Topic 5

Brave New Worlds

Contents

Learning Objectives

- **Understanding of the concepts and principles of open source**
- **Appreciation of future trends in IT and their potential impact**

5.1 Introduction

We shall round off this unit by considering some recent developments which are likely to have a significant impact on the way we develop and use information technology in the future. With the movement towards a greater acceptance of open source software (DiBona et al. 1999) we are seeing a return to the ethos that prevailed in the early days of computing when people willingly shared their files and programs. Software is becoming more freely available but not simply on our own computers. Pervasive systems running across wireless networks are making it possible for us to tap into services provided by others from almost anywhere (Saha and Mukherjee 2003). We can expect more and more of the services we use to be provided by these networks as time goes on. There is much to think about regarding the effect this might have on the way we live. Not least what might happen to those who are excluded or alienated from all of this technology.

5.2 Co-operative computing

Co-operation was once quite normal in the world of computing. Prior to the 1980s source code was always made available - even for proprietary systems. Copyright and Patent Law should have protected intellectual property rights and fostered the dissemination of information. However, trust broke down and binary-only releases have now become the norm for proprietary

systems. The sharing ethic of the pre-1980s has endured in a few places and seems to be taking off again. Trust, however, is essential for any form of co-operation

The Free Software Foundation (Williams 2002) and the Open Source Initiative (Raymond 1999) have provided a way forward with tools such as Copyleft, the GNU General Public Licence and the Open Source Definition which provide protection to the originators of work that is released as open source. The success of Linux is a testament to the effectiveness of these protections and the quality of the software so developed.

Peer-to-peer networks (Oram 2001), the antithesis of the client/server approach to networking, have enabled like-minded individuals to come together and share files, sometimes controversially, without the need for a central repository. Co-operation and trust appear to be making a come-back.

5.2.1 Open source

The increased interest and participation in open source developments have, as we have seen, led the purveyors of proprietary software to become very concerned. The Linux operating system is open source and can be downloaded from the Internet at no cost. New applications which run under Linux are being made available daily via web sites such as sourceforge (Sourceforge 2005) and even Microsoft is having to look to its laurels as the Linux snowball continues to gather momentum. Open source software has, of course, been written for other operating systems as well, including Microsoft's Windows family.

Copyleft

The trouble with making software freely available is that somebody else can pick it up, modify it slightly and then "take it private", or claim it as theirs. In order to protect free software from such a fate something akin to a copyright notice is required. Not the usual copyright notice that preserves all rights to the originator but a notice that gives away all rights except for the few necessary to prevent anybody else claiming all of those rights back again. This is the intention behind copyleft.

Copyleft gives permission to –

Run
Copy
Modify
Distribute modified versions of

a program. Source code must clearly be made available for this, so binary-only releases cannot be covered by copyleft. Copyleft does not allow the adding of extra restrictions or taking the program, or modifications to it, private. Consequently the combination of copyleft code with non-copylefted code is non-trivial and this hampered the spread of open source software in the early days.

GNU

GNU stands for GNU's Not Unix and, whilst it was initially solely concerned with producing a free rival to the Unix operating system, it has become the "brand name" for many open source products. The GNU General Public Licence (GPL), in keeping with the notion of copyleft, forbids mixing GNU software with non-free software. The problems which this continued to create led to the GNU Lesser GPL (LGPL), which relaxed the non-mixing requirement for software libraries. That is, proprietary products could use open source software libraries under an LGPL licence.

Open Source Initiative

The Open Source Initiative was formed in order to take an even bigger step in permitting the mixing of open source with proprietary software. Open source licences confer a right to use modifications of the original open source in non-open applications. The Open Source Definition explicitly states that selling-on as part of an aggregate must be permitted under an OSD licence. Clearly, this permission to allow people to make money from the open source work of others is controversial but it was certainly key to the expansion we have witnessed in the use made of open source software.

5.2.2 Peer-to-peer

Peer-to-peer systems aim to harness the massive computational power and storage resources that even a few tens of computers can collectively deliver. They aim to support direct person-to-person (P-P) or application-to-application (A-A) network connectivity. Typically the nodes in the system would be home PCs. This meant that no one node could be relied upon to always be present. Thus, Peer-to-peer systems had to be decentralised and every node had to have a degree of autonomy. It is this decentralisation that has caused much of the controversy surrounding peer-to-peer systems. There is no ring-leader to take to court when these systems are used for exchanging files of pirated music for instance.

Apart from the technological aspects of the networks, peer-to-peer's biggest contribution has been in letting ordinary people publish to the world from their home PCs. Note that we are not simply talking about authoring. Anybody can author something on their PC but in order to distribute it to the wider community they would normally need access to a web server. Peer-to-peer systems remove that need; people can publish material directly from their own PCs. This ability has been dubbed the "Cornucopia of the Commons" because of the enormous variety of material which it permits to be broadcast. Sadly though, it has also sometimes been the "Tragedy of the Commons" with people freeloading off the publishings of others whilst offering nothing in return. Once again we find trust and accountability becoming critical elements of the system.

5.3 *e*Life

*e*Life is a term, coined elsewhere by this author, to describe what our lives might be like as the many and diverse "*e*" technologies of today and tomorrow make their unpredictable impacts upon us. Before exploring this technological dream world, though, we should pause and ask ourselves if it will be open to all. Exclusion and alienation of sectors of the community are a distinct possibility.

Exclusion is most likely to arise as a result of the cost of the technology, which may be beyond some people's means. Are there parts of the world which will be left behind as we race forward? Are their sectors within our own communities that will simply not be able to keep up with the cost of endless upgrades and so not be able to take advantage of all of the services on offer? People with disabilities might also be excluded from certain services if not enough thought is put into their delivery by service providers. Streaming audio and video should mean that very few services would be impossible to deliver in a suitable form to a deaf person or a blind person, etc. The cost of providing such services may mean that they are not though.

Alienation can come from being unfamiliar with the technology and so being afraid to use it. Fears that the older generation might fall foul of this seem, on the whole, to have been misplaced. Are there other groups within society who might be alienated though? Will some groups with special needs be alienated as a result of the exclusions we mentioned previously? Might they give up on the whole business if it requires an inordinate amount of effort on their part to access the services they want? Can we cater for people who are not disabled in the conventional sense, but become so because of our reliance on computer technology? People with numeracy and literacy problems for instance.

As information technology professionals we can't make poor people richer but we can, and should, be able to ensure that potentially high-risk groups are not disenfranchised by tomorrow's computer technology.

5.3.1 Technology

Finally, we can now ask what tomorrow's computer technology is likely to be like?

We already have embedded systems in car engine management systems, mobile phones, microwave ovens, washing machines, DVD players, etc. In the future we can expect software to be embedded in practically any piece of hardware that could benefit from adaptive control. The choice between a hardware or software solution which we are used to is likely to become a non-issue.

The Semiconductor Industry Association (SIA) predicts that it will soon be possible to place 100 million transistors onto a chip. It will be possible to put complete computer systems onto a single chip. This will take integration beyond VLSI and into System Level Integration (SLI) or System-on-a-Chip (SoC) technology. The design and verification of such systems will pose major challenges.

Micro Electro Mechanical Systems (MEMS) are currently in their infancy but they offer the potential for incredible miniaturisation of sensors, communications and actuators. Mechatronics in miniature, nanotechnology, molecular machinery and micro-motors are all examples of MEMs technology. There is tremendous scope for applications in medicine and healthcare. Pacemakers, cochlear implants, prosthetics, even nanorobots running around in your blood stream breaking up clots so you don't get thromboses. All sorts of mundane objects could become active and reactive.

Wireless networks come in two main forms nowadays; mobile phone networks and wireless LANs (WiFi). The latest mobile phones already use GPRS (General Packet Radio Services) which means they can be permanently online on a pay-per-byte basis. Wireless LANs permit computers to connect to Access Points on wired networks. Our mobile phones and many other devices could become nodes on Wireless LAN networks and thence connect to the Internet over high-bandwidth links. Concerns over the security of wireless networks are being addressed by Extended Service Set ID (ESSID) and Wired Equivalent Privacy (WEP).

The Semantic Web is a vision of the World Wide Web in a machine usable form. Currently information is provided in a form suited to viewing by us. What if all the information could also be provided in a form suited to computer programs? We could send software agents out into the Internet to find appropriate information, combine it, perform calculations on it for us. A semantics is needed to describe each item of information so the agents could identify what was what (cf. Meta-tags).

We've already discussed Peer-to-Peer systems. We can expect these to spread but they have already made a contribution to the development of even more powerful systems such as Grid computing. The Grid is a reliable, scalable, heterogeneous, dynamic, global infrastructure which links a wide range of computing and non-computing devices. It offers enormous capacity in processing power and storage volume. It can also be used to make complete facilities available. Already Grid computing is being used to link scientific laboratories so that researchers in one lab can conduct experiments in other labs anywhere on the Grid.

Computing resources everywhere is a concept we have already mentioned in passing. There are two senses in which this can be viewed and both are currently under development. Pervasive computing conceives of computers everywhere in a "right here and now" sense. The Holy Grail is universal availability. Computers in everything - personal digital assistants (PDAs), mobile phones, wearable computers (in our clothes), smart buildings (Internet Zero). IBM has a whole division working on this paradigm. Taking a slightly different perspective is Ubiquitous computing which focuses on keeping the technology in the background; transparent and invisible. The Holy Grail here is for users to become oblivious to the technology which surrounds them. The late Mark Weiser, father of the computers everywhere concept, described this "calm technology" as follows –

"The ubiquitous computer leaves you feeling as though you did it yourself"

Computing resources might end up being supplied just like any other utility such as electricity, gas, water, etc. This idea has, not surprisingly, been dubbed Utility computing. Will it herald the return of computer bureaux? It might offer low entry cost options to enormously powerful information processing systems on a "pay as you go" basis. Service level guarantees will be required for such an idea to take off but if it does it will be the ultimate in outsourcing.

5.3.2 Society

How might the societies in which we live be affected by computer technology? This is difficult enough to predict without even considering some of the developments we have just presented.

Home-working is one thing we may see more of as improved technology makes it possible for us to be at work in a virtual sense whilst remaining at home. Before rashly assuming that improvements in the quality, cost and availability of streaming video systems and the like will make home working more attractive, we should ask if there might be other reasons why it hasn't already taken off. Productivity can be an issue for some home workers, distractions at home may lead them, or their bosses, to prefer the office environment. Maybe the personal contact we get at work is a key factor?

Perhaps developments in Computer Supported Co-operative Work (CSCW) could help? We're all doing CSCW already but in a hap-hazard and slip-shod fashion. We use mailing lists, discussion fora, etc. We pass documents and spreadsheets around amongst collaborators. CSCW sits between organisational and individual computing. Research into CSCW focuses on systems to support small groups of workers. CSCW is "socio-technical". Social scientists are needed to find out how we use, and what we want from, CSCW systems to make them more useful.

Where is *e*Commerce heading? There has been a remarkable take-up rate in online shopping. Data-mining techniques are likely to lead to better targeting of direct marketing which will be more acceptable to consumers. We might all end up using *e*Cash.

Could *e*Healthcare provide virtual surgeries on the web? Routine medical problems can probably be dealt with automatically, thus saving doctors' time for more serious cases. Perhaps video-streaming will enable doctors and patients to interact without the necessity of patients leaving their sick-beds?

Perhaps we will see the evolution of *e*Democracy. Virtual surgeries might facilitate communication between constituents and their representatives. Intelligent FAQs might be able to automatically answer common questions which constituents ask. Representatives might be able to take advantage of constituency alerting systems. News alerts about issues affecting their constituencies. Online opinion polling might help representatives "test the water" about potential policy decisions. Online voting might result.

And what of government itself? *e*Government? The UK already has an "Office of the e-Envoy" whose mission it states is to "ensure that the country, its citizens and its businesses derive maximum benefit from the knowledge economy". Will we eventually get that long sought after "joined-up government" via integrated databases?

The possibilities are, of course, endless. We need to start thinking about them though and what might go wrong as a result of these advances.

5.4 End of topic test

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Please insert a multiple choice test here. The correct answers to each question are underlined.
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Q1. Prior to the 1980s source code was always –

a). Bug-ridden
b). Cheap
c). Made available
d). Written in Fortran

Q2. Linux is an example of –
a). CSCW
b). Open source
c). Pervasive computing
d). Proprietary software

Q3. Which of the following is NOT permitted by copyleft –
a). Copying
b). Modifying
c). Running
d). Taking private

Q4. The licence which permits proprietary software to use open source library software is –
a). Free Software Foundation
b). GNU General Public Licence
c). GNU Lesser General Public Licence
d). Open Source Definition

Q5. Which of the following phrases has been used to describe peer-to-peer –
a). Client/server
b). Cornucopia of the Commons
c). House of Commons
d). Tragedy of the Common Man

Q6. What societal concern was raised about advances in computer technology –
a). Exclusion
b). Piracy
c). Pornography
d). WiFi

Q7. Alienation was NOT suggested as a concern in the case of –
a). Illiterate people
b). Innumerate people
c). People with special needs
d). Visitors from Mars

Q8. The Semantic Web was described as the World Wide Web in what form –
a). Hardcopy
b). Machine readable
c). Mobile phone
d). Ubiquitous

Q9. Pervasive computing was described as computers everywhere in what sense –

a). Background
b). Right here and now
c). Transparent
d). Virtual

Q10. When do we need to start thinking about what might go wrong –
a). Later
b). Now
c). Tomorrow
d). Yesterday

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