

Electronic Commerce

7. Emerging Applications and Some Legal Issues

V Rajaraman



V Rajaraman is with the Jawaharlal Nehru Centre for Advanced Scientific Research and the Indian Institute of Science, Bangalore. Several generations of scientists and engineers in India have learnt computer science using his lucidly written textbooks on programming and computer fundamentals.

In this concluding part we describe mobile commerce and peer to peer computing, which are two emerging application areas of e-commerce. We also discuss some legal issues, which have arisen with the spread of e-commerce.

Introduction

In the previous parts we described the evolution of e-commerce and some of the technologies crucial in its development. The area of e-commerce is very young and dynamic. Not only has it introduced new technologies but also brought in its wake a number of new social and legal issues. Our purpose in the last part of this series is to describe some of the emerging technologies. We also discuss some aspects of the information technology act passed by our parliament last year whose primary purpose is to promote e-commerce and e-governance. We first briefly describe mobile commerce commonly known as m-commerce.

Mobile Commerce

Mobile commerce is defined as the conduct of business and providing services using portable wireless devices, which can communicate with computers connected to the internet. The number of mobile phones and portable personal digital assistants is increasing rapidly and it is predicted that by 2005, 40% of C2B e-commerce will be from mobile phones and mobile personal digital assistants. In *Figure 1*, we give a layered architecture [1] of m-commerce. We will focus our attention on the top layer, namely, novel applications. In *Box 1*, we briefly describe wireless application protocol used with mobile devices, which relates to the next two layers from the top. A number of innovations are possible when we introduce mobility. One of the

Part 1. What is E-Commerce?, *Resonance*, Vol.5, No.10, 13-23, 2000.

Part 2. E-Commerce System Architecture, *Resonance*, Vol.5, No.11, 26-36, 2000.

Part 3. Secure Messaging, *Resonance*, Vol.6, No.1, 8-17, 2001.

Part 4. Payment Schemes, *Resonance*, Vol.6, No.2, 6-13, 2001.

Part 5. Cash Transactions, *Resonance*, Vol.6, No.4, 8-14, 2001.

Part 6. Electronic Data Interchange and XML, *Resonance*, Vol.6, No.6, 8-27, 2001.

Mobile user applications (mobile inventory control, product location, mobile entertainment, mobile information, mobile distance education).	Application layer
Wireless user infrastructure (browsers for hand held devices)	Software layer
Mobile middle ware. Wireless application protocol (WAP)	Middle ware
Wireless network infrastructure. Cellular systems, wireless in local loop, satellite.	Hardware layer

most interesting applications is tracking and routing goods in transit. In this application each package being shipped has a small broadcast device embedded in it which continuously broadcasts its unique identity code. With the help of a cellular

Figure 1. Layered architecture of m-commerce [adapted from 1].

Box 1. Wireless Application Protocol (WAP)

Mobile commerce requires use of wireless communication between mobile devices such as personal digital assistants or cell phones with servers, which are normally connected to the internet. Fixed computers connected to the internet use a set of standard rules to communicate with one another called a protocol. This protocol is known as TCP/IP (transmission control protocol/internet protocol). The internet protocol routes small packets called datagrams belonging to a message, using the address of the intended receiver. TCP provides an error free connection between the sender and the receiver. In this protocol the sender dispatches a datagram and waits till it gets back an acknowledgement of its safe receipt (from the receiver) before despatching the next datagram. Mobile hand held devices connecting to the internet have two problems. Cellular wireless communication is slower and the delay is variable as it depends on the base station in each cell for despatch of datagrams. Hand held devices have a small screen and limited computing power. They cannot compete with a PC, which has a large screen and high computing capability. Thus both the communication protocol and the application environment have to be different to cater to mobile devices' special requirements. This has led to wireless application protocol (WAP) for mobile devices. The communication protocol is a variation of TCP/IP called UDP/IP. In this protocol the sender despatches datagrams without waiting for acknowledgement. This is less accurate but faster in a wireless environment.

The application layer of the protocol is called wireless applications environment (WAE) which supports three different applications. A wireless mark up language called WML which is similar to XML, WML script is similar to Java script and WTA (wireless telephones application), an interface which allows WAP to access a phone's features. WML recognizes the fact that screen size of a mobile device is small and available computing power is low. Although WAP uses its own protocols, it is designed to be compatible with internet. Pages written in WML travel across the internet using http over TCP/IP and are converted to WAP at the gateway between the fixed internet and the wireless network.



Peer to peer computing, or P2P computing for short, is the technology in which computers connected to a network (such as internet) communicate directly with one another and manage computing tasks without intermediation by a server.

wireless infrastructure its location can be found. One can use this to trace packages and inform customers when they can receive a package. This information can also be used to reroute a package where it is critically needed.

Another application is to inform a chemist or a hospital about expiry dates of drugs in their inventory. This is done by embedding, a small wireless device in the packing of expensive drugs which have a short life. These packets broadcast their status once a day, which is monitored by a server in the shop or hospital and appropriate action is initiated. An emerging application is to provide information on delays in flight schedules, traffic jam reports, etc., to mobile users. Mobile commerce is also used for providing to customers who are in transit, information on nearby stores, which have an item they need and also comparative prices to let them decide where they want to shop.

Peer to Peer Computing

Peer to peer computing, or P2P computing for short, is the technology in which computers connected to a network (such as internet) communicate directly with one another and manage computing tasks without intermediation by a server [2]. The two most important applications of P2P computing are file sharing and distributed computing. One of the most popular (and notorious) P2P file sharing program was developed by a company named Napster for sharing on-line music files. A Napster user registers with the company (www.napster.com) and notifies its server (computer) regarding the music files he or she has. This enables Napster to have in its server a directory of users and the music files they are willing to share. These files are compressed audio files, in what is known as MP3 (see *Box 2*) format, stored in a user's disk. When a user wants a music file he/she sends a request to Napster's server. The server searches its directory and sends back a list of PCs currently logged on and, which have the requested file. A user can now connect to one of those PCs and initiate a request for the file, which moves directly from its disk to the requestor's disk.



Box 2. What is MP3?

The audio file exchange in P2P computing would not have been possible but for MP3. MP3 is the short form for Moving Pictures Experts Group – Version 2 – layer 3 – audio compression standard. A typical audio music covers the frequency range 15 Hz to 20 KHz and is a continuous waveform. This continuous waveform is sampled at discrete intervals and the amplitudes represented by digital values. This is done by using an analog to digital converter which is an integrated circuit chip. This digital information is stored in a CDROM. In good quality CDs 44,100 samples/second are taken in order to preserve the information in the audio signal. The amplitudes are represented using 16 bits, which gives adequate amplitude range. As most audio CDs are stereophonic, 2 channels are recorded. Thus the total number of bits required to store a minute of music is:

$$44100 \times 16 \times 2 \times 60 = 84.67 \text{ Mbits.}$$

If this digital file is to be sent using the internet, we have to use a modem. Most home connections use modems, which can at the most transmit 56 Kbits/second. The time taken to send a file which has 1 minute of music is thus $(84670/56)$ seconds = 25.2 minutes, obviously impractical. Thus the music file should be compressed if it is to be sent using the internet. The basic question which arises is whether it is possible to compress a music file without sacrificing its tonal quality. The answer is yes and that is what MP3 does. The compression algorithm uses characteristics of the human ear such as the fact that if two sounds play simultaneously the louder one is heard rather than the softer one. The sampling rate can be reduced during periods, where the frequency of the audio waveform is low. MP3 algorithm compresses the file size by a factor of 10 to 14. Thus a music file storing one minute of music can be transmitted in about 2.5 minutes – still large but practical. When the compressed music file is received it is stored in the hard disk of a PC. Software in the PC is used to expand the MP3 file and play it using the speakers attached to the PC. Recently MP3 audio players are being marketed, which store MP3 music in solid state memory – usually a flash memory. These players have a microprocessor to expand the MP3 files and give high quality audio. The memory available in such players is around 64 MB to 128 MB. Assuming that MP3 compresses the audio file size by a factor of 10 we can store in a 64 MB memory $(64 \times 8/8.467) = 60$ minutes of music. MP3 players using solid state memory are compact and thus portable.

The major advantages of Napster are:

- ❖ It is easy to use and thus has a large client base.
- ❖ As the client base is large the probability of finding the requested music file is high.
- ❖ As Napster is run as a business, user support is available.

The major disadvantages are:

- ❖ Napster's server could become a bottleneck as its directory has to be searched by all users.



The fact that Napster provided the technology, which enabled the exchange of copyrighted music without the copyright owners' permission led to a case in a US court.

- ❖ Only MP3 files are in the directory. No other files are allowed.
- ❖ It can clog a network as the service is highly popular. Many universities banned students using Napster as the networks were clogged with music traffic!

The fact that Napster provided the technology, which enabled the exchange of copyrighted music without the copyright owners' permission led to a case in a US court. The court recently ordered Napster to remove all copyrighted file names from its directory. (See *Box 3*.)

Another popular P2P file sharing software is known as Gnutella (www.gnutellanet.com), which may be downloaded and stored in a user's PC. A hello message with a request for a file is sent to a computer connected to the internet, which is currently on-line and has Gnutella program in it. It forwards the request to seven other computers having Gnutella letting them know of the request. If any one of them has the file the search ends and the file is sent to the requester directly. If none of them have it then each PC in turn sends it to six others PCs on-line. Thus the request fans out rapidly and stops when the request is fulfilled or the requested file is not found. The main advantages of Gnutella are:

- ❖ As it does not depend on a central server, no bottleneck can develop.
- ❖ It works for all types of files, not only MP3.
- ❖ It is very difficult to charge any one with copyright violation as no central directory is kept. The traffic is like any other web traffic and not easy to monitor.

The main disadvantages are:

- ❖ It is 'free-ware' and thus technical support is not there. It still has bugs.
- ❖ You need cooperating users logged on the network.

The other interesting application of P2P computing is the use of



idle computers connected to the internet. The most interesting program is SETI@home, which uses the CPUs of idle or under-loaded computers to run applications that analyze radio-telescope data. This program has been developed as part of the search for extra-terrestrial intelligence (SETI) project at the University of California, Berkeley. In SETI@home, peers communicate directly with one another to distribute computing tasks and return the results. It is estimated that the total processing power of computers connected to the internet is several peta(10^{15}) flops and the storage available is around 10 peta bytes. Hardly 1% of this resource is utilised at any given time! P2P computing thus provides an opportunity in e-commerce to auction CPU cycles and also to significantly increase C2C e-commerce.

An interesting application of Peer to Peer computing is SETI@home, which uses the CPUs of idle or under-loaded computers to run applications that analyze radio-telescope data.

Intellectual Property Rights and Electronic Commerce

The advent of internet which allows easy distribution and copying all types of information, text, audio and video has alarmed publishers of books, music and films. A landmark case was the Napster case (see *Box 3*), which has gone in favour of the music industry. The copyright issue has also plagued the spread of digital library movement. The major problem with content available in digital form is the ease with which they can be copied. Digital information can flow across national boundaries freely at electronic speed and is practically impossible to monitor and control. Many content providers encrypt material they store in the web to prevent easy access and copying. Such encryption impedes free flow of information and the 'fair use doctrine', which governs the existing copyright laws for print media, tapes and CD. Users have thus been trying to find methods of decrypting encrypted material. In a new landmark law enacted by United States Congress in October 1998, called the Digital Millenium Copyright Act, it has been made illegal to circumvent access controls used by copyright owners to protect their work and even to develop technologies, which may be used



Box 3. The Napster Story

The idea of sharing music files using the internet was in the minds of many people but it was technically difficult in mid 1999. Shawn Fanning, who was a second year student at Northeastern University in Boston, was convinced that there should be an easier way to do it and was consumed by the idea. He dropped out of college and worked alone with his lap top computer for 6 months and developed the music file sharing program and named it Napster which was his nickname in high school. He was barely 19 at that time. Fanning's program ranks among the greatest internet applications ever. Napster's site is the fastest growing in history crossing 25 million users within its first year of operation. Industry programmers opine that Fanning's program could not have been written by any one older than 21 or by a team of programmers! It was an individual effort and Fanning did not understand the legal implications and nobody told him it could not or should not be done! The recording industry filed a case against Napster for copyright violation. Even though Napster does not store music files and distribute them it facilitates others to infringe copyright. The recording industry was alarmed because of the enormous popularity of Napster with a user base of tens of millions of persons. Napster's argument was that what they did was perfectly legal as it does not store music files and distribute them. It only provides a directory of available music files to its users. Actual copying is done by individuals for which Napster is not liable. In March 2001, Napster lost its case and has been asked to remove all copyrighted music from its directory. The judge maintained that Napster was an accessory to music piracy and was thus indirectly responsible for violation of copyright laws in USA.

to circumvent protection. There is raging debate on this issue as it seems to prevent 'fair-use' which is the basis of agreements arrived at in the World Intellectual Property Treaty [3,4]. The copyright issues get highly complicated when it comes to computer software. The issues are not yet fully resolved and it is still being argued by lawyers and ethicists [5].

Information Technology Act 2000

Our Parliament passed the Information Technology Act, 2000, which provides the legal infrastructure for e-commerce in India. It received President's assent and is now a law. The object of the Act has been stated as:

"To provide legal recognition for transactions carried out by means of EDI and other means of electronic communication commonly referred to as e-commerce which involves the use of alternatives to paper based methods of communication and storage of information, to facilitate electronic filing of docu-



ments with the Government agencies and further to amend the Indian Penal Code, the Indian Evidence Act, 1891, the Banker's Book Evidence Act, 1891 and the Reserve Bank of India Act, 1934 and for matters connected therewith or incidental thereto" [6].

This act is a landmark act, which now gives legal status to e-mail correspondence and soft-copies of documents. The major interesting aspects of the act are:

1. E-mail correspondence has legal status and thus can be used in evidence. Digitally signed documents are now recognised.
2. A controller of public key certifying authorities has been appointed by the Government. This office will recognize certifying authorities, who will have the authority to issue public key certificates and verify digital signatures.
3. All applications to Government bodies can be filed in electronic form. Government can issue licences, permits, sanctions, approvals, etc., on-line, in electronic form.
4. Many archival documents of companies and government departments, required by law to be kept for a specified period, can now be stored in CD-ROM, or tapes saving precious space and enabling easy retrieval. Care must be taken that such electronically stored documents keep details, which will identify the origin of the document, date and time of despatch or receipt.
5. The IT Act provides statutory remedy to companies whose networks are illegally accessed and stored information is stolen or damaged. Monetary claims upto Rs.1 crore can be made against intruders.
6. The Act provides punishment to a hacker who:
 - (i) Downloads, copies or extracts data from a database without permission of the owner
 - (ii) Introduces any soft-contaminant or computer virus into any computer or computer network
 - (iii) Damages programs or data residing in a computer or network or illegally copies them

The Information technology act is a landmark act, which now gives legal status to e-mail correspondence and soft-copies of documents.



Suggested Reading

- [1] U Varshney, R J Vetter and R Kalakota, *Mobile Commerce: A New Frontier*, *IEEE Computer*, Vol.33, No.10, pp.32-38, October 2000.
- [2] D Clerk, *Face-to-Face with Peer to Peer Networks*, *IEEE Computer*, Vol.34, No.1, pp.18-21, January 2001.
- [3] P Samuelson, *Why the Anti-circumvention Regulation Need Revision*, *Commn. ACM*, Vol.42, No.9, pp.17-21, Sept.1999.
- [4] L D Paulson, *Copyright Ruling Generates Concern*, *IEEE Computer*, Vol.34, No.1, p.30, January 2001.
- [5] D G Johnson, *Computer Ethics*, Pearson Education, Asia, Delhi, 2001.
- [6] P Duggal, *Cyberlaw in India - An Analysis*, Saakshar Publications, New Delhi, 2000.
- [7] R Kalakota and A B Whinston, *Frontiers of Electronic Commerce*, (International Edition), Addison Wesley Longman, Reading, MA, USA, 1999.
- [8] D Minoli and E Minoli, *Web Commerce Technology Handbook*, Tata McGraw Hill, New Delhi, 1999.

- (iv) Disrupts a computer or network
- (v) Denies access to a computer or a network by authorised persons
- (vi) Charges the services availed of by a person to another person by tampering or manipulating accounts in a computer or network.

Hacking has now been classified as a crime under the Indian Penal Code. Punishment for hacking is imprisonment of upto 3 years or fine up to Rs. 2 lakhs or both. Teenagers who hack 'for fun' should realise that they will have fun in jail up to 3 years!

Even though the IT Act has a number of laudatory features it still has some flaws [6]:

- (i) It is not clear how cyber crimes affecting computers in India committed from outside India using the internet will be handled.
- (ii) It is not clear how many of the provisions in the Act will be enforceable.
- (iii) The IT Act does not apply to a number of important legal documents such as a power of attorney, a will, any contract for the sale of immovable property and a negotiable instrument.
- (iv) The Act does not have any provision regarding domain names and resolving disputes on such names.
- (v) It does not deal with intellectual property rights, trade marks and patents.
- (vi) Many cyber crimes are not defined in the act such as cyber defamation, cyber harassment and cyber stalking.
- (vii) Statutory bodies may at their discretion not accept electronic documents. In other words a person cannot insist that he/she will submit only an electronic document.

Besides the above, there are some aspects of privacy and individual freedom, which these laws dilute by giving enormous power to the executive. For instance, it allows any agency of the



government to intercept any information transmitted through any computer resource if the same is necessary in the interest of the sovereignty or integrity of India, the security of the state, friendly relations with foreign governments, maintaining public order or for preventing incitement to commit a cognizable offence. Another draconian provision is the powers given to police officers not below the rank of a Deputy Superintendent of Police to enter any public place and search and arrest without warrant any person found therein who is reasonably suspected of having committed or of committing or of being about to commit any offence under the IT Act. This provision is supposed to prevent software piracy and hacking but has enormous scope for harassment.

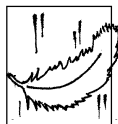
It is heartening to note that India is one of the few countries in the world, which now has an IT law in place even though it is not 'perfect'. It is expected to boost e-commerce in the country.

Conclusions

In this series we have tried to give a broad overview of the emerging technology of e-commerce. It is not comprehensive. The purpose is to arouse the curiosity of our young readers to find out for themselves more about each of the topics using the Suggested Reading list [7, 8]. Most of the so called e-commerce courses advertised by private teaching industry seem to imply that e-commerce is only concerned with designing web pages. It has hardly any academic content; it is transient as new tools to design web pages appear frequently. The attempt in this series has been to emphasise basic ideas rather than cataloguing tools and techniques.

It is heartening to note that India is one of the few countries in the world, which now has an IT law in place.

Address for Correspondence
V Rajaraman
IBM Professor of Information
Technology
JNCASR
Bangalore 560 064, India.
Email:rajaram@serc.iisc.ernet.in



Measure what is measurable, and make measurable what is not so.

Quoted in I Gordonand and S Sorkin
The Armchair Science Reader(New York, 1959)

