently proprietary software companies have sought to gain market advantage by legally closing access to the source code[3] and exploiting to the full the strategic opportunities implicit in the nature of software technology. The competitive battle was among different proprietary software and the victors have been those who have more successfully built strongholds ("locking users") in strategic pervasive products such as

[1] "Network-externalities.- Technologies in which the benefit users derive from their use often is an increasing function of the number of other users acquiring compatible items. Network technologies such as the telecommunications network have *direct externalities* in that the greater the number of subscribers on a given communications network, the greater the services provided by that network. Non-network technologies (i.e., without physical network) have *indirect network externalities* in that their benefit to the users entail the provision of a complementary good. For instance, computer hardware requires software and the number of units sold tends to increase with the amount and variety of software." See also Farrel, J.and Saloner, G., Standardization, Compatibility and Innovation, *Rand Journal of Economics*, Vol. 16, No.1, 1985, pp.70-83. Also, Katz, M. and Shapiro, C., Product Compatibility Choice in a Market with Technological Progress, *Oxford Economic Papers*, Vol.38, No.5, 1986, pp.146-165. Also, Katz, M. and Shapiro, C., Technology Adoption in the Presence of Network Externalities, *Journal of Political economy*, Vol.94, No.4, 1986, pp.822-841.

[2] For an analysis of the role of the nature and state of development of technology in market strategies, see Molina, A., The Role of the Technical in Innovation and Technology Development: The Perspective of Sociotechnical Constituencies, *Technovation*, Vol.19, 1999, pp.1-29. Also, Molina, A. In search of insights into the generation of techno-economic trends: Micro- and macro-constituencies in the microprocessor industry, *Research Policy*, Vol.22, Nos.5/6, 1993, pp.479-506.

[3] Some authors prefer to talk of "closed software" rather that "proprietary software" given that the latter does not excluded opening the source code for access to others. Here however proprietary will also imply closed for access to source code.

operating systems and from there have expanded their conquest of other markets – old and new. The larger have grown the strongholds, the more the market has consolidated into a "stable order" of unassailable dominant players sustained by a governance that legally excludes all others from access and use of the source code of pervasive products with major impact on the evolution of the information society.

In recent years, however, a new market development has begun to disrupt the peace of the "stable order." Like the cannon for the Norman castles, *free(libre) and open source software (FLOSS)*[4] has appeared in the horizon threatening to destroy the sociotechnical walls of market control carefully build over the years with a combination of technology and above all proprietary governance.

The disruptive fire of the "FLOSS cannon" is also a combination of technology and governance. But it is not in the technology where the primary destructive power lies, unlike Schumpeter's "gales of creative of destruction."[5] It rather lies in the challenge to the "exclusion effect" intrinsic to the governance of proprietary (closed) software. In this sense, although the entire process is clearly sociotechnical, it is the social innovation rather that the technical innovation that has triggered the dialectical process.

The challenge is recent and it is likely to unfold for a decade or more before the real depth and breath of the disruptive impact of FLOSS becomes clear, on both the global software sector and industry in particular and the fabric of society at large.

One of the areas where the FLOSS challenge is beginning to make inroads is that of government, particularly in connection with governments' mission for public good, as we shall see below. This is the objective of this paper - *to provide a systematic analysis of key issues and trends characterizing the emergence and development of free(libre) and open source software (FLOSS) in the government sector, with reference to both national and local/regional levels.*

With this purpose, following this Introduction, the discussion is structured in four major sections. Section 2 deals with the trends and major issues in the rise and development of FLOSS, including the origins of FLOSS, its rise in the software markets and the factors behind this rise. Section 3 addresses several themes of importance to understand the evolution of FLOSS in e-government. It starts by discussing the arguments against and in favour of FLOSS in public administrations, including the relationship of FLOSS to the State's mission of public good. It follows with a selective overview of policy and use of FLOSS in national public administrations, before examining FLOSS use and policy in local/regional public administrations through the analysis of a short web-based survey, a longer postal survey and four selected cases of FLOSS implementation by local/regional authorities. The final section 4 is the conclusion.

The data and information for the analysis conducted by the paper has been gathered from paper- and web-based secondary literature, personal communications with relevant players, and two preliminary studies conducted by (1) ERIS@ on FLOSS

[4] A discussion explaining the use of the term FLOSS in this paper is found in Section 2.1
[5] Schumpeter, J., *The Theory of Economic Development*, Harvard University Press, Cambride, 1934. Also Schumpeter, J., *Capitalism, Socialism and Democracy*, Harper & Row, NY, 1942.

technology and research issues;[6] and (2) Telecities on the Local/regional use of FLOSS for e-government.[7] The latter report contains an indicative survey run by Telecities across Europe.[8]

2 Trends and Major Issues in the Rise and Development of FLOSS

The strong emergence of FLOSS –**F**ree/**L**ibre and **O**pen **S**ource **S**oftware- in the global software scene in the last few years is probably one of the most important phenomena facing the evolution of public authorities into e-government. Indeed, as we shall see, public authorities are beginning to act as drivers for the market growth of FLOSS to the point of even passing legislation that makes it compulsory to favour the use of FLOSS. This is a major change in relation to just a few years ago when proprietary software completely dominated the software market, and Microsoft in particular was the overwhelming dominant leader in the desktop and workstation/server markets.

Indeed, Microsoft's computer market success and expansion was (and it is) so strong that competitors had to look for ways of differentiating, often, joining forces to create critical mass. But the progress of these efforts had not made much of a dent in Microsoft markets buttressed by a huge accumulated base of proprietary software. Something more radical was needed for a real shake up in the software market - something that would challenge not just technology and products but the fundamental way of doing business: the "proprietary" model that had become well consolidated during the eighties and nineties. This was to be the role of "free (libre)/open source software" – FLOSS.

2.1 The Origins of FLOSS

The radical FLOSS idea had been developing almost unnoticed by the world since the mid-1980s. It originated with Richard Stallman who back in September 1983, announced that he was to commence work on a Unix-like software system called GNU (for GNU's not Unix) that everyone would be free to use, change, share, and improve. Work started in 1984 and in 1985 Stallman released the first major product of the system (GNU Emacs), along with his GNU Manifesto on free software.[9] He also created the Free Software Foundation (FSF)[10] to give institutional visibility to the GNU project. Most critically, Stallman began to lay down the licensing principles that would bring about a fundamental challenge to the "proprietary" way of doing business. He sought "to give users all possible freedom consistent with respecting the freedom of other users"[11] by asking users to adopt the same licensing approach. The strategic implications of this step have only recently become fully visible. Users were now free to modify the software on condition of publishing their modifications and giving the

[6] ERIS@, Research *Community and Technological Constituency Building (Sub-report),* CEC Project Three Roses, IST – 2001 – 37967, April 2003.
[7] TeleCities, *Local/Regional Government Constituency Building (Sub-report),* CEC Project Three Roses, IST – 2001 – 37967, April 2003.
[8] The two studies are part of 3R's approach to the constituency-building process coordinated by the three main European networks of cities and regions working on the Information Society.
[9] The concept of "free" in Stallman's meaning is related to "freedom" rather than "gratis."
[10] http://www.fsf.org
[11] Personal communication with R. Stallman, 13 April 2003.

same right to other users in relation to the "modified" work, and so on. This freedom is decomposed into four fundamental components in the GNU website:[12]

> Freedom 0 - the freedom to run a program, for any purpose
> Freedom 1 - the freedom to study how a program works, and adapt it to your needs
> Freedom 2 - the freedom to redistribute copies of a program so you can help your neighbour
> Freedom 3 - the freedom to improve the program, and release your improvements to the public, so that the whole community benefits

As Stallman developed more software this "revolutionary" licensing approach was, in 1986, generalised from "GNU Emacs" to simply "software." Thus a generic copyright cover for all GNU project software emerged – the GNU General Public License (GPL). Version 1.0 of the GPL was eventually published in 1989.

GNU project made important progress in various software tools but found it difficult to develop the operating system kernel that was required to bring all the pieces together into a one single operating system. This breakthrough came in 1991 when graduate Finnish student Linus Torvalds developed the flexible Linux kernel working on a $3,500 386-computer, and decided to adopt Stallman's 'free software' license approach, GPL, thus providing the critical missing piece of the GNU operating system. Available GNU programmes were gradually ported to the Linux kernel during the next three years leading to the emergence of the full free operating system.

But the Linux kernel was not the only strategic contribution of Linus Torvalds. He also exploited the decentralized, collective design & development potential of the Internet to great benefit.[13] Thus although he controlled the design of Linux content himself, he opened the process in such a way that others could track his work and progress and above all to contribute to the solution of problems. Through this process, *the development of Linux became the result of a collective learning environment, where the strategic task of the overall leader is to be the ultimate referee while stimulating, facilitating and maintaining the flows of ideas, knowledge, experience, etc.*[14] The implications for software development are momentous: (1) the Internet becomes the design and development medium, (2) all those who can and wish to contribute can do so in a process of collective development that tends to produce reliable and secure software, and (3) conflicts about intellectual property are reduced due to the legal free-software environment.

So successful became Linux and Linus Torvalds that many people tend to refer to the entire GNU/Linux operating system as simply Linux. But a more accurate name would in fact be GNU/Linux, in recognition of the large amount of work contributed

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[12] http://www.gnu.org/philosophy/free-sw.html

[13] Raymond, E., "The Cathedral and the Bazaar" (original 1997), found in http://catb.org/~esr/writings/cathedral-bazaar/.

[14] "A common method is for a project to have a central committee (as for Apache) or a benevolent dictator (as for Linux) that determines the general software design, identifies projects to be worked on, and determines what modifications get incorporated in the "official" version of the open-source product. Individual programmers pursue these projects and identify and possibly fix bugs in the software. They may also work on projects of their own choosing that result in modifications to the software. Communication is electronic, via email and news groups." (Evans, D., *Is Free Software the Way of the Future*, March 2003. Found in http://www.microsoft.com/resources/sharedsource/Articles/EvansNERA.mspx

by Stallman and many other people by almost a decade (8 years) before the development of the Linux kernel.[15]

By the mid-1990s GNU/Linux was coming of age and, for the first time, the most important competitor operating system and constituency to Microsoft's, Unix, was faced with a new path to reinvigorate future development. Unix had been gradually loosing ground within the "proprietary" workstation/server camp and it did not have a presence in the PC sector. *GNU-Linux radically changed this by enabling a Unix-like operating system for the PC that was completely made up of free software and, therefore, anybody could use, modify, contribute and distribute in a process of continuous collective development.* In the past the Unix constituency had suffered in the market as a result of fragmentation into incompatible proprietary systems and the consequent failure to present a unified standardised front to Microsoft's OS. Indeed, Microsoft represented the largest standardised and unified technical and market environment for the users and they clearly preferred it, regardless of the oligopolistic situation. Now, GNU/Linux avoided the fragmentation that a "proprietary" business model would have most certainly caused and has triggered off a market re-alignment whose implications are yet to unfold fully.

In effect, the GNU/Linux constituency began to grow rapidly and by late 1993 there were somewhere between 20,000 to 100,000 users.[16] Around the same time, Stallman's Free Software Foundation also decided to add its weight to Linux, thus *de facto* aligning the free software movement with the growing number of GNU/Linux developers and users. The period 1993-1994 saw the emergence of Debian and Slackware, two important GNU/Linux (or FLOSS) distributions.[17]

In 1998 however the overall movement officially separated into two camps: the original camp sticking to the word and meaning of "free as in freedom," a new camp adopting the term "open source software" for two reasons. The first was tactical and tried to eliminate the confusion generated by the double meaning that the term "free" has in the English language – "free" as in freedom and "free" as in gratis or zero cost. In particular, most business people used to think in terms of costs would confuse "free" with "gratis," something that could be true or not but it was surely not the central tenet of "free software." The second reason was strategic in that the new camp wished to move away precisely from the attachment of the movement to issues of freedom that were seen as more politically-laden and therefore dissonant with business. Williams (2002) summarizes well the final conclusion leading to the separation institutionally represented by the Free Software Foundation (FSF) and the Open Source Initiative (OSI).[18] Quoting one of the players who moved to the OSI camp, he writes:

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[15] More recently, following the emergence and wide adoption of the concept of "open source" software, the name of "free/libre and open source software" – FLOSS for short has been adopted to cover all software that relates to the original GPL intellectual property innovation. See Ghosh, R., Krieger, B., Glott, R. and Robles, G., *Free /Libre and Open Source Software – Survey and Study, Part 2B: Open Source Software in the Public Sector: Policy within the European Union, Final Report,* June 2002. International Institute of Infonomics, University of Maastricht (the Netherlands) www.infonomics.nl/FLOSS

[16] Williams, S., *Free as in Freedom. Richard Stallman's Crusade for Free Software*, O'Reilly Online Catalogue, www.oreilly.com, CA, 2002.

[17] Ibid. and also see note 4 above.

[18] http://www.opensource.org

> "There's no question that the use of the word free was confusing in a lot of situations," Tiemann says. "Open source positioned itself as being business friendly and business sensible. Free software positioned itself as morally righteous. For better or worse we figured it was more advantageous to align with the open source crowd. …
> By the end of 1998, Stallman had formulated a position: open source, while helpful in communicating the technical advantages of free software, also encouraged speakers to soft-pedal the issue of software freedom. Given this drawback, Stallman would stick with the term free software. [19]

This division for strategic and tactical reasons is one of the salient features of the development of the overall movement around GNU/Linux. The depth of the philosophical split however contrasts with the great deal of unity found between the two camps at technological level, since they both recommend very much the same software. This is of course consistent with the previous point that it is the social innovation rather that the technical innovation that's central to the overall movement.

This gives its rationale to the selection of the term FLOSS[20] -free/libre and open source software- used in this paper: "free/libre" to try to eliminate potential confusion with the meaning "gratis" by attaching "libre" (the Spanish word for free as in freedom). The use of "open source" to specify the existence of the new camp; and the use of "and" to stress their philosophical and institutional distinctiveness; and the use of "software" – all in a single phrase to emphasise the fundamental technological (software) foundation uniting the two camps into a single overall movement.

Since this paper is about "free/libre and open source software" as a single constituency in opposition to the "proprietary (closed) software" constituency, the appropriate term to use is that of FLOSS, when referring to the constituency as well as to the overall technology. And as already noted, GNU/Linux is more appropriately used to refer to the entire operating system environment, while Linux refers to the kernel of the operating system only. In the market, Linux is widely used as a simplification of GNU/Linux, with the result this paper will also contain references to Linux rather than the accurate GNU/Linux, especially in exact quotations.

2.2 FLOSS Rise in Software Markets

The second half of the nineties marked the definitive market emergence of GNU/Linux or FLOSS into the software arena, especially in the computer server sector, but in other areas too. Thus the period 1996-1998 saw most Unix companies increasing their awareness, preparations and, eventually, beginning commercial activities in the FLOSS arena. Table 1 provides a list of some key activities that, starting in 1998, have led to the definitive establishment of FLOSS in the key corporate computer market and, gradually, in other markets such as public administrations evolving towards e-government.

[19] Ibid., Chapter 11.
[20] As we saw in note 13, the term FLOSS was first used by the team of the International Institute of Infonomics, University of Maastricht (the Netherlands) www.infonomics.nl/FLOSS

Table 1. Some Key Developments in the Commercial Establishment of FLOSS

- August of 1998 - Intel purchased a stake in GNU/Linux vendor Red Hat and Apple Computer announced adoption of the open-source Apache server
- Late 1999 - Red Hat started selling shares on NASDAQ.
- December 1999 – record market flotation of VA Linux at NASDAQ. Starting share price of $30 eventually settled at $239 – a 698% increase.
- 1999 – launched of Ximian Inc., a private Boston company that sells GNOME software for making GNU/Linux easier to install and update.
- Late 1999 IBM decided to make GNU/Linux the pillar of its strategy and, in 2000, devotes $1 billion to make its software and computers compatible with GNU/Linux. 250 engineers to work with the FLOSS community, thus reinforcing the trend towards lower-cost Intel chips
- 2000 - Sun Microsystems announced dual licensing of its new OpenOffice application suite under the GNU Lesser General Public License (LGPL) and the Sun Industry Standards Source License (SISSL).
- Hewlett-Packard, Oracle, Cisco, Dell begin to use GNU/Linux
- 2000 - Norwegian software company Troll Tech announced GPL licensing of its Qt suite of graphics tools for the GNU/Linux
- Late 2001, Intel's promotion of GNU/Linux to software producers (e.g., Veritas Software) and financial-information suppliers (e.g., Reuters Group)
- 2002 – In first half of year, IBM's shipped mainframe capacity reaches about 15% and, in the last quarter alone, the company sold GNU/Linux servers for a value of $160 million. Hewlett-Packard and Dell together generated a similar amount. It is estimated that IBM has over 4,600 GNU/Linux customers.
- 2003 – Sun announces that it will sell GNU/Linux-based desktop computers and Star-Office (word processor, spreadsheet, and database programs).
- 2003 - 39% of large corporations use GNU/Linux and this is bound to grow as an improved GNU/Linux version is due to arrive this year.
- GNU/Linux reaches 13.7% of the $50.9 billion computer server market in about three years, and this share is expected to increase to 25.5% by 2006
- Web-server software Apache dominates the market with 62% share against 27% for proprietary MS software
- GNU/Linux is moving into consumer-electronics products such as video game consoles (Sony PlayStation) and TV-programme recorders (TiVo).

Source: Based on data found in *Business Week*, The Linux, Special Report, 3 March 2003 and Williams, S., *Free as in Freedom. Richard Stallman's Crusade for Free Software*, O'Reilly Online Catalogue, www.oreilly.com, CA, 2002. Also, Hof, R. D., Tech Outfit Should Take Notes, *Business Week*, 3 March 2003, p.58.

But FLOSS is not only making inroads in computer and network markets but also in other technological areas and including 3G Mobile Services, Embedded and Real-time Systems, and Digital TV.[21]

2.2.1 3G Mobile Services

Mobile phones are a new area for FLOSS - and companies such as Monta Vista Software, TimeSys, Red Hat, Linux Works and Motorola are all trying to adapt the software for the embedded computing market, which includes cell phones and other

[21] This section is based on ERIS@, Research *Community and Technological Constituency Building (Sub-report)*, CEC Project Three Roses, IST – 2001 – 37967, April 2003.

consumer-electronics products and services. For instance, in July 2001 Red Hat and 3G LAB - the multimedia software developer for next generation mobile communications - announced that they were jointly designing and developing the first open source, real-time operating system for next generation 2.5G (GPRS) and 3G (UMTS) mobiles devices. The solution –eCos for 2.5/3G mobile devices- is based on Red Hat's open source embedded real-time operating system eCos (eCos is a highly configurable, portable, open source, royalty free operating system for real time embedded applications).

Competition in the mobile phone sector however is strong with the Symbian operating system backed by most of the industry, including large players such as Nokia, Motorola, Samsung, Electronics, Siemens and Sony Ericsson. FLOSS however has also attracted the support of some large companies. For instance, chipmaker Texas Instruments and device-maker NEC have decided to support Linux for mobile phones.

2.2.2 Embedded and Real-time Systems

FLOSS solutions are already making an important contribution to embedded and real-time systems, one of the fastest growing R&D fields.

According to recent data compiled by *Evans Data Corp*[22] *(EDC)* from a sample of 444 developers, Linux[23] and Windows are running neck-and-neck in terms of developers' use for future projects. The newest instalment of EDC's *Embedded Systems Developer Survey* shows 30.2% of embedded developers expect to use Linux in their next embedded project, while 16.2 % say they will use Windows CE and another 14.4% say they will use Windows XP Embedded. Embedded Linux however shows a much more dynamic growth with nearly double the growth rate of Windows.

EDC's data indicates that "proprietary in-house" -the current favourite- is rapidly losing ground to a combination of off-the-shelf operating systems for future projects. The greatest beneficiaries of this trend appear to be Embedded Linux and Windows Embedded, with 20.1% and 13.9% for expected use in future projects respectively. Interestingly, Wind River's VxWorks embedded OS, which is generally considered to be the incumbent embedded software market leader, trails slightly behind Embedded Linux for current project use. Additionally, VxWorks' gain of just 2.9% for expected use in future projects places it into a distant third position, with less than half the usage rate of the two future project usage leaders (Windows Embedded and Embedded Linux).

Traditionally, it has been common to develop a home-grown system for embedded use. However, according to the EDC study there is a shift towards adopting standard systems, in particular those based on embedded Linux. Some examples of current

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[22] http://evansdata.com/ESTOC.htm EDC's *Embedded Systems Developer Survey, Volume* 2[22], 2002, is the second edition of an in-depth survey series that measures attitudes and intentions regarding technology amongst over 400 embedded systems developers. Conducted in July 2002, this volume includes sections on hardware platforms and considerations, Linux and Open Source Software in the embedded world, Java in embedded devices, embedded databases, tools, tasks, languages, and issues with embedded systems development.

[23] It is worth noting that in embedded systems the use of the name "Linux" rather than "GNU/Linux" is appropriate given that embedded-systems developers make use of the Linux kernel rather than of the full GNU/Linux operating system environment.

projects in this field can be found at the website of the *Free and Open Source software Developers Meeting.*[24]

2.2.3 Digital TV

Digital TV is an important area of implementation for FLOSS given the importance of open standards. The open standard for content presentation in digital television is called MHP[25] (Multimedia Home Platform). MHP is heavily based on Sun Microsystems' Java technology and the openness of its implementation is constrained by so-called implementation arrangements.

FLOSS is becoming increasingly popular as an embedded operating system for set-top boxes, digital TV sets and mobile devices. Thus the company *Open TV* - the world's leading interactive television and media solutions operation[26] - announced in April 2001 its commitment to make available the company's key embedded products to integrate with the Linux operating system, including Open TV's proven interactive television (iTV) middleware solution. Netgem[27] is also a leading provider of interactive TV technologies based on open, DVB and Internet standards. Netgem licenses its interactive TV software platform to analogue and digital network operators and consumer electronic manufacturers.

At the same time, many consumer electronics manufacturers are already experimenting with FLOSS, although not all of them release the drivers for encoders in source code and this prevents the FLOSS constituency from making a contribution to the development of digital television development. Other FLOSS developments in DTV applications include new projects such as GNU Radio and Dscaler.

An important association in DTV area is the AAF[28] (Advanced Authoring Format) Association Inc., a broadly based trade association created to promote the development and adoption of AAF technology. AAF technology allows content creators, editors and rich-media authors to exchange video, audio, images, text and metadata between applications. The AAF Software Developers Kit (SDK) is open source, and is licensed under the AAF Public Source License (PSL). This license allows users to 1) use the software for free forever, 2) allows users to modify the source code, 3) allows users to charge others for their modified source code, 4) provides a patent pool for copyright protection.

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[24] www.fosdem.org/index/dev_room/dev_room_embedded
[25] www.mhp.org
[26] www.opentv.com Open TV builds a complete software and infrastructure platform that enables digital interactive television and brings on-demand content to other digital communications devices. Open TV solutions are crafted to meet the needs of digital communication networks and include operating middleware, content applications, content creation tools, professional services expertise and strategic consulting.
[27] www.netgem.com
[28] www.aafassociation.org

2.3 *Factors behind the Market Rise of FLOSS*

The growth of the FLOSS constituency in the last few years points to a phenomenon that it has arrived not only to stay, but also to transform dramatically the global HW/SW industry and market. A number of factors lend support this assertion.

- The economic recession has been fundamental in galvanizing the change, by forcing cost-cutting in the corporate sector and hence, a search for avenues of lower ICT costs that have led to FLOSS. Among the many stories are, Morgan Stanley's Institutional Securities Division is replacing 4,000 high-powered servers with cheaper servers running GNU/Linux. Estimated saving for a five-year period is $100 million. Also E*Trade Group Inc., replaced 60 $250,000 computers running on Sun's Sparc chip with 80 Intel-based GNU/Linux machines costing just $4,000 each.[29]

- Increasing richness of GNU/Linux environment as more and better software and hardware is being produced, with Intel, for instance, making chips for GNU/Linux, established software suppliers such as IBM, HP, Oracle, etc. offering software and services, and the many FLOSS volunteer programmers working collectively to improve and further the development of FLOSS.

- "Movement" spirit of FLOSS developers who tend to work collectively for the satisfaction of developing good software and/or the contribution they can make to society. This "movement" spirit multiplies the power of the "collective innovation" model enabled by the Internet. FLOSS programmers come from all sorts of backgrounds and places to contribute, frequently as volunteers, to develop and improve software, with results that tend to reflect the motivation to produce good software for movement's peers. On the other hand, volunteer programmers are often too fragmented to present a credible business proposition to large customers and this prevents them from gaining the specific knowledge required to develop and work with, for instance, applications for complex business processes.

- Market opportunity offered not only to Microsoft's competitors but also to new start-up companies such as Red Hat that makes a business by selling related software, technical support, maintenance for corporations, and distribution deals with, for instance, IBM, HP and Dell. Microsoft has argued that FLOSS undermines the software business by not charging by the operating system and other software tools.[30] In fact, the business moves to other aspects as IBM, HP, Oracle, and others have already shown. Indeed, if anything the FLOSS concept affects the viability of new start-up companies that find it difficult to make a business without being able to sell the software. So far Red Hat is the most successful company and only recently was able to make its first profits. VA Software Corp. that makes GNU/Linux-based computers is still trying to break through and many of those that were focused on the dot.com market have disappeared.

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[29] *Business Week*, The Linux, Special Report, 3 March 2003.

[30] See article by Bradford L. Smith, Senior Vice President and General Counsel, Microsoft Corporation. Smith, B. L., *The Future of Software: Enabling the Marketplace To Decide*, March 2003. Found in: http://www.microsoft.com/resources/sharedsource/Articles/Future.mspx

- Market opportunity offered to all those customers who for one reason or another do not wish to depend on Microsoft's software completely and hence, do not like Microsoft's market oligopoly.

- Growing development of e-government, following on the steps of e-business and e-commerce. FLOSS offers an opportunity to those governments that are uneasy with the oligopolistic and consequent strong negotiating power of single companies to acquire (even in principle) greater access and control over HW/SW processes at a time of growing investments in e-government.

The marriage of all these factors is the source of FLOSS strength and momentum, but it is also the source of some important limitations that would be important to solve to expand even further FLOSS' potential for change. For instance, business models are required to transform FLOSS movement's programmers into credible business proposition to large customers, probably in association with established ICT companies such as IBM, HP, etc. Interestingly enough, the evolution towards e-government may play an important role, provided that governments are interested in fostering the development of a FLOSS capability in their regions as a path to both economic development and greater control of the hardware and software they use.

3 FLOSS in e-Government (FLOSSeG)

This section addresses several themes of importance to understand the evolution of FLOSS in e-government. It starts by discussing the arguments about the pros and cons of FLOSS in public administrations. It follows with a selective overview of policy and use of FLOSS in national public administrations, before examining FLOSS use and policy in local/regional public administrations through the analysis of a short web-based survey, a longer postal survey and four selected cases of FLOSS implementation by local/regional authorities.

3.1 The Case Against and in Favour of FLOSS Implementation in Public Administrations

FLOSS is beginning to make significant advances in the public administration (PA) sector. The reasons for this development have a great deal to do with the role of public administrations both as service providers and holders of the public good. Thus as service providers public authorities find themselves under increased pressure to deliver better services for less cost ("more for less"), while as holders of the public good they are under increased pressure for security, transparency, accountability, and equanimity regarding all citizens/customers. As a CEC FPVI report[31] put it:

> government like business requires greater efficiency, productivity, cost reductions, and treating citizens like customers. As such, they share the need for business process re-engineering. On the other hand, government, unlike business cannot choose its customers and, indeed, people are more than just customers, they relate to government as legal subjects (forced to pay taxes), users (use information), customers (hospital services) and, generally, citizens who want to be: aware, considered, recognised participants in the democratic

[31] See report prepared by Prof. Alfonso Molina for the CEC under title *Technologies for Major Business and Work Challenges - Programme Consultation Meeting*, Brussels, 19-20 April 2001, CEC, Brussels, 21 May 2001. http://www.cordis.lu/ist/fp6/fp6consult.htm

process, expressing his/her rights (e.g., e-voting[32]). In addition, governments also have stringent requirements such as:

- exemplary public service ethics with a focus on non-economic policy issues such as welfare and health of the citizen, avoidance and/or closing of social, educational and financial gaps between all groups of the public
- access for all
- caring for a sustainable environment, affordable public transport, etc.
- mainly non-market driven supply and demand for e-service. No profit incentive.
- provision of institutional and service framework for wider economy.
- requirement for accountability, transparency and democratic practices.

These characteristics frame the growth of FLOSS in public authorities. They also frame the debate currently raging between advocates of proprietary software and those advocating FLOSS. Indeed, the arguments and counter-arguments cover multiple dimensions from cost comparisons to issues of privacy, security, transparency as well as job creation and local/regional economic development. Thus, most analyses seek to identify the advantages and disadvantages for governments of using FLOSS vis-à-vis proprietary software.[33]

Not surprisingly the advantages are largely rooted in the GPL approach and the "freedoms" associated with FLOSS, while the disadvantages are rooted in the fact that volunteer programmers are often too fragmented to present a credible business proposition to large customers. Of course the latter disadvantage does not apply to the FLOSS offer of large ICT companies such as IBM, Cisco, Siemens, HP, etc.

Thus among the advantages of FLOSS for e-government, the ethical and political advantages figure prominently, especially as access to the source code has significant implications for the ability of governments to fulfil key requirements of democratic responsibility towards their citizens. This is also an area where FLOSS and proprietary

[32] It is interesting to note that free software is not in itself a guarantee of freedom. A conspicuous controversial example is precisely e-voting. As R. Stallman recounts: "We had a GNU package for e-voting, called GNU.FREE, but both the developer … [Jason Kitcat] … and I independently came to the conclusion that e-voting introduces a terrible risk of centralized fraud in the vote counting facility. Even if the vote-counting program is free software, and you can check the code to verify that that program is fair, you cannot verify that the program which really ran and counted the votes is the same program you studied. And there's no way to do a recount." Communication with R. Stallman, 13 April 2003. J. Kitcat says, "Scrutiny. It's vital and inherently missing from electronic systems." For a system to be beyond any doubt voters must be "clear that what their intention was is in fact clearly and unequivocally recorded." (Personal communication with Jason Kitcat, 13 May 2003)

[33] Some interesting studies are: FSFeurope, *Free Software/Open Source: Information Society Opportunities for Europe*? www.fsfeurope.org/coposys/index.en.html; Wheeler, D. A., *Why Open Source Software/Free Software? Look at the Numbers!*, www.dwheeler.com/oss_fs_why.html; Feller, J. and Fitzgerald B., *Understanding Open Source Software Development*, Addison-Wesley, UK, www.opensource.ucc.ie/uossd; Ghosh, R., Krieger, B., Glott, R. and Robles, G., *Free /Libre and Open Source Software – Survey and Study, Part 2B: Open Source Software in the Public Sector: Policy within the European Union, Final Report*, June 2002. International Institute of Infonomics, University of Maastricht (the Netherlands) www.infonomics.nl/FLOSS; IDA, *Study into the use of Open Source Software in the Public Sector*, June 2001. http://europa.eu.int/ISPO/ida/jsps/index.jsp?fuseAction=showDocument&documentID=333&parent=chapter&preChapterID=0-17-134. From a Microsoft's point of view, see Smith. B. L., The Future of Software: Enabling the Market to Decide, March 2003. Found in: http://www.microsoft.com/resources/sharedsource/Articles/Future.mspx Also, Evans, D., Is Free Software the Wave of the Future? March 2003. Found in: http://www.microsoft.com/resources/sharedsource/Articles/EvansNERA.mspx

software show more clearly their differences, as compared for instance to total cost of ownership (TCO) which tends to depend on multiple influences. In this respect, it is worth reproducing the key arguments given by two members of parliament – Buenos Aires' Senator Alberto Conde and Perú's Congressman Edgar David Villanueva Nuñez - in defence of law projects they have promoted in their respective juridictions.[34]

The main tenets of the argument given by Conde and Villanueva are based not on issues of cost but on the ability of the State to fulfil its mission. For Conde, the State's mission regarding data processing: "is to be the guardian of the public record: to maintain updated and accurate information about the identity and patrimony of its citizens, of its interactions with these citizens, of its actions, etc." This implies that the acquisition and use of information technology by the State should guarantee the following principles:

?? Security of the State and its citizens by ensuring that (a) only authorized persons have access to data, and (b) no third party can deny this access
?? Permanence of public data by ensuring that data will be available and accessible for the useful life of the data, often hundreds of years
?? Transparency and free access by citizens to public information by ensuring publication of all records with exception of those that will compromise the security of the State and of its citizens as required by the law

In accordance with both parliamentarians the proprietary licensing model is incompatible with the upholding of these principles given explicit prohibitions and practical restrictions imposed on licensees regarding the execution of tasks needed to uphold the principles. Amongst them:

1. Inspection of the programme's function. Only the original author has access to the source code of the programme, leaving the State unable to ensure by its own means the security of the software in relation with its mission of public good. Furthermore, citizens who have the right to know, for instance, how their taxes are calculated or their votes counted, are also denied this right by the lack of access to the source of code of the proprietary programmes that perform these functions. It must be taken into consideration that all software processes information and it is itself information, in a special format that enables machine interpretation that, in turns, leads to the execution of anticipated actions. In this sense, it is crucial information for the citizen who has the right to have access and learn –if s/he wishes- about information that directly concern the exercise of his/her rights in a democratic society.

2. Improvement of the programme's functionality. Only the original author has the right to correct errors, modify, or add to proprietary programmes, leaving the State

[34] See letter dated 8th April 2002 from Dr. Edgar David Villanueva Nuñez, Congressman of the Republic of Perú, in reply to letter from Sr. Juan Alberto Gonzalez, General Manager of Microsoft Perú, dated 21st March 2002. 2002, and criticizing Proyecto de Ley Nº 1609, "Software Libre en la Administración Pública," promoted by Congressman Villanueva. The letters are found in http://www.hispalinux.org. See letter dated 28.11.2002 by Buenos Aires' Senator Alberto Conde's in reply to a letter dated 4.10.2002 by CESSI – the Cámera de Empresas de Software y Servicios Informáticos a local chamber of software entrepreneurs (sponsored by the telecom companies, Microsoft and Oracle). The letters are found in http://proposicion.org.ar/doc/gob/Conde-281102/.

dependent on a single provider and, consequently, without the freedom to take the best course of action if this were to differ from the supplier's alternative.

3. Preservation of technological neutrality. Given the strategic place of software such as operating systems, decisions that correspond to the State are implicitly dictated by the author of the programme, including choice of hardware platform and application programmes.

4. Provision of services independent of licensing details. Given the confusion sometimes generated by the different and changing models of proprietary licensing, the State run the risk of disruption of services that it must fulfil by obligation in a continuous, timely and effective manner. For instance, a misunderstanding about licensing terms, a change, expiration, or a price increase could force the State to suspend services unless it satisfies the terms of the supplier.

This highly unsatisfactory situation from the point of view of the State's mission of public good may be acceptable when there is no choice, for instance, in the case of a monopolistic situation. But it is not acceptable when there is a choice that better enables the State to fulfil the principles intrinsic to its mission. Today, this choice exists in the form of FLOSS for many programmes. They give the State permission to carry out "without limits on time nor on number or type of computers, the execution, study, correction, improvement, expansion, and adaptation of the program in accordance with the necessities of the State, not those of the provider."

A final consideration made by congressman Villanueva concerns the role of government particularly in facilitating economic development and employment through the software sector in developing countries such as Perú and Argentina. Responding to the idea that governments' preference for FLOSS will lead to economic losses and decline in the software sector of countries such as Perú, Villanueva points out that:

> "With regard to jobs generated by proprietary software, these deal mainly with small valued-added technical tasks. At local level, personnel providing technical support to transnational companies' proprietary software are not able to solve a bug; not necessarily because of lack of technical capacity or talent, but rather because of lack of access to the source code where the repair must happen. Free software helps create more skilled jobs as well as stimulating an environment of free competition, where success only depends on the capacity to provide good technical support and quality of service. It also stimulates the market and increases the common reservoir of knowledge, opening alternatives to create services of greater value-added and quality, thus benefiting all parties: producers, service providers and consumers."

In addition, Villanueva argues that by enabling work with free software for the State on a large scale, the [law] project stimulates the offer of better qualified professionals, as well as an increase in the experience of national technical personnel. This in turn will place Peruvian professionals in a competitive position to provide their services nationally and internationally

Along with the advantages specific to the State mission of public good, other advantages of FLOSS are also mentioned:

- Lower costs due, for instance, to savings on continuous license fees and equipment replacement as FLOSS often performs satisfactorily on cheaper and even older equipment. The savings can then be used to help the local economy, for instance, by nurturing the FLOSS capacity in the region.
- Equal or superior reliability, performance, scalability, and security due to extensive review and access to source code
- Possibility of "forking" into alternative code base if necessary or convenient
- No software obsolescence as FLOSS can be modified to take account of new requirements
- Improvements in software skills base due to the ability access, scrutinize and analyse the inner workings of the software
- No fees per copy can be requested for modified versions
- No need for license management and policing given that there is no danger of employees using unauthorised copies
- Affordable software for individuals, enterprise and government
- Participation in global networks of collaborators from all over the world, benefiting from the sharing of expertise and experience in software development.
- Access to the international FLOSS user community, often accessible and able to assist rapidly over long distances
- Lowered barriers to entry for software businesses as no single entity controls the future of the software.
- Stimulation of local software industry, leading to better local capacity to satisfy Government' needs and to significant contribution to human resource development, especially in the area of ICT. In this respect, government is well placed to lead the switch towards FLOSS in its jurisdiction given the role in education, e-government, e-business, etc. All this would act synergistically with the saving benefits already mentioned in the first point of this list.
- Finally, for those governments interested in issues of freedom and e-democracy through technology, a switch to free software in the original Stallman's version also helps to "encourage the citizens to recognize and value freedom as computer users, leading society as a whole out of the burden and limitations of dependence on proprietary software."[35]

In contrast, among the disadvantages, the following are mentioned:

- Not all software projects are useful or motivating to the volunteer programmers of the FLOSS constituency and this commonly implies a need for a large user base to provide the necessary volunteers. Of course, FLOSS operations seeking to make a business by developing and selling customised FLOSS services (e.g., website development) will not have this problem
- Risk of sub-standard code as not all programmers are good or motivated by routine tasks of software development
- Managing a FLOSS project is a convoluted process, and details are often overlooked. Difficult management of deadlines is risky, for instance, for projects with critical short-term deadlines. Funding is required for development and for a deployment system (concurrent version control, bug tracking, mailing lists, etc.).
- Difficulties in modularity potentially leading to maintenance and reliability problems of FLOSS products
- variety of motivations of volunteer programmers participating in FLOSS projects (e.g. anti-Microsoft, free software ideals, technical interest in coding) may blur definition of sharp a strategic focus for products
- Complex hybrid FLOSS business models potentially leading to breakdown of trust. This implies a great weight of responsibility on FLOSS project leaders and champions, or gatekeepers, potentially leading to burn out

It is interesting to sight here the findings of a study on commissioned by the Danish Technology Board on FLOSS and proprietary software.[36]

[35] Personal communications with R. Stallman, 13 April 2003 and 29 June 2003.

[36] Working Group for Danish Board of Technology, *Open Source Software – In Digital Administration*, Danish Board of Technology, October 2002
http://www.tekno.dk/subpage.php3?article=901&language=uk&category=11&toppic=kategori11

From the point of view of property rights the study identified that, in the short term, there are clear economic advantages in procuring FLOSS rather than 'proprietary' software when there are comparable products. More specifically, at *the desktop*, the study finds that changing from Microsoft to StarOffice/OpenOffice generates direct savings can in license payments and costs of replacing software (as StarOffice/OpenOffice makes different/lower demands on the hardware). At the *infrastructure level*, FLOSS was also found to be cheaper than proprietary software for the areas of application selected by the study. Finally, for *highly customised FLOSS systems* (user-owned) the study found that their actual development is more expensive but they provide an opportunity for greater competition in continued development and therefore tends to be cheaper in the long run.

In general, the Danish study finds that the development and maintenance of FLOSS requires greater local skill and this is likely to be reflected in increased costs in both building up expertise among systems managers and in end-user training. There are also problems with compatibility, particularly with layout and complicated spreadsheets that tend to translate in higher costs. Against this is the fact that proprietary software implies continuous expenditures through license ties and the effect of frequent upgrades.

The Danish study also raises a critical aspect. As governments implement e-government they will make huge investment in highly customised or specialised software over the next few years. Given this prospect, many institutions would like to see competition and not high dependence on a single software supplier, especially as the software continues to evolve with adaptations and modifications and the systems have to be put out to tender under the EU Directive. In this context, the issue of the source-code property becomes critical for public authorities, particularly, because under ordinary market conditions proprietary software tends to lead to a very small number of suppliers while FLOSS tends to facilitate the entry of new market participants.

This plainly favourable assessment of FLOSS is contradicted by other studies that produce results in favour of 'proprietary software." For instance, a Microsoft's commissioned study conducted by IDC and released in late 2002 concluded that in 4 of 5 selected applications Windows was cheaper to run than GNU/Linux by a margin of between 11% and 22% over a five year period. [37] This study however has been

[37] The IDC study compared "the five-year total cost of ownership (TCO) of Microsoft Windows 2000 server environments with that of Linux server environments (from multiple Linux vendors) at 100 different North American companies." It concluded that: "Microsoft Windows 2000 offers lower total cost than a Linux solution in four of the five workloads common to most corporate IT environments. In these four workloads (network infrastructure, print serving, file serving, and security applications), the cost advantages of Windows are significant: 11%-22% less over a five-year period. The cost advantages are driven primarily by Windows' significantly lower costs for IT staffing, generally the largest single component of IT costs. For the fifth workload, Web serving, Linux had a cost advantage of 6% compared with Windows 2000 over the five-year period."
Bozman, J., Gillen, A., Kolodgy, C., Kusnetzky, D., Perry, R. and Shiang, D., *Windows 2000 Versus Linux in Enterprise Computing. An Assessment of Business Value for Selected Workloads*, IDC, Framingham, Mass., 2002. See also Richardson, B., "Linux Servers: No "Silver Bullet "for Total Cost of Ownership." 22. November 2002, *META Delta*, META Group, US. Richardson\s analysis concludes: "Most perceived cost savings for Linux are due to upfront Intel versus RISC hardware, or DBMS cost

questioned by claims that Microsoft selected computer applications favourable to Windows.[38]

In practice, the issue of total cost of ownership is not completely clear-cut because it depends not only on the value of the hardware and software but also on the characteristics and capacities of the users. Thus a divergent view regarding the total cost of FLOSS ownership would stress that the cost of training, adapting, maintaining, etc. of FLOSS could easily exceed the savings on FLOSS purchasing and licensing. A similar divergent view may apply regarding FLOSS security benefits vis-à-vis "proprietary" software. In the end, it seems clear that the potential cost savings for each application environment will tend to be unique for each public authority; while proper design and rigorous maintenance of security architectures will be deciding factors in matters of security.[39]

Thus there is no single universal recipe because *the specificity of every case is critical.* In this respect it is important to look at why many public administrations are yet to embrace FLOSS definitely in their e-government processes. This leads to another interesting study, this time conducted by CEC's IDA (Interchange of Data between Administrations) in 2001.[40] The IDA study identified first the general criteria behind the adoption of software of any kind: either proprietary or FLOSS. Then they looked at the reasons for the limited use of FLOSS in the public sector.

On the first score, IDA found that the main priorities in the selection of software are: inter-operability, security, respect to standards and functionalities (they received 80% priority); "low cost" came in 6th position, and political reasons (meaning "independence from vendor domination") and support from large ICT organizations were less important. *A major conclusion was that the public sector will continue to pay more as long as interoperability of FLOSS cannot be certified.*

On the limited use of FLOSS by the public sector so far, IDA found the following:

- Inertia generated by weight and quality of existing ICT infrastructures that are standardized at the desktop and server levels. This leads to organizational reluctance to introduce new components
- Inertia generated by contractual and legal engagements, since services are often contracted for periods of 5 years and more
- fear of overall budget reductions as public sector IT budgets are not adapted to the use of FLOSS
- lack of pre-installed system delivery, lack of accountability, interoperability hw / sw problems
- reduced set of public-sector oriented applications and lack of public sector "turn-key" distribution, translating into the need for ICT managers to have the expertise and devote time to evaluate the 5-6 main distributions in order to decide which one is the most appropriate to requirements, integration and support by existing ICT infrastructure.

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differences. Because Linux support costs often are higher, Linux does not significantly reduce application infrastructure total cost of ownership."

[38] *Business Week*, The Linux, Special Report, 3 March 2003.

[39] Government IT Officers' Council, *Using Open Source Software in the South African Government, A Proposed Strategy Compiled by the Government Information Technology Officers' Council*, South Africa, 16 January 2003.

[40] *Study into the use of Open Source Software in the Public Sector*, June 2001. http://europa.eu.int/ISPO/ida/jsps/index.jsp?fuseAction=showDocument&documentID=333&parent=chapter&preChapterID=0-17-134

In conclusion, the preceding discussion on the strengths and limitations of FLOSS vis-à-vis proprietary software is not absolutely decisive in terms of an automatic selection and use of one or the other by public administrations. This will depend very much on the specific characteristics, strategies and policies pursued by each specific administration, as well as on the existing capacities and constituency-building strategies of the FLOSS and "proprietary" constituencies. One conclusion is clear however, namely, *for public sector's decision-makers the consideration of FLOSS in the development of strategies for future e-government investments is no longer an option to be disregarded. It is an intrinsic element of well-informed e-government strategy-making processes, particularly with those concerned with the rights of citizens regarding security, transparency, accountability and perenniality of data. In addition, as FLOSS continues to grow in strength in the coming months and years, it is bound to present an ever more powerful challenge to the hold of proprietary software in government.*

On the other hand, another clear conclusion is that, at this stage, it will be difficult for the FLOSS constituency to break the hold of "proprietary" software in e-government without offering a clear set of capacities for FLOSS development, implementation and maintenance/servicing. This would include the following capacities:[41]

- *Capacity for software selection*, i.e., expertise to assist users to select the best option, FLOSS or otherwise. A decision to migrate to FLOSS must be based on sound short, medium and long-term business and government principles and not on subjective preferences
- *Capacity to support users*, i.e., rapid and efficient support to users with both the development of new software and the enhancement of existing software
- *Capacity for implementation and troubleshooting*, i.e., rapid and effective support to help with the operationalisation and troubleshooting of implemented FLOSS
- *Maintenance capacity*, i.e., provision of continuous maintenance support, including continuous updating, induction of new users, and maintaining/amending documentation
- *Training capacity*, i.e., proficient training for FLOSS developers and users
- *Research capacity*, i.e., research activities enabling optimal understanding of, and well-informed decision making on FLOSS, harnessing the potential of higher education institutions and schools
- *Capacity for security measures*, i.e., the security of FLOSS systems must satisfy all requirements applicable to Government ICT systems in general.
- *Capacity for inter-operability with ICT legacy systems*. FLOSS developed and implemented in e-government must be able to inter-operate with other ICT systems already in use

It is precisely the challenge of this capacity-building which gives government such a strategic place in the evolution of FLOSS and, ultimately, the general software market. Not surprisingly, Microsoft claims that they are adopting some of the best characteristics of FLOSS in their recent licensing initiative known as Shared Source Initiative or Shared Source Philosophy. As Craig Mundie, Microsoft Senior Vice President, explains:

> Shared Source is a balanced approach that allows us to share source code with customers and partners while maintaining the intellectual property needed to support a strong software business. Shared Source represents a framework of business value, technical innovation and licensing terms. It covers a spectrum of accessibility that is manifest in the variety of source licensing programs offered by Microsoft.
> The principles of the Shared Source Philosophy are:

[41] Government IT Officers' Council, *Using Open Source Software in the South African Government, A Proposed Strategy Compiled by the Government Information Technology Officers' Council*, South Africa, 16 January 2003.

- ?? Helping customers and partners to be successful through source access programs
- ?? Building the development community, offering the tools to produce great software
- ?? Improving the feedback process in order to create better products for Microsoft's customers and partners
- ?? Maintaining the integrity of our customers' environments
- ?? Increasing educational access in order to get the technology into the hands of universities worldwide, and to seed the future of a strong technology industry
- ?? Protecting software intellectual property based on the firm belief that software offers value as the basis of a successful business.[42]

The key difference is that the Shared Source Philosophy maintains Microsoft's control of IP, as the company sees this as the key to a "strong software business."[43]

3.2 Selective Overview of Policy and Use of FLOSS in the National / Federal Public Administrations[44]

In practice, it is difficult to estimate the volume of overall use of FLOSS and its particular use in the public sector.[45] However there seems to be large differences in FLOSS development and use both between and within EU member states, largely depending on the strength of government policies. Figure 1 reproduces the findings of the Infonomics report by Ghosh et al (2002).

[42] Mundie, C., *The Commercial Software Model*, Prepared Text of Remarks given at The New York University Stern School of Business, May 3, 2001. Found in: http://www.microsoft.com/presspass/exec/craig/05-03sharedsource.asp

[43] For a critique of the Shared Source Philosophy, see Open Source Initiative (OSI), Shared Source. A Dangerous Virus, ISO, 2003. Found in: http://www.opensource.org/advocacy/shared_source.php

[44] Largely based on TeleCities, *Local/Regional Government Constituency Building (Sub-report)*, CEC Project Three Roses, IST – 2001 – 37967, April 2003.and, also, Ghosh, R., Krieger, B., Glott, R. and Robles, G., *Free /Libre and Open Source Software – Survey and Study, Part 2B: Open Source Software in the Public Sector: Policy within the European Union, Final Report*, June 2002. International Institute of Infonomics, University of Maastricht (the Netherlands) www.infonomics.nl/FLOSS;

[45] Ghosh et (2002) al gives the following reasons: Impossibility of counting licenses; poor indication given by number of downloaded copies since it is uncertain whether and on how many computers the copy is then installed; poor indication given by the number of delivered pre-installed machines because this will not reflect the actual number of pre-installed (open source or proprietary) operating system. Computers pre-installed with Windows, for instance, may migrate to Linux and old computers may be reused with Linux and open source software, rather than implementing a costly upgrade to a newer version of proprietary operating system. Furthermore, FLOSS is often not used as a single platform but as an additional feature on a proprietary operating system.

	Developers Activity	Implementation	Policy	Future Trends
France	High	Ministries, Public Administration, National Education	strong	Growing Implementation, Stronger Policies
Germany	High	Parliament, Public Administration, Police	strong	Growing Implementation, Stronger Policies
Spain	Middle	Ministries, Public Administrations	starting	Growing Implementation, Developing Policies
United Kingdom	Middle	Public Health	increasing	Starting Implementation, Stronger Policies
Austria	Low	marginal	marginal	Implementation and Policy not expected in the near Future
Belgium	Low	National Army, Public Administration	starting	Growing Implementation, Developing Policies

Figure 1: Relationship between Policy and Developer Activity

This shows the national governments of France and Germany pursuing strong policy approaches in favour of FLOSS development and implementation. Thus in France public sector institutions increasingly use FLOSS solutions for their IT systems since the end of the 1998. Table 2 lists a variety of specific FLOSS applications and plans by a number of French government institutions and educational institutions.

Table 2. FLOSS Applications and Plans by French Government and Educational Institutions

Institution	FLOSS Implementation	FLOSS Plans
Ministry of Defence	Installation of FreeBSD	
Ministry of Culture	400 servers migrated from Unix and NT to GNU/Linux	Entire system based on FLOSS by end of 2005.
Ministry of Justice and Casier Judiciaire National (National Crime Register)	Use of various FLOSS solutions such as Apache web servers, Perl, SamBA, and fetch mail.	A migration from proprietary Unix to GNU/Linux, PHP, and MySQL is envisaged
Ministry of Economy, Finance, and Industry and Direction Générale des Douanes et des Droits Indirect		Migration of 950 server and 60 workstations to Red Hat 6.2 Linux
Educational Institutions		
Louis Pasteur University in Strasbourg	26% of servers are based on GNU/Linux, Apache, Zope, Postfix, or SendMail.	
Laboratoire de Probabilite, Combinatoire et Statistique at the University of Lyon	set up all their servers, and 80% of their workstations on open source software.	
Universities of Artois, Nancy 2 and the Academie Rouen	about 50% of servers and 10% of workstations run on FLOSS	
Institut National des Sciences Appliqués at Toulouse	20% of servers and 40% of workstations based on FLOSS solutions.	

Source. Ghosh et al. (2002)

France is undoubtedly a leading player on the policy side leading to the take up of FLOSS in Europe. Table 3 shows some of the main developments of the French Governmental Policy towards FLOSS:

Table 3. France's Key Policy Developments Supporting FLOSS

- *January 1998 - PAGSI* (government action programme for the Information Society): states that "bringing in the open standards of the Internet is a necessity"
- *April 2001 - Carcenac Report* (report by French MP Thierry Carcenac entitled "Ways and Means to a Citizen-friendly, Electronic Public Administration) points to: "regular use of OSS, the natural tools for the public administrations". This report recommends the implementation and encouragement of FLOSS projects. It recommends in its action plan as one of its six priorities the regular usage of FLOSS in public administration (next to demand for open standards)
- *2001 - ATICA* (French Agency for ICT in Administration) established by the Prime Minister as an e-Government Agency to provide strong support to the implementation and encouragement of FLOSS in the French Public Sector
- *October 2002 - Report from the Working Group chaired by Hugues Rougier; Commissariat Général au Plan.* It encourages diversity of software by developing open standards and recommends the French administration to buy FLOSS in order to support modernization and offer a better public service to citizens.
- *October 2002 - French legislative proposal n°117* (proposed by Mr. Cabanel, Mr. Laffitte and Mr. Trégouët) tends to generalize the use of FLOSS in French administration (PAs) and fixes the following deadlines
  - From 1st July 2003 all PAs to inter-exchange their data electronically
  - From 1st January 2004 all software used by PAs should be free, modifiable and with available source code
  - The same legislation creates an official Agency for the free software.
- *December 2002 - ATICA Guidebook* to guide the selection and use of FLOSS licences by public administrations.

Source. TeleCities, *Local/Regional Government Constituency Building (Sub-report),* CEC Project Three Roses, IST – 2001 – 37967, April 2003.

In Germany the policy involvement of the Federal government in support of FLOSS is equally strong as that in France. The German government's motivation is based on the view that FLOSS offer clear political and economic benefits, manifested at three synergistic levels:

- Improved security for the country as a result of reduction of dependence on monopolistic suppliers
- Opportunity for further development of the German ICT industry
- Reduction of costs in the operation of public administrations. Expected savings are commonly a major criterion in feasibility studies of FLOSS adoption

The main government player driving FLOSS policy is the Ministry of Internal Affairs, with its Koordinierungs - und Beratungsstelle für Informationstechnik (KBSt) that coordinates and advises PAs on their FLOSS implementation processes. And the Ministry of Economy and Technology (Bundesministerium für Wirtschaft und Technologie – BMWI) which provides information for SME's and funds BerliOS, a platform mediating open source software and software projects like GnuPG, an encryption technology basing on OpenPGP standard.

Among the major landmarks regarding FLOSS support by the German government, we find the 2001 decision to favour the use of FLOSS in all areas where there would be cost savings. Later in March 2002, the Minister of the Interior (Otto Schily) and the Head of IBM Germany (Erwin Staudt) signed a cooperation agreement for the promotion of open computer operating systems and software in Germany's public

administration. Describing the agreement, minister Otto Schily clearly highlight its double political and economic motivation

> This cooperation agreement is based on an initiative I took following the terrorist attacks of September 11. Back then, I endeavoured to contact a number of important industry representatives of the German IT sector. My goal was to secure Germany's IT infrastructures with security partnerships between public and private sectors. To that end, the use of secure systems and software is a prerequisite. The newly signed cooperation agreement will achieve three goals: increase the IT security by avoiding monocultures, reduce the dependencies from individual software providers, and save money for the software acquisition and operating expenses. Thus, we spearhead the promotion of a greater variety in the IT landscape. The savings do not only help the Federal Government, but also the states and communes, who can now obtain products for Open Source environments in a rapid, easy, and uncomplicated manner.
> The master agreement with IBM offers all government offices the opportunity to attain a higher level of software heterogeneity. The fact that [GNU]Linux is an alternative to the Windows operating system gives us [the German government] independence and a stronger customer position, as a large software customer. Therefore, [GNU]Linux contributes considerably to the efficiency of IT deployment in the administration.[46]

The IBM/German government agreement enables federal states and communes to acquire GNU/Linux-based software at reduced rates. In addition, a strategic cooperation management has been set up to contribute to the creation of innovative and reusable ICT solutions for the German federal administration. The cooperation also strengthens the German IT industry since the GNU/Linux operating system preinstalled on shipped IBM servers comes from SuSE Linux AG, a German medium-size company.

Among German public administrations' important implementation of FLOSS the following are cited by Ghosh et al. (2002)

- The Bundesanstalt für Landwirtschaft und Ernährung (Federal Institute for Agriculture and Food) uses SuSE Linux for the web servers on their intranet.
- Migration to GNU/Linux of all servers of the Administration of the German Parliament (Deutsche Bundestagsverwaltung) (decision in early 2002); updating of workstations to Windows XP. Arguments about one-supplier dependency and lack of transparency/security and interoperability figured prominently in the decision of the Council of Elders (Ältestenrat)
- Installation of GNU/Linux in 11,000 workstations of Lower Saxony Police, mainly for cost reasons.
- The Ministry of Internal Affairs of the Bundesland Niedersachsen (Lower Saxony) expects savings of 20 million Euros within the next ten years.
- Several other ministries and PAs use FLOSS partly in pilot projects and mainly in the Internet area.
- The Munich Municipality has conducted feasibility study for the migration of 10,000 workstations to GNU/Linux.

Other European countries are not that advanced as Germany and France but the trend is for an increment of FLOSS policy and implementation activities. For instance, in Spain there is as yet no official national policy but a good number of FLOSS activities are reported, for instance, implementation of GNU/Linux and other server applications like SamBA, NFS, Zope, or OpenSSH in institutions like the Senate, the Nuclear Security Council, the Ministry of Home Affairs, and the Ministry of Justice. An important FLOSS implementation in the public sector is Virtual MAP - a project by the

[46] Quotation reproduced from "TeleCities, *Local/Regional Government Constituency Building (Sub-report)*, CEC Project Three Roses, IST – 2001 – 37967, April 2003."

Ministry of Public Administration that migrated to GNU/Linux 220 servers from the established Unix system. The decision to use GNU/Linux was cost-driven, favouring low-cost hardware and a MAP GNU/Linux distribution based on Debian, along with greater investment in personalization and training. Virtual MAP's final goal is to have GNU/Linux running on MAP's 400 servers connected to 4,000 clients.

Spain is also well known for the policy decisions to support FLOSS at the level of local/regional public administrations. Thus the regional government of Extremadura has adopted GNU/Linux as the official operating system to be used in the 670 schools of the region. The adapted version of GNU/Linux is referred to as Linex (for **Ex**tremadura) and the region is now training 15,000 teachers to ensure the success of the transformation. More recently, in March 2003, la Junta de Andalucía published an official decree aimed at encouraging the information society in Andalusia establishing the conditions for the use of FLOSS by the Andalusian Administration.[47]

In Chapter II – *Public Services in the Knowledge Society*, its Article 11 reads:

1. Public educational centres will be equipped with ICT-based educational programmes and materials, based preferably in free software.
2. Likewise, teachers will be encouraged to produce curricular programmes and materials based on ICT or for their use in Internet, specially those developments generated by means of free software

In Chapter III – *Digital Alphabetization and Accessibility to ICT's*, Article 31 takes FLOSS support much further:

1. In the acquisition of IT equipment for public educational centres, to be used in educational activities, it is made compulsory that all hardware be compatible with operating systems based on free software. Computers will have pre-installed all necessary Free Software for the specific intended use.
2. The IT equipment that the Administration of the Junta of Andalusia makes available at centres of Internet public access will use Free Software products in its operation.
3. The Administration of the Junta of Andalusia will promote diffusion and use geared to the educational, personal and domestic use of Free Software. To this end an online support service will be established for the installation and use of this type of products.

A crucial aspect in favour of FLOSS growth in Spain - found by Ghosh et al. (2002)- is the relatively high degree of developers' activity in the Spanish private sector. They find that there is a high amount of FLOSS community members, and most importantly, they tend to have a high degree of experience in terms of both connectedness and project leadership.

In Italy, the development of FLOSS in e-government also shows a great deal of activity.[48] Thus Italy's Informatics Authority for Public Administrations (Autorità per l'Informatica della Administrazione Publica – AIPA) has supported a series of studies on FLOSS' development models and experimental activities. For instance, in 2000,

[47] BOJA Nº 55, Boletín Oficial de la Junta de Andalucía, 21 March 2003. Andalusia is one of Spain's largest Autonomous Communities. It has 8 provinces with a population of 7,478,432 inhabitants or 17% of the total population of Spain

[48] Based on Di Marcello, P., L'open Source ed il suo Utilizzo nella Pubblica Amministrazione Italiana, I.A.L. - University of Malta, Tesi di master realizzata durante lo stage presso il Consorzio Gioventù Digitale di Roma, March 2003.

AIPA provided funding to the Scuola Superiore S. Anna di Pisa to work on a FLOSS-based ICT protocol system. The project is known as PA-Flow and is focused on an analysis and optimization of administrative procedures in Public Administrations through the practical experimentation of tools, methodologies and multi-disciplinary products. PA-Flow is important because the implementation of new technology in PAs is a complex organizational, legal and technical process and the project is using FLOSS to face this problem. PA-Flow aims at generating software for the experimentation of FLOSS tools in the management of PAs' information flows. This is the Free Software Information Protocol System, PA-Flow, developed by Icube (a company of the CDC Group) in collaboration with the Scuola S. Anna. The software will be released with GPL license in order to encourage experimentation in the largest possible number of situations.

Most importantly, the Italian Government through the Minister of Innovation and Technology, Lucio Stanca, has created a Commission to make recommendations on FLOSS in PAs, and a great many deal of FLOSS initiatives are happening at local and regional authorities. Indeed, some regional administrations are already adopting legislation on the matter.

Thus, on 2nd July 2002, the Toscana region made public a regional law on free software. Among the most important points it states:
"HEADING I – GENERAL PRINCIPLES
Art. 1 (purpose of the law)
1. The Region favours informatic plurarism, guaranteeing access and freedom to choose in the generation of informatic platforms, thus eliminating all barriers due to diversity of standards.
2. The diffusion and development of free software is favoured … in consideration of its positive impact on the public economy, on competition and market transparency, on the development of scientific an technological research. The Regional Administration … privileges the use of free software."
"HEADING III – FREE SOFTWARE
Art. 5 (Obligation for the Regional Administration)
1. The Regional Administration is obliged to use, in its own activities, computer programmes of which it holds the source code.
2. The Regional Administration, in the selection of computer programmes necessary to its own activities, favours programmes belonging to the category of free software or, alternatively, open source code. Whatever is favoured, free software or open source code, the supplier must of necessity and without additional costs for the administration consent the modificability of the source code. The availability of the source code is also put in the perspective of the opportunity for the Regional Administration of being able to modify the computer programmes in order to adapt them to its own requirements.
3. Should the Regional Administration intend to make use of non-free software, it should explain analytically the reason for such a choice.
4. In case of an eventual larger expenditure, derived from an opposite choice not technically required, the responsible for the procedure will respond patrimonially in accordance with Art. 4, National Law of 7 August 1990, n. 241."
HEADING 4 – PUBLIC EDUCATION, RESEARCH AND DEVELOPMENT
Art. 6 (Incentives to research and development)

1. The pertinent Regional Council Offices produce an annual free software research programme specifically for project on the development of computer programmes to be released under free software license.

Art. 7 (School education)

1. The Region, with due respect to the didactic autonomy of the school institutions, makes available knowledge and favours forms of collaboration for the adoption of the content and principles of the present law in the school environment and in the curricular programmes inside the progressive informatization of public education. The Region recognizes the particular educational value of free software and it encourages its adoption in teaching."

Along with the Toscana Region's adoption of free software, the Firenze Council has approved (Ordine del Giorno no. 620 - 16/12/02) the creation of the new portal *People* for Firenze's citizens and enterprises – and the software to be used will be primarily free software. In fact, the resolution makes explicit the need "to give priority to free software for the realization of the informatic infrastructure of the *People* project on e-government."[49]

One of the main promoters of free software in Firenze, Papini (leader of the Green Party), explains that "the use of proprietary software in the environment of public administrations and for e-government, casts serious doubts on the security of sensitive data administered by public entities. The use of free software for e-government is a priority in order to guarantee the security of data and for the development of the potential of the Italian software producers." Others advantageous aspects noted by the Firenze City Council include: the larger cost of acquiring proprietary products with their subsequent updates; the possibility of reading and using the produced documents at any time after, independently of the version of software used; the benefits derived from the re-allocation of resources today often spent in the acquisition of proprietary software instead of in training. The Firenze City Council goes further to take a commitment to promote the advantages of free software to other public entities, as well as to favour the use of open and documented standard data format. This is considered of major importance and flexibility to maintain full compatibility with future technical change. Finally, the Firenze authority has also decided to introduce training on the use of GNU-Linux operating system and other free software products in the programme of courses for the informatics re-qualification of city employees.[50]

In the province of Milan, the City Council of Lodi has adopted a proposal supporting the introduction of free software as an alternative to proprietary software in the local authority. According to the Lodi Council only free software offers a paradigm of security, compatibility, accessibility and stability in such a way as to guaranteeing efficiency and productivity to the public administration, at the same time as helping to reduce the costs of updating. The proposal concludes with an invitation to the City

[49] **"IL CONSIGLIO COMUNALE**
Vista la delibera sul progetto PEOPLE per l'e-government;
Vista la mozione approvata dal Comune di Firenze che chiede di estendere l'uso del software libero;
Vista l'istituzione della Commissione ministeriale sul software libero;
SI IMPEGNA l'A.C.
A prevedere prioritariamente l'uso di software libero per il progetto PEOPLE." Found in: http://soant.comune.fi.it/consiglio/G00620-02.htm

[50] www.comune.firenze.it

Council to carry out projects and to make available the budget necessary to verify the modality and time for the progressive introduction of free software as a central and 'preferable' technology for the authority's own information system.

The Council of Argenta, thanks to the support of the Province of Ferrara and with reference to the project of regional law n. 3017/2002 (*Norms regarding matters of informatics pluralism, on the adoption and diffusion of free software and on the portability of digital documents in the public administration*[51]) with Council Deliberation n. 177 of 24th September 2002 has decided to introduce open source software in the public administration, as well as to promote its diffusion and development in the city environment, starting from the school system.

The Council of Luco dei Marsi has also decided to adopt free software. On 20th May 2002 was published the Protocol n. 4829, specifying that the adoption by the PA will be accompanied by the diffusion of free software in schools and eventually to all citizens. For this purpose the Council di Luco dei Marsi has already started to sponsor free courses on the GNU-Linux operating system.

The Council of Pescara has taken a similar path with the approval of a proposal for the introduction and expansion of free software in the public administration. Thus the Province of Pescara will assess carefully proposals to acquire copyrighted software and verify whether it is really necessary. For instance, new versions of software products for the office that fail to bring about significant improvements in relation to previous versions may be considered unnecessary for most of the offices of the Pescara Province. An additional reason is that the new versions of documents produced with new releases of proprietary software in general cannot be read with the previous version of the same programme. This causes communication problems among offices and consequently forcing all the offices to buy the same programme even if this is not really necessary. For this reason, the documents generated by the offices of the Pescara Province (e.g., text, spreadsheet or images) will have to be generated in a format of easy exchange with other programmes from any producer and any operating system.

The large Lazio region has also decided to adopt free software and it has collaborated with IBM to realize a solution in GNU/Linux environment.[52] The new website – redefined as a portal[53]- will provide information on the Regional entity, as well as facilitating interactions with citizens who will be given information on a variety of opportunities: economic, commercial (including local public tenders), social and cultural. As IBM has explained "the portal enables residents and businesses to apply for a variety of permits and respond to bids for various government contracts. The bid process allows local organizations to publish bids in the system. Any private company can read the relevant documents and soon will be able to print them. Within a year, Laziomatica …[Lazio region IT company]… will add 10 new online self-service

[51] *Norme in materia di pluralismo informatico, sulla adozione e la diffusione del software libero e sulla portabilità dei documenti informatici nella pubblica amministrazione.*
[52] http://www-3.ibm.com/software/success/cssdb.nsf/cs/NAVO-5DMV8T?OpenDocument&Site=linuxatibm
[53] www.regione.lazio.it

applications, including a central scheduling system for healthcare appointments."[54] The new website was created in a period of two months and Giulio Gargano, regional minister for IT, explains the reasons for the choice of GNU/Linux: "Linux made sense for us because it was open source. And the e-mail, firewall, FTP and proxy server functions embedded in the [GNU]Linux operating system gave us a cost-effective, integrated solution for the portal that is very easy to manage."

In 2002, the Modena City Council also started a process of adoption of free software making available the structure, knowledge and content of the city administration. This has led to the emergence of low-cost applications, something very appealing to PAs. The main aim is to consolidate the main administrative functions of the Council's information system on a GNU/Linux server.

The Italian and Spanish FLOSS experiences at the level of regional administrations provide a suitable introduction to the discussion of the next section on local/regional public administrations.

3.3 Selective Overview of FLOSS Use and Policy in Local/regional Public Administrations

European project Three Roses conducted a simple study of FLOSS in local/regional authorities between January and March 2003. It made use of the facilities and members of the three most important networks of regions and cities working for the information society: Telecities, ERIS@ and ELANET (all partners in project Three Roses[55]).

The study was composed of two surveys conducted simultaneously. A short survey carried out electronically through the Telecities website and a longer survey sent out to members of the three networks, covering 14 European countries and 3 accession states. Forty-four administrations replied to the surveys, including 13 regional administrations and 31 municipalities or their ICT partners.

3.3.1 Results of Short Web-based Survey

The web-based questionnaire was responded by 26 administrations, with the overwhelming number of respondents (23) being local authorities, as one would expect from the placement of the questionnaire on the Telecities website. Since Telecities has over 100 members the proportion of respondents is roughly equivalent to 20% of the Telecities membership. The results of this web-based survey revealed the following

- 76% of the respondent administrations have implemented some form of FLOSS system and all of these have implemented FLOSS at server level (most likely some form of GNU/Linux distribution). At the same time, 75% of these administrations have also implemented FLOSS at the application level.
- 24% of the respondent administrations said that they have not implemented FLOSS solutions, however 58% stated that they were actively considering it.

[54] IBM Corp., *Regione Lazio Delivers e-Government in 60 Days with IBM eserver zSeries Running Linux*, IBM Corp., 2003. Found in: http://www-3.ibm.com/software/success/cssdb.nsf/cs/NAVO-5DMV8T?OpenDocument&Site=linuxatibm

[55] http://www.prelude-portal.org/3roses/

3.3.2 Results of Longer Postal Survey

The longer postal version of the survey probed more in-depth the FLOSS activities and plans by public administrations. A total of 22 administrations responded to this survey and the results are as follows:

- 77% of respondents stated that FLOSS played a part in the strategic direction of their organisations, and of these 84 % felt that they could identify a FLOSS constituency in their area.
- 36% of the respondents are considering adopting FLOSS as part of the IT strategy.
- 68% of respondents stated that there was a definable constituency that could promote FLOSS in their respective regions
- 22% of the respondent's administrations have already implemented some form of FLOSS. Of these, 100% have implemented FLOSS at the server level with Linux Apache. And 50% have utilised FLOSS for security and authentication.

The longer questionnaire sought to enquire about barriers to uptake of FLOSS technologies. Replies to this section were given by only 22% of the total number of respondents, of which 40% were FLOSS adopters; 10% were at planning stage; and another 40% had no plans to adopt FLOSS solutions. The results are as follows:

- 100% felt that the FLOSS license posed no problems to the adoption of FLOSS solutions since their internal procurement rules allowed them to utilise FLOSS technologies.
- 80% felt that the largest obstacle to adoption of FLOSS is the lack of in-house expertise as well as of software support.
- 40% felt that sustainability was an issue and 10% felt that cost was a barrier.

The above results are indicative of local/regional FLOSS activity in Europe, although it is not possible to extrapolate an accurate picture of the extent and depth of this activity. The 3 networks cover a limited number of local/regional authorities and the number of respondents was also a limited proportion of their membership. The results regarding the major barriers to FLOSS adoption, however, tend to agree with some of the points raised earlier, particularly the need for FLOSS expertise and capacities that will re-assure ICT managers and decision-makers of the lower-cost and sustainability of the model.

In the following, the paper looks in some detail at a few implementation processes of FLOSS solutions in different European local/regional administrations in order to highlight the variety and specificity of the FLOSS constituency-building processes in different authorities

3.3.3 Four Selected Cases of FLOSS Implementation by Local/Regional Authorities

This section will give an idea of some of the factors and issues involved in real processes of FLOSS adoption and implementation. The focus is on the adoption of the following specific FLOSS technologies: email server, desktop and firewall.

(1) FLOSS Email Server Application in Nottingham City Council[56]

The Nottingham City Council is a major economic player and the largest employer in the City of Nottingham, with over 16000 employees. It provides a range of services to citizens including refuse collection, public health, housing, education, leisure and culture. An extensive IT network sustains the Council's activities, including support for 7500 internal operational email accounts that produce millions of email messages a month, equivalent to 36 Giga bytes of data.

In 2002, the Council's email system consisting of Mdaemon and Worldclient was stretched to the limit. Frequent crashes of up to six times a day meant not just messages lost but also increasing unpopularity with the majority of the Council's email users who were forced to re-launch the browser to retrieve email every time the system crashed. Pressure for change towards a robust and scalable solution was mounting fast and, worst, this solution had to carry little disruption given the relatively recent migration from Microsoft Mail to Mdaemon, and it had to be low-cost given the limited resources available. In addition there were policy pressures, as email was perceived as the key concept of "e-government" and "joined up government." Without a new solution in the short term the ICT departments' credibility was going down the drains, and spending the way out of the problem was not an option since traditional solutions could not be afforded. And Paul Martin, Head of ICT of the Nottingham City Council, has also noted: "High capital costs mean on-going capital costs."[57] This led to a decision to move to an Internet Mail based system and FLOSS seemed to offer the practical way to do it.

Richard Heggs, systems analyst for the Council, had experience of Red Hat and Mandrake and figured that a shift towards FLOSS would bring about both greater control over the system and savings for the council. He examined a number of FLOSS products and decided that the SuSE Linux Email Server III offered the best solution. SuSE however advised that this system would be unable to cope with the large numbers of users. This led to a 17-day consultation with Suse at a cost of £17,000 and the company specified a FLOSS-based system: EXIM mail transport agent with the scalable client interface HORDE, utilising space in the Councils' two existing servers with SuSE Linux 8.0 operating system.[58] Heggs recently replaced the internal disc storage on the e-mail server with a storage area network. The implementation and consequent shift from MDaemon/Worldclient to the new solution took between two to three months.

As expected, there were problems during the implementation process but these could be tackled by Council and company working together, as FLOSS did allow both of them equal access to the source code. Thus, says Heggs "Because we could modify it and add things we ended up with software that did exactly what we wanted it to."[59] For instance, he made changes to the source code prompted by feedback coming from

[56] Case study is based on material found in the references given in the notes that follow inside the section on Nottingham.
[57] Paul Martin, "Implementing Email on LINUX & OSS," ICT Nottingham City Council, presentation found in http://www.netproject.com/presentations/LFB/paul_martin.pdf, accessed on 10th August 2003.
[58] A 4-way Xeon server with 4Gbytes of RAM and a two-way Xeon machine with 2Gbytes of RAM.
[59] *ST Technology*, "Nottingham City Council and SuSE," found in http://www.sttechnology.co.uk/nottinghamcc.htm, accessed 10 August 2003.

users who connect to the Council's e-mail system either via a web user interface or from Outlook on Windows PCs. The result was an increase in reliability.[60]

The "people" factor, however, always presents a challenge during the implementation of new technologies and this was not different with the migration to FLOSS by the Council's ICT support staff used to work on Windows-based environment. Interestingly enough, some important lessons about the difficulties of technology implementation had already been learnt by the IT management team as a result of difficulties faced during the initial migration from MS Mail to WorldClient and Mdaemon. This had been done without consultation with the end users, and had caused some friction. On the other hand, as Heggs tells, "the migration to the FLOSS solution, although already decided by the IT management team, was phased in such a way that the key 'power' users in the various departments felt a part of the process. [Thus] "we learned from our previous mistakes with the migration from MS Mail. I do feel, however, that we did not engage with the departments as well as we might have done, so although we improved upon the last migration, we learned further lessons this time around."[61]

The reported results show major improvements regarding the key challenge facing local authorities today, namely, the delivery of better services at lower costs, or what has been referred as "more for less." Thus, the estimated total cost after about a year, according to Heggs, is about £60,000 (including Suse's consulting fee), amounting to a rate of £8 per end-user mailbox over a year.[62] In addition, in the first six months the system crashed about 12 times - 6 due to failed disk drives and 6 due to the shortage of disk space – a rate comparable to two days of operation of the older system. Considering that the email traffic on the network increased eightfold after the FLOSS system went live this was clearly superior reliability, openness and cost-performance. For the Council's ICT staff the added bonus was an improvement in the quality of work since they can now concentrate on new projects rather than on routine support.

In the end Nottingham City Council got a stable, low cost, reliable and upgradeable system to suit evolution of requirements. They also got more flexibility and choice in relation to suppliers' support options and the possibility to configure the system themselves through access to the source code. Above all for the people who betted on FLOSS-based email system, they got an 'invisible' email system. In the past, email used to be at the top of any meeting agenda, now never gets mentioned, reports Heggs. It has become transparent in the operation of the Council.[63]

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[60] Saran, C., "Nottingham City Council rolls out open source e-mail system at £8 per user per head," *ComputerWeekly.com*, 7 May 2003, found in http://www.computerweekly.com/Article121523.htm

[61] Personal communication with Richard Heggs, 19 August 2003.

[62] Saran reports that: "According to Ashim Pal, vice-president at analyst Meta Group, the cost of running commercial systems such as Microsoft Exchange and Lotus can be more than £80 per user, but these products have features open source systems lack." Saran, C., "Nottingham City Council rolls out open source e-mail system at £8 per user per head," *ComputerWeekly.com*, 7 May 2003, found in http://www.computerweekly.com/Article121523.htm.

[63] "Nottingham City Council – SuSE Linux case study," found in http://www.suse.co.uk/uk/company/press/press_releases/archive03/nottingham_city_council.html, accessed on 10 August 2003. Also *Open Source Migration* Guide, Workgroup and Messaging Case Studies, SuSE Linux Open Exchange Server, found in http://news.zdnet.co.uk/business/0,39020645,2135726,00.htmhttp://migrationguide.org.uk/CaseStudies/SuSE_Open_Exchange_Server.php, accessed on 10 August 2003.

The Nottingham City Council is certainly impressed with the results achieved by FLOSS. This means that FLOSS solutions will be given serious consideration as the Council comes up for new software investments in the future, particularly, if savings, reliability and openness similar to those achieved in the email system are possible.

(2) FLOSS Network and Desktop Application in Central Scotland Police[64]

The Central Scotland Police (CS Police) faced a strategic problem. How to ensure that every office in the region has access to the same range and quality of computer facilities, regardless of location and staffing levels, and at a cost that allows the force to invest the most in servicing and protecting the public. For instance, each £25,000 saved would roughly allow for an extra highly appreciated British policeman on the beat.

Given the limited resources, the challenge was not straightforward for the CS Police, especially as the region has all types of communities, from heavily populated cities in the southeast to sparsely populated rural communities in the northwest. Thus, when Microsoft announced changes in their licensing model, [65] the alarm bells started ringing at the CS Police. The force perceived the changes as leading to major increases in its IT costs, with a consequent negative impact on their service to the public. In the words of Chief Inspector Stewart Marshall, "We saw how Microsoft was moving with licensing and how much it was going to cost."[66] Also Jim Jarvie, IT Manager for Central Scotland, explains: "Our view is that our limited budget is intended to be used for protecting the public, not on computing infrastructure unless truly necessary. At the prices Microsoft charges, we just couldn't see equipping everyone who could have benefited from office productivity applications."[67] At this point, CS Police turned to Sun, a company whose technology they have been using for a decade or more, and which had released the StarOffice suite - a software using the open source model aimed at displacing Microsoft Office suite while maintaining compatibility with it.

By mid-2000, Jarvie and his team began downloading Sun's StarOffice for Windows from Sun's Web site in order to carry out initial tests. They also bought a copy to obtain the documentation and proceeded to set up a test environment that showed very good outcomes. In Jarvie's opinion: "Our experienced Microsoft Office users found the StarOffice suite easy to learn and easy to use. The operational differences between the packages are quite minor. We also tested StarOffice software's compatibility with Microsoft Office, and found that almost all files can be transferred between them with no problems."[68]

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[64] Case study is based on material found in the references given in the notes that follow inside the section on Central Scotland Police.
[65] Microsoft' has introduced a three-year rental pricing model, with the potential elimination of all perpetual licenses.
[66] Quoted by Holland, M., Sun's rising star enters Microsoft Space, *Computing*, 3 August 2001, found in http://www.computing.co.uk/News/1124456
[67] Quoted in *Sun*, "Government Success Stories. Central Scotland Police," found in http://www.sun.com/products-n-solutions/government/docs/central.html.
[68] Ibid.

The success of the pilot led CS Police to the permanent installation of the following configuration:[69]

- ?? StarOffice Suite
- ?? Sun Ultra 60 server for running Star Schedule Server as the central hub of a two-tier distribution architecture. Based in Sterling.
- ?? 30 Intel/Linux servers for StarOffice in each of the force's offices, networked to the central server in Sterling
- ?? 400 networked PC/Windows desktops shared among the 30 offices' servers and over 1000 users.
- ?? 10 Sun servers for business applications

The results reported by the CS Police are significant: savings of almost a quarter of a million pounds and the extension of computing applications to users who in the past would have been excluded by cost. In addition, it has been found that StarOffice has advantages in online documentation, complex calculations, and other areas while maintaining compatibility with Microsoft Office.

Following this success, the CS Police has moved further into the use of FLOSS solutions by also partnering with SuSE Linux and implementing a pioneering systems and facilities previously unavailable in other forces. In particular, they installed an Oracle 8i server running on SuSE Linux to support their mission-critical Command and Control system. The system performs multiple functions from co-ordinating all ongoing activities of officers on duty to controlling every call for assistance (from urgent 999 calls to routine visits) and recording all crime and offence reports. The latter provide the basis of reports submitted to the Procurator Fiscal. These are all mission-critical services and failure of any of them would cause massive disruption to normal policing service. Strong reliability is thus required and this is provided by the SuSE Linux system.

A more recent example of the continued use of FLOSS by CS Police is the installation of a network video broadcasting facility using the VideoLAN project (http://www.videolan.org) that enables distribution of the Chief Constable's Force Update video. Jarvie explains: "Using traditional methods, this required duplication of the video on tape, distribution of the tapes and then scheduling of Police Officers to attend a screening of the message. This was particularly time consuming and could be disruptive of an officers valuable time. By using the video broadcasting system, any officer can simply connect to the broadcast at a time convenient to them and view the message on their desktop computer. It is no longer necessary to arrange video players, projector screens and rearrange shifts to ensure officers view the message. This represents a real efficiency and cost saving to the Force which, in turn, leaves officers more available to meet the needs of the public we serve."[70]

Overall, it is clear that through the use of FLOSS solutions CS Police is very much at the forefront of using FLOSS solutions in a regional context and, from the above, they seem to be reaping high benefits from this pioneering role. Thus, "We have found Open Source to enable us to react quickly to changing requirements and circumstances

[69] Ibid and *Sun*, "Government Agency Saves on Cost-Effective Office Productivity Application; Invest More in Law Enforcement, found in http://wwws.sun.com/software/star/successstories/CSP.html, accessed on 10 August 2003.

[70] Personal communication with Jim Jarvie, 27 August 2003. The open source "transcode" project (http://zebra.fh-weingarten.de/~transcode/) was used to prepare the video material.

in a way which is not always possible when using traditional proprietary applications."[71]

(3) FLOSS Desktop Application at the West Yorkshire Police[72]

In early 2002, the news broke out that the Police Information Technology Organization (PITO) for England and Wales had commissioned the consultancy netproject to examine the potential issues with and benefits of, using GNU/FLOSS solutions on police forces desktops – up to 60,000 of them.[73] The report was commissioned on behalf of the Association of Chief police Officers' Information Technology Advisory Group (ITAG).[74]

At the time, PITO's Marco Dawson said: "This work is part of Project Valiant that is examining the requirements for the next generation of police computing … The police need very secure, virus resistant and stable desktop computing. We believe that Linux can provide this. There is a potential total requirement for 60,000 Linux desktop systems within the UK Police Forces so we need a very good understanding of the deployment and migration issues to Linux on the desktop."[75]

On his part, netproject's Eddie Bleasdale confidently stated: 'Our experience with Linux is that it provides very high levels of security, is very reliable, virus resistant and stable. With the development of Open Source Office Automation Software and the software tools that enable Microsoft Windows applications to be ported - Linux is now ready for deployment on the desktop."[76] As part of the study, netproject would also examine strategies and software tools to enable applications previously developed for PITO and running under Microsoft Windows to be ported GNU/Linux. In addition, the FLOSS-based police force's desktops would be configured to be highly secure, using both Smart Cards and Biometrics user identification.

A few months later netproject delivered its report under the title "Linux Feasibility Study," and by October 2002 the West Yorkshire Police begun to take delivery of the first low cost GNU/Linux-based desktop computers as part of a trial that will migrate existing police applications to the GNU/Linux operating system (Red Hat Linux version 8) and will make use of netproject's Secure Open Desktop Architecture. The software environment includes Linux, OpenOffice, GNOME, Evolution and WINE. The GNU/Linux computers are low-cost at £299 per piece (exc. VAT) and are manufactured by the Taiwanese company GCI – with European headquarters in Telford. They come with smartcard readers –using Gemplus's smart card technology- for better security and to enable police to log on at any of them. West Yorkshire police

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[71] Personal communication with Jim Jarvie, 27 August 2003.

[72] Case study is based on material found in the references given in the notes that follow inside the section on West Yorkshire Police. The content of this section has been checked for accuracy with Eddie Bleasdale, key player in the FLOSS experience of West Yorkshire Police.

[73] "Linux Desktop Computing for UK Police," news posted on netproject's website on 20 January 2002, found in http://www.netproject.com/blank.html. See also *LinuxUser*, "UK police investigate desktop Linux," February 2002, p.8, available in http://www.linuxuser.co.uk/articles/issue18/lu18-News.pdf. And *DesktopLinux.com*, " Linux looked at for 60,000 police desktop computers," 21 January 2002, found in http://desktoplinux.com/news/NS5941090625.html.

[74] "Police service maps out the way forward on operating systems," news posted on netproject's website on 9 December 2002, found in http://www.netproject.com/blank.html.

[75] Ibid.

[76] Ibid.

has a total of 3,500 desktop computers with the result that wider deployment would mean substantial savings for the force.

Paul Friday, Head of IS for West Yorkshire Police said: "We are very interested in the advantages of the Secure Open Desktop Architecture. We believe that they (the machines) could decrease our costs while improving our security. Our initial estimates show that with an installed base of 3,500 machines, we could save up to £1 million per year and be able to extend our information systems into places where police officers work in local partnerships."[77]

West Yorkshire Police is at the forefront of adopting FLOSS at desktop level, just as the Central Scotland Police in Scotland. The trial will allow further and quicker development in the tradition of FLOSS development processes that stimulate quick feedback to improve the systems. "It is the open-systems approach – release early and release often," says netproject's Eddie Bleasdale.[78] For Steve Hnizdur, netproject Director, those involved in IT strategy should examine the approach to desktop computing in the light of the new situation. "Linux enables very low cost computing, there is no vendor pressure to constantly upgrade working systems and Linux enables very secure systems which are highly resistant to virus infections."[79]

A substantial FLOSS breakthrough in desktop computing, however, is a tall order. Indeed, some analysts believe that Microsoft's 95% market share of desktop software is simply too strong to change. Nevertheless, netproject's Bleasdale points out, "We are getting considerable interest from other organisations that are exploring the use of desktop Linux as part for their infrastructure. We are confident that the deployment of Linux on the desktop will grow at a very fast rate."[80]

Fast however is a relative term that might mean a good number of years, especially when it comes to substantial displacement of an entrenched pervasive technology such as Microsoft desktop software. Evidence of this comes from the recent UK police service updating of strategy for the use of Microsoft operating systems that recommends the forces to standardise on both client and server, and provides specific guidelines for short, medium and long term.[81] At the same time the police service is keeping an open mind on the emerging benefits of FLOSS, keeping an eye of the West

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[77] Hayday, G., "Police put Linux on trial," *Silicon.com*, 16 October 2002, found in http://news.zdnet.co.uk/software/0,39020381,2123999,00.htm Also, Williams, P., "Linux-based PCs go on duty in Yorkshire," found in http://www.vnunet.com/news/1136041.

[78] Williams, P., "Linux-based PCs go on duty in Yorkshire," found in http://www.vnunet.com/news/1136041.

[79] Hayday, G., "Police put Linux on trial," *Silicon.com*, 16 October 2002, found in http://news.zdnet.co.uk/software/0,39020381,2123999,00.htm

[80] "Desktop Linux for West Yorkshire Police," news posted on netproject's website on 11 October 2002, found in http://www.netproject.com/blank.html

[81] "ITAG has recommended that forces migrate their Microsoft-based server infrastructure from NT4 to Windows Server/2000 in the short-to- medium term. The potential for migration to the .net server architecture in the medium-to-long term will be monitored by ITAG with support from the Police Information Technology Organizations (PITO). The group further recommends that the forces should move their Microsoft-based client infrastructure to Windows 2000 or Windows XP in the short term. Selection of an operating system will be dependent on whether the client or the applications software can support or be supported on Windows XP, the medium-term objective will be the full adoption of XP." "Police service maps out the way forward on operating systems," news posted on netproject's website on 9 December 2002, found in http://www.netproject.com/blank.html.

Yorkshire Police trial and its results that, among other aspects, should help quantify the business case for possible future alternatives to Microsoft software. In this respect, the trial must take notice of the significant strategic direction via Microsoft products recommended by ITAG.

On the other hand, evidence of FLOSS spread comes not just from Nottingham City Council but also from other UK Councils, for instance, Penwith District Council in Cornwall, which has shifted some 300 desktops due to "lower licensing costs." Now, in mid-2003, Newham has commissioned a feasibility study potentially leading to the migration of its 5,000 desktop computers to FLOSS. This move is seen of particular significance because of its potential to spread to a group of seven neighbouring councils involved with Newham in a successful e-government 'pathfinder' project completed in 2002.[82]

Thus the FLOSS advance at the desktop level is really just starting and any significant displacement is likely to take more time that FLOSS supporters would wish. Nevertheless the game is open and given the pioneering role of some local/regional authorities, it is possible that it might be the evolution of Public Administrations towards e-government that ultimately leads FLOSS to break the historical Microsoft's monopoly of the desktop.

(4) Linux Firewall Application at Schwäbisch Hall[83]

The German City of Schwäbisch Hall is the centre of the Hohenlohe-Franken region, 60km northeast of Stuttgart, and a population of 36,000. It is the regional administrative and educational centre, as well as the unofficial cultural capital, of the economic area Heilbronn-Franken.

The Schwäbisch municipal administration is highly advanced in the implementation of ICTs, and has implemented a 'virtual city hall' that constitutes an important channel for closer proximity to citizens and for promotion of the region. Routine procedures are all available via the Internet, including registration, petitions, and certifications.

At Schwäbisch Hall the required IT infrastructure for these municipal services consists of Windows NT for the LAN and the Internet connection including a firewall and a proxy based on SUN Solaris. The increasing shift towards the Internet raised security concerns and the need to consider the installation "a cold standby firewall in a pseudo-cluster architecture, thus enabling an immediate compensation of the operational firewall in the event of a failure."[84]

Horst Bräuner, IT coordinator of the City of Schwäbisch Hall, came to the conclusion that FLOSS provided the right avenue for change.

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[82] Parkinson, D., "UK Councils dump Windows for Linux," *Silicon.com*, 6 June 2003, found in http://www.zdnet.co.uk/business/0,39020645, 2135726,00.htm.

[83] Case study is based on material found in the references given in the notes that follow inside the section on Schwäbisch Hall.

[84] "SuSE Linux, "The Secure Official Channel," found in http://www.suse.com/en/company/customer_references/pdf/schwaebischhall.pdf, accessed on 10 August 2003.

> Open Source technology is simply safer by nature. IT monocultures invite external attacks and make cyber crimes much more attractive for hackers. Furthermore, the open source code allows security patches to be made available much quicker. As the person in charge, you have the good feeling that you have your own software under control and do not need to rely blindly on the manufacturer.[85]

Following an assessment of possibilities, the city decided to deploy SuSE Linux Firewall on CD, since it provided all the necessary functionality such as support, documentation, and above all, regular system maintenance. Furthermore, users of SuSE Linux Firewall on CD need not make sacrifices. Thus, "SuSE Linux Firewall on CD is easy to install and administer and offers all necessary features for a convincing and individual security concept. The installation of the security updates also works perfectly. As for the price, SuSE Linux Firewall on CD is unsurpassed by comparable proprietary products."[86]

Schwäbisch Hall however will not stop at the firewall. This was the start and, indeed, in November 2002, the city announced a project to deploy SuSE Linux on IBM Intel-based servers and up to 400 desktops, Hermann-Josef Pelgrim, Mayor of Schwäbisch Hall, explained this decision as follows:

> "My decision for Linux is based on three factors. First, I expect a considerable reduction of out IT cost expenses due to lower software license fees. This will contribute to the consolidation of our municipal budget. Second, based on Linux's excellent grades from the experts on security, our IT structure will become more secure. Third, the choice of open standards ensure interoperability among different technical offerings."[87]

Initially, the project will migrate 120 client computers from Windows and Microsoft Office to the SuSE Linux Enterprise Client and OpenOffice.org for 120, reaching up to 400 in the final stage. At the server level, SuSE Linux Enterprise Server will be implemented on IBM's eServer xSeries systems. The savings to be realized by the changeover are estimated at more than 100,000 Euro.

At present the state of the project is as follows:[88]

- All clients (NT and Linux) switched to Linux Servers and centralization of the user-management on OpenLDAP Servers (HA-Cluster) using SuSE-Linux Enterprise Server in combination with SuSE Linux OpenExchange Server on IBM x-series305, 335 and 360.
- Rolling-Out of the Linux Clients, 48 are already installed (on IBM S42).
- Main problem is to find special software for government on OSS-Platforms.

Through its decision to migrate to FLOSS, the City of Schwäbisch Hall has joined the increasing number of German administrations and government offices that have followed the recommendation to consider FLOSS given by the German Federal Ministry of the Interior and many experts. The expectation is that GNU/Linux has the potential to minimize dependencies from individual software providers, while helping to preserve the dwindling budgets of cities and municipalities through substantially

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[85] Ibid.
[4] Ibid.
[87] "German City Goes Entirely Linux," found in http://www.suse.de/us/company/press/press_releases/archive02/german_city.html
[88] Personal communication with HorstBräuner, 20 August 2003. Additional information is found in http://www.schwaebischhall.de/presse/linuxinthecityhall.pdf

improved total costs of ownership (TCO). In the words of Bräuner, "the reasons for migrating to OSS are independence, security and cost-savings."[89] In short, realizing the ultimate dream of delivering "more for less."

4 Concluding Remarks

This paper started by identifying that new developments in the software sector in recent years are beginning to disrupt the "market order" built by proprietary software companies in a context ruled by a governance of exclusion from access and use of the source code of pervasive products such operating systems. The responsible for the disruption is the market emergence of *free(libre) and open source software (FLOSS)*, whose primary disruptive power lies in the effective challenge it has mounted to the "exclusion effect" intrinsic to the governance of proprietary (closed) software.

The paper noted that the challenge is recent and is likely to unfold for a decade or more before the real depth and breath of the disruptive impact of FLOSS becomes clear, both on the global software sector and industry in particular and on the societal fabric at large.

In this context, the government sector at national and local/regional levels has begun to emerge as a major area of growth for FLOSS. This is due not just for competitive market reasons that include issues of cost and security but, also, the suitability of FLOSS's governance of "freedom of source code" to the fulfilment of governments' mission of public good. In particular, the discussion has shown that the adoption of FLOSS seems to enable public administrations to do things that the alternative proprietary software did or would not allow them to do. Thus Central Scotland Police were able to extend computing processing power to places before excluded by the costs of available proprietary solutions. Likewise, as envisaged by the Peruvian Congressman and the Buenos Aires Senator, FLOSS will enable their government to satisfy their requirements of security, perenniality, transparency and ethical responsibility towards their citizens to an extent not possible with the use of proprietary software.

Widespread diffusion, however, never follows automatically the "better mousetrap" and the analysis confirms that *the successful adoption and implementation of FLOSS by government depend very much on the specific characteristics, strategies and policies pursued by each administration, as well as on the existing capacities of the competing FLOSS and proprietary constituencies.* This includes amongst other aspects: cost and quality of offer by software providers; PAs' short, medium or long-term perspective; political visions, relevant legislation and, in general, the capacities for delivery, maintenance, service and future sustainability of both the proprietary and FLOSS e-government constituencies. In this respect, we have seen that the presence of companies such as SuSE Linux, Sun and IBM have given credibility to competitive FLOSS solutions in the face of competing Microsoft solutions. These successes are initial however and there is a long road for FLOSS to travel before displacing proprietary software from its dominant position. Evidence of this is the recent recommendation from the UK police's ITAG recommending the forces to standardise

[89] Ibid.

on Microsoft client and server in the short, medium and long term. At the same time, the police authority is monitoring the results of FLOSS implementation by pioneering forces such as that of West Yorkshire.

At this stage, it is clear that the proprietary software constituency has the strength of a long and widely established global presence buttressed by a large accumulated software base protected by exclusive rights of exploitation. This advantage is manifested most strongly at the level of operating systems and customer applications where indirect network externalities and generational compatibility help "proprietary" software to sustain its market stronghold. On the other hand, the "FLOSS" constituency is benefiting from a long and widely established global presence in workstation and server technology, where the UNIX operating system has been traditionally strong. Above all, it is benefiting from the competitive advantages derived from its "freedom of source code" model that proprietary-software companies find very difficult to counteract. This is especially the case in front of governments determined to fulfil in the best available way the requirements of the government's mission of public good.

All in all, FLOSS has opened a major "window of opportunity" for change in the global software sector. Increasingly for the foreseeable future, there will be plenty of scope for variety in the public administrations' decision-making processes about software, as well as in the constituency-building processes of those promoting the development, adoption, and implementation of FLOSS. At stake, there are issues that range from 'freedom to 'cost-savings,' from 'new business models' to 'local/regional economic development,' etc. Above all, at stake are new forms of governance that radically challenge the predominant "proprietary" and "exclusive" way of making business with software – one of the most strategic elements of the information society. A question comes to mind, would a success of FLOSS help bring closer the dream of an information society for all?