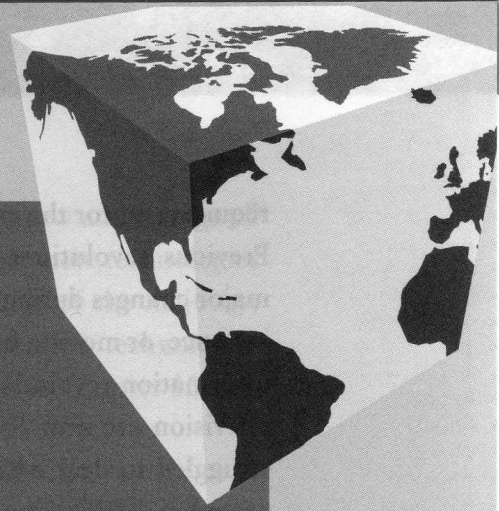


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EMERGENCE AND CONVERGENCE OF TECHNOLOGIES

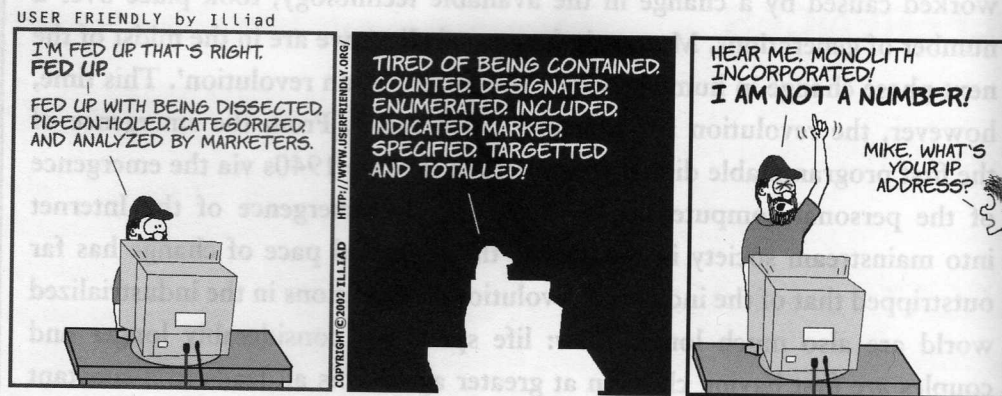
INTRODUCTION

The industrial revolution, which was a revolution in the way people lived and worked caused by a change in the available technology, took place over a number of generations. Many scholars now believe we are in the midst of the next phase change in human society: the 'information revolution'. This time, however, the revolution is happening much faster. From the emergence of the first programmable digital computers in the late 1940s via the emergence of the personal computer in the 1970s to the emergence of the Internet into mainstream society in the 1990s, the scale and pace of change has far outstripped that of the industrial revolution. Generations in the industrialized world are also much longer now: life spans are considerably longer and couples are first having children at greater ages. This all leads to a constant

requirement for the individual to cope with a great many changes during a lifetime. Previous revolutions required most individuals to cope with only one or two major changes during their lifetimes – moving from a rural to an urban lifestyle, for instance, or moving from hand-driven machinery to steam-driven machinery. In the information revolution, the people who lived through the change to multichannel television are now living through the change to on-demand services. Those who struggled to deal with videocassette recorders are now dealing with digital video recorders, DVD players and recorders, and PC-based entertainment systems.

In this chapter, we present the emergence of some of the most important technologies and the societal and psychological changes they produced and then we concentrate on the growing convergence of established technologies into synergistic forms which radically alter those effects once more. We draw comparisons between the uptake of recent new technologies and the speed of uptake of previous technologies, and also the failure rates of new concepts and technologies.

Beginning with regular postal services and continuing with telegraph, telephone, e-mail, mobile phone, text message, chat room and instant messaging, the cost, time and difficulty of communicating with other people have all reduced. This has had an enormous effect on society, from the local to the national to the international. Some of these effects are obviously beneficial and others obviously detrimental, but in many cases they are both beneficial and detrimental, or different people make different judgements. However, the genie of data processing and



communication is not only out of the bottle, but continuing to grow and change all the time. The challenge is for people to take advantage of these new technologies rather than allowing small groups of people to take advantage of the majority. Many of the obviously negative effects of modern communication technologies such as spam, cold calling and online harassment are presented in Chapter 13.

EMERGENCE

The Rise of Print Media

The social changes produced by the mass production of copies of written work should not be underestimated. When books had to be laboriously copied by hand and each copy included new and different errors, controlling the dissemination of information within a society was much easier. Ideas were transmitted from person to person with the interpretation of each changing the idea so that eventually something completely different might emerge. Cheap and quick reproduction of texts, everything from full books, such as bibles, histories, political treatises and fiction, to individual flyers and posters allowed anyone with sufficient money to disseminate their ideas unfiltered by intermediate minds. The reader still makes their own interpretation of the writer's words, but there is no doubt as to what the text says whereas with oral accounts what is reported to have been said can always be disputed. Mass sales of printed matter required mass literacy. This brought the publishing business into social policy conflict with the employers of unskilled and semi-skilled labour: literate workers are far more likely to organize on a wide scale, be aware of concepts of trade, economics, the value of labour and other ideas dangerous to the profits of factory owners. This is, of course, a simple view but it sets the pattern for various social changes due to technology. Where a technology requires significant investment which can only be recouped by a social change that may be detrimental to other vested interests, there is a battle between entrenched and new interests. This battle may take many forms: economic

competition, lobbying for legal changes favourable to one side or another, or social attacks on the new technology as too dangerous or immoral.

Following the increase in literacy rates, other social changes were wrought by the rise of print media. Various groups which had exerted control over others had that control undermined by access to printed matter. One example of this was the control of the church over the populace. When bibles were hand-copied in Latin, at a time when most people did not read any language and did not understand Latin, the local priest occupied a unique position as the interpreter of the bible and therefore of the will of God. The availability of mass-produced bibles translated into local languages allowed ordinary members of the congregation to read the bible themselves and contest the interpretation of the priest. It is no wonder that the Catholic Church (unsuccessfully) resisted such moves. This demonstrates a theme which will occur in a number of other chapters, whereby control of which information people may access comprises a large part of controlling those people.

Another major change that derived from the growth in print media was the beginning of development of a globalized society. Cheap and easy printing allows for mass production of books, which allows for people in geographically distant places to achieve a similarity of experience which is otherwise unattainable. In addition, newspaper printing allows for the reporting of major events from distant places. This convergence of information has been heightened and expanded by other technological advances. The ability for many people to read the same reports of events none of them witnessed is the beginning of a move away from geographic isolation. Although writing itself was the first step in this direction, it was the rise of the printing press that brought this change to the mass of the population rather than to the privileged few.

The Rise of the Telegraph and the Telephone

The first significant method of near-instantaneous communication over great distances was the telegraph. This required expert operators to encode and decode the messages. While this is not necessarily a skill beyond most people, it made

economic sense to restrict access to the communication network to those skilled operators. Laying the wires required significant investment which needed to be recouped quickly. The overall cost of a network was therefore reduced if only skilled, and therefore fast and accurate, operators used the system. The telegraph had a number of features that distinguished it from other communication methods:

- Near-synchronicity: the telegraph was almost instantaneous over the long distance but then relied on local postal services or personal collection for the 'last mile' connection.
- Privacy: If one trusts the postal and telephone services then communication can be assumed to be private. However, at least two operators (more if the message is relayed) have to know the contents of a telegraph message for its transmission.

It is not surprising that the success of the telegraph was most marked in the United States. The combination of a low-density population clustered around existing lines of physical communication (the railroad) in a country where even the fastest previous method of communication (the Pony Express) took days provided the perfect opportunity for the telegraph to succeed. Compare this with the United Kingdom where postal services only took one or two days to go between the extreme ends of the country. Telegraph services were far less used since the benefits were proportionally lower. It should be noted that the telegraph is a digital form of communication: each letter is sent individually using a discrete coding system rather than relying on analogue variations. The main social effect of the telegraph in the United Kingdom was on commerce, rather than individual communications, although the ability to 'wire' money from person to person instantly did have a significant impact.

The telephone offers completely different benefits but also has some disadvantages – for decades, a person had to be at the physical location of a telephone in order to receive the communication, whether the intended recipient or not. Even with the advent of answering machines and now exchange- or switchboard-based voicemail services, the interactivity benefit of the telephone over the telegram or a letter are lost. People are, in general, quite poor at leaving messages on answering machines. The ability to concisely include all the necessary information without

hesitation, repetition, deviation or omission is something few people have. Part of this is due to the 'surprise' factor of getting a machine instead of the person. The main one, however, is that missing information can neither be prompted for nor noticed on re-reading. Only very recently have voicemail systems begun to allow replaying of messages before ringing off and, even without the 'surprise factor', people may keep omitting or garbling important elements of a complicated message.

When it first emerged, the telephone system was almost as labour-intensive as the telegraph, requiring operators at each exchange to make the appropriate connections. Automated electrical switching replaced a large number of low-paid exchange operators with a smaller number of higher-paid engineers. Until the development of cell-based mobile phone services, telephone technology barely changed, with the main social impact being the near ubiquity of telephones in homes and businesses and the reducing costs of calls and fixed-rate charges making telephone use more of a constant and less of a necessity-only method.

The biggest change in telephone usage, of course, was produced by cell-based mobile devices. Beginning with radio pagers which only had a single message (they would buzz or beep) that usually meant 'ring the office', numeric services then followed whereby a number to call could be sent to the device. Even with the prevalence of multi-tone push-button phones over older loop-disconnect dial services, these systems typically used human operators to take the number and, later, a short text message to send, with at times understandable but hilarious mistakes in transcription and at others cryptic errors rendering the message meaningless. The text messaging capabilities of pagers is an important concept to recall because it was this which inspired mobile phone operating companies towards an accidental 'killer application'. As mobile phone operators moved to the second generation of services, digital rather than analogue transmission, they initially included a short messaging service (SMS) as a free add-on. In Europe, this quickly became a more commonly used variant of the service than voice calls. Of course, the companies then swiftly moved to generate a revenue stream from such a popular service, but their pricing structure made each individual message cheap enough that it never seemed worth considering the cost.

Killer app: an application that many people want to use and which ensures the success of the hardware or software platform on which it is based; examples include the spreadsheet for personal computers and text messaging for mobile phones

Short Messaging Service (SMS): a short piece of text passed between digital mobile phones

Multimedia Messaging Service (MMS): pictures or short video sequences passed between 2.5G or 3G mobile phones

A whole new aspect of youth, particularly teenage, culture has grown up in Europe around the use of text messaging. This subculture has its own variants of written language. Because of the very limited number of characters it was originally possible to send in individual messages and because of the inefficient nature of entering text on a numeric keypad, a whole vocabulary of abbreviations for use in text messaging has grown up, further reinforcing the feeling of involvement in a separate cultural zone from ordinary life. Various scare stories about potential health risks from prolonged and regular use of mobile phones have circulated but none have so far been clearly demonstrated. However, one recent study (bmj.bmjournals.com/cgi/content/full/bmj;327/7415/582-c) did show an alarming problem with teenagers' and children's use of mobile phones in that they often do not switch them off before going to sleep and a majority of young people reported regular disturbance of their sleep due to incoming calls or messages – most often messages.

Mobile phones (both voice calls and text messaging) have become an indispensable part of many people's lives, although they can often be a problem to others, when phones are left switched on (and with audible alarms) in places such as cinemas, theatres, classrooms and lecture halls. While more often an oversight than a deliberate act for most, still there are those who believe that they absolutely must be contactable at all times and that any inconvenience to others around them is someone else's problem. Whether inadvertent or deliberate, the distraction to others caused by a phone alert seems highly anti-social.

The Rise of Broadcast Media

The difference between printed media and broadcast media is similar to the difference between a letter and a telephone call. The comparison is not perfect, however, because radio and television broadcasts are not interactive between the listener or viewer and the presenters. In addition, although the presentation itself contains spoken (and, for television, visual) aspects much television and radio is presented according to a prepared script, even when not recorded and edited. There are also significant social differences in people's perceptions of material depending on the medium. One of the best known examples of this is the 1960 presidential election debates in the United States (see www.museum.tv/archives/etv/K/htmlK/kennedy-nixon/kennedy-nixon.htm for an in-depth analysis). For the first time, four debates between the two candidates were broadcast on television while the sound was broadcast simultaneously on radio. Polling data differed considerably between those who watched the debate compared to those who only listened to it. Those who watched were far more likely both to believe that Kennedy had performed better and to decide to vote for him, whereas those who listened found Nixon more compelling. In many ways, instant and widespread news reporting has changed the way politics works: it is now far more important to avoid being seen to make mistakes than it is to actually perform well overall. The insatiable appetite of the 24-hour news channels, in particular, means that any negative story is carried multiple times before any 'fix' can be produced.

Broadcast media were originally very heavily regulated in most countries. Part of the reason for this was purely technical: analogue transmission requires a broad band of 'clear space' around it to prevent cross-channel interference. Although radio transmission and reception has improved over the more than a century since its introduction, such advances have been very small incremental changes: the basic technology remains pretty much the same. Only very recently has broadcast digital radio become a reality and there has been a slow take up of both digital audio broadcast (DAB) reception equipment and broadcast provision. Even in the United Kingdom, where the BBC's unique position as a well-funded public service broadcaster often leads to early provision of new broadcast technology, more people

listen to digital radio channels via satellite television equipment or over the Internet than use dedicated DAB equipment. Part of the reason for this is the cost of DAB receivers; there was until recently very little available in the way of cheap low-end equipment. The main reason, however, is the durability of existing radio reception equipment, which lasts for many years since it is now a very mature technology.

Despite the capabilities of digital broadcasting to allow for almost unlimited numbers of stations in fairly small sections of bandwidth, many governments (usually through 'independent' agencies such as the Office of Communications (OFCOM) in the United Kingdom and the Federal Communications Commission (FCC) in the United States) are still heavily regulating broadcast technologies and artificially maintaining a scarcity of licenses by restricting the bandwidth available for such services. There are a growing number of people lobbying for a much more open approach to radio frequency bandwidth allocation but, as is common, a number of existing players are lobbying to maintain the current system in which they have privileged incumbent positions.

The Office of Communications (OFCOM): successor to OFTEL and the Broadcasting Standards Authority, with power to regulate the communications industries in the United Kingdom

The Federal Communications Commission (FCC): similar powers in the United States

The Failure of On Digital

The United Kingdom has seen the swiftest move to digital television of any major industrialized nation (news.bbc.co.uk/2/hi/entertainment/4816832.stm). Spurred on by the dual engines of the publicly-funded BBC (able to invest in new broadcast technologies without worrying about short term investor returns) and an early analogue satellite system which invested quickly in digital broadcasts as well, the UK government is planning to switch

off all analogue television transmissions by about 2010. The first pilot area had their analogue system turned off in March 2005. This was deemed a great success although the only reason it was possible was the provision of set-top boxes and technical support funded by the UK government.

The set-top boxes provided were those for 'Freeview', a BBC enterprise which provides only free-to-air channels. This uses the same technology (and is compatible with) the previous terrestrial digital system originally called 'On Digital' then rebadged to 'ITV Digital'. This offered a smaller scale version of the digital satellite and cable services already available to much (though not all) of the UK population. On Digital offered a combination of free-to-air services and subscription channels, together with subsidized reception equipment. Subscription channels included movies, sports and 'adult' content (late at night, usually channel sharing with more innocuous material, such as teleshopping, during daytime hours).

ITV Digital failed in April 2002 to be replaced by Freeview. The reasons for the failure have been covered in great detail by the press and have even been the subject of a statement in the UK Parliament by the culture secretary. Basically, ITV Digital signed an incredibly expensive deal with the Nationwide Football League to show live football matches from the lower divisions of English soccer. This contract assumed large revenues from subscriptions to the sports channels which would show these matches. The drop in other advertising revenues (following the dot com crash and subsequent global economic downturn) and the non-appearance of high subscription rates for these sports channels led to the contract being uneconomic for the parent companies of ITV Digital. If the parent companies had been liable for the cost, then ITV Digital would probably have survived. As it was, the parent companies managed to claim that the liability only applied to the subsidiary and they let it fail rather than pay out large sums for unprofitable rights.

Subsequently a very small subscription service was launched using the same technology as ITV Digital. The problem is that the decryption

equipment needed to ensure that only those who pay for it can receive the subscription channels is expensive to include in the set-top box (this was one of ITV Digital's major costs). The new Freeview boxes do not generally include such equipment, simply that needed for free-to-air subscriptions. Only those who buy new (more expensive) decryption-enabled set-top boxes or those who own ITV Digital boxes can use top-up-TV services. This lack of scale of potential audience is hampering their competition with cable and satellite reception options (which also have the opportunity to amortize fixed costs over a much larger number of channels).

The failure of ITV Digital should not be seen as an example of a badly thought out technology or even of a market that was not there; it was simply the result of a single highly risky decision: to pay relatively huge amounts of money for second-rate sport on the assumption that it would be as lucrative a market as the top flight – in other words, plain old bad management. Further information can be found at news.bbc.co.uk/1/hi/1897316.stm.

The Rise of the Computing Industry

There is a famous (though possibly spurious) comment attributed to Thomas J. Watson, the founder and chairman of IBM: 'I think there is a world market for about five computers'. Of course the meaning of this statement depends on what you mean by a 'computer'. If it is defined as any digital electronic device capable of performing automatic computation then there are now more computers in the world than people (consider that most people in the industrialized world own more than 20).

At the time, computers were envisaged as machines for tabulating large amounts of statistical information or a small number of other specialized tasks such as cryptography. In fact, the demand even for these purposes quickly outstripped this supposed blunder. Pharmaceutical companies employed computers to calculate

efficient chemical supply logistics, for instance. The first big killer application of computing in business was one which was reinvented for the home Internet boom: airline ticket sales. Before this industry was computerized it took days to book an airline ticket. With computerized seat booking systems, it became possible for travel agents to get a confirmation number over the phone and issue a ticket for a customer within half an hour. In many ways, this was the first true e-commerce system and it set the pattern for a move to computerization of business information, particularly business information where multiple people needed read access to some or all of it at the same time or where multiple people needed instant feedback on an ability to change information (seat availability for instance). When business computing started out, it comprised a 'priesthood' of staff who ran the programs, submitted on punched cards, through the mainframe computer. The minicomputer industry moved things on such that interactive computing could be developed, with multiple terminals timesharing access to the power of a single machine. The wheel turned again in the late 1970s with the introduction of the personal computer and the emergence of the first home computers. This gave individuals the full power of a machine at their own disposal, with removable data storage for transfer between machines. It was the introduction of the personal computer that led to the modern office with a PC on almost every desk.

The social impact of computers was felt first in the job market. Those with a talent for programming, or even just operating the complex machinery of the early computers, were few and far between. As computers have become ubiquitous, most people in white-collar employment have been more or less forced to develop at least basic computer skills. This has also led to a huge new industry in personal and business computer training. Good programmers are also still in demand, which will be music to the ears of most computer science students, no doubt. However, the difficulties of modern computing are often more about identifying the problem to which computer power can be applied, than in getting the computer to perform an understood task. Without the computer revolution, various other social changes would not, of course, have been possible.

The Rise of the Content Industry

Since the Stationer's Guild was granted a monopoly on the printing of books in the United Kingdom (see Chapter 12), there has been a significant commercial sector whose primary purpose is to act as the middle man between the producers and consumers of information. There have been many revolutions in the content industry. Sometimes companies use their existing market strength to move into new markets and sometimes they miss the boat and are superseded. It is interesting to consider the differences in producer and consumer relationships to different forms of content, particularly since there is a growing convergence in both content itself and the companies providing different forms of content.

The social effects of various technologies are often as much to do with the amount, variety and accessibility of various forms of content. While telegram, telephone and e-mail systems all allow many-to-many communications, the content industries rely on the interest of a large number of people in communication from a small number of people. The requirements of one-to-many distribution systems are very different from those of many-to-many systems, although the Internet is providing convergence on some of these aspects.

Consider the production of books. The effort it takes to produce a book written out in long hand with few mistakes in grammar, punctuation and flow of information is immense. To distribute that book to a large number of people each one has to be hand copied, which introduces further mistakes. It is far easier to have a typeset edition which is copy-edited and proofread by people other than the author and significant errors corrected (it is easier to spot the logical, spelling and grammatical errors in someone else's writing than in one's own – when reading one's own, work one reads what was meant rather than what was written, whereas another reader does not have the memory of the intended text). Films require even more people with different skills to produce a finished product which many people will wish to see: story writers, script writers, directors, editors, actors, developers, special effects producers, and so on. In order to supply the demand of

the general public for information and entertainment at an affordable level, various compromises are made, sometimes enforced by law and sometimes necessitated by market forces. Copyright is one of those compromises (see Chapter 12 for a much deeper discussion of this issue); another is the acceptance of advertising during television programmes.

Advertising is a particularly interesting aspect of content industries. There are two basic methods of funding television broadcasts: subscriptions and advertising revenue. It should be noted that the television licence fee in the United Kingdom is simply an enforced variant of a subscription system. Advertising was the dominant form of payment for about 50 years, to the extent that the placement of advertising slots even dictates the story format for television shows. One of the distinct differences between made-for-television movies and made-for-cinema movies is the obedience to advertising slots by providing mini-climaxes or cliffhangers to keep the viewer watching the programme through the advert break.

A perennial debate amongst arts critics is the translation of stories between media. Is it really possible to produce a good movie from a novel or to produce a good computer game based on a movie? These days, brand recognition among a wide population is the starting point for many projects, leading to some convoluted genealogies: from Spider-Man comics to the Spider-Man cartoon television show, Spider-Man novels, Spider-Man radio plays, Spider-Man movies, Spider-Man computer games and back to novel and comic-book adaptations of the movies. The outcome of this cycle sometimes becomes heavily ironic. There have been many interpretations of Bram Stoker's classic vampire novel *Dracula* in a variety of formats including film, television, radio and even re-interpretations in written form, such as Fred Saberhagen's Book *The Dracula Tape*. When Francis Ford Coppola titled his version *Bram Stoker's Dracula*, despite being a radical re-interpretation (from such a title one might be expecting a more faithful version), it becomes highly ironic that Fred Saberhagen and James V. Hart were commissioned to produce a novelization of the film. So, when searching for 'Dracula' and 'Bram Stoker' in book catalogues, there is *Dracula* by Bram Stoker and *Bram Stoker's Dracula* by Saberhagen and Hart.

The Rise of the Internet

Although it has been in existence for over 30 years now, the Internet only really emerged into the consciousness of the general public in the late 1990s, primarily due to the development of the Web, which allowed inexperienced users to access readable and nicely formatted documents through a simple and intuitive interface. While there had been commercial Internet (and other online) service providers around before that, it was the Web which paved the way for ordinary companies to make significant use of the Internet for communication with their customers. Until the advent of the Web, Internet information provision by companies for customers was usually limited to software companies providing updates. Once the Web came on the scene, however, a feeding frenzy gathered pace, with everyone scrambling to 'be online', to do e-everything. The normal rules and expectations of business plans, identified revenue streams, accountability and sustainability were abandoned. Some businesses survived, often more by luck than judgement, but most were gone as soon as the tolerance of the venture capitalists and banks dried up. The results of the dot com bubble and the aftermath of its bursting included instability in stock markets, ridiculous swings in the technology job market and an overcautious attitude even to well-planned sensible ideas for online business. The upside of this was that there were some less obvious successes and failures of what looked like sure things, all dealt with in a very compressed time frame. Even now, sexual material aside, web sites which make money purely by charging for access to information are relatively few in number. What has succeeded best is access to traditional goods or services which are individually identical and mass-produced, which can easily be delivered or required delivery anyway. In general, things which require individual fitting have been less successful in online sales.

The most successful dot com company to date is Amazon. Starting out as a US online book seller, it has been franchised out to various other countries, including `amazon.co.uk` in the United Kingdom, `amazon.de` in Germany and `amazon.co.jp` in Japan, and has branched out into providing various other types of goods, with a different mix for each country. The first move was into music and movies, a fairly

obvious expansion as there are distinct parallels with books: the homogeneity of stock, the small size allowing for ordinary postal delivery, the existing advertising by the publisher for the individual items. It would be easy to think that Amazon is simply an online storefront operating in exactly the same way as an ordinary store, but this is not the case. There are substantial differences. When a customer comes to Amazon's site, if they identify themselves then they may be provided with a personalized 'store' – impossible to do for everyone in a physical shop. In a real location the advertising displays are the same for everyone whereas in Amazon's virtual location there can be as many displays as there are books in the store. One significant way in which the personalization of the online store can be produced is to compare an individual customer's prior purchases, and even searches and browsing, with other customers' activities, and with both publisher and user categorizations of items. Physical stores have long tried to identify appropriate items to display next to each other. Ideally, suitable potential 'impulse buys' are displayed next to probable 'deliberate purchases'. This is done with great success using relatively naive algorithms that mine the activity of Amazon customers. Their highly successful recommendation system even admits feedback from individual customers: as well as not recommending for further purchase books they have already bought from Amazon, the recommendations list allows users to differentiate between items that they are not interested in purchasing either because they are not interested in that book at all or because they already own a copy.

While Amazon has arguably been the most successful online-only business, and online book sales in general are quite successful, another general area which has seen a significant shift to online purchasing is the travel business, particularly airline tickets. In an interesting parallel to the early days of business computer usage, individual purchase of airline tickets was one of the early adopters of Internet selling and has been instrumental in some major changes in the industry as a result. So-called 'bucket shops' or aggregators have been around in the travel industry for quite some time, but the necessity for shop premises, or huge advertising budgets to run a mail order business kept their number limited. Seat pricing on air tickets is an incredibly complex business and it has been suggested that seat availability changes so quickly that it is impossible to ensure that the

absolutely best price for a particular trip is being found because by the time it is identified and a decision made to purchase it, one or more aspects of the price may have gone up or down. The introduction of the Web was an incredible opportunity for seat consolidation agents to bring their product to a much larger market. Sending airline tickets through the post generally costs next to nothing compared to the other transaction costs and so is lost in the financial 'noise' of the business; the recent introduction of e-tickets (boarding cards are provided on production of suitable ID and a reference number matching the booking), allow purchasing of flights to be completed wholly online.

The package holiday market is a related industry that is making great use of new technology developments, combining television presentations on cheap satellite and cable broadcasting and even booking via interactive digital television, together with Web-based booking services. Since the purchase of a holiday is done entirely remotely anyway, the advantages for many of doing their own price (and other aspect) comparisons online often outweigh the cost of commission at a high street travel agents. Finally, the explosion of no-frills, low-cost airlines in the last few years depends heavily on direct booking over the Internet. One of the main reasons such airlines can offer ridiculously low prices for travel is the lower cost of selling tickets provided by direct booking only (no agents' or sellers' fees and no contracts preventing airlines from undercutting their resellers) and the ability to advertise constantly changing prices. These airlines are effectively offering a strange type of auction for a limited resource which disappears for the seller if not sold.

e-ticket: an airline ticket which is not physically held by the passenger but is held in the airline's computer system and accessed by showing suitable ID

This brings us on to our final area of study for the rise of the commercial Internet, which is online auctions. One of the potential strengths of the Internet over previous forms of communication technology is its many-to-many nature: telegraph and telephone are one-to-one communication media; print and broadcast media are essentially one to many; the Internet raises this to a many-to-many model, which

can radically alter the economies associated with it. This is nowhere better illustrated than by eBay, the most successful of the online auction sites. Online auctions, where ordinary individuals offer the goods for sale as well as buying them, make use of the fact that, while the move from one-to-one communication to one-to-many communication provides an economic efficiency level that has essentially linear growth with respect to the number of people using it, a many-to-many system enjoys efficiency levels dependent on the square of the number of people using it. So, four people using a one-to-many system is twice as efficient as two people using it. But four people using a many-to-many system can produce efficiency gains of up to eight times as much as two. There is a great deal of economic theory about the way auctions run. There are a great deal of variables: how rare an item is, how many people are interested in buying it, what value they place on it and so on.

The obvious benefit of online auction systems for individuals and small businesses is that they provide an infrastructure for bidding and paying, as one might expect, but the biggest thing they provide is a system of trust. By providing a feedback mechanism for both buyers and sellers, eBay provides a mechanism for trusting other sellers without paying for expensive escrow payment and delivery systems (i.e. the cash-on-delivery service offered by parcel carriers, such as UPS). Such escrow systems tend to have a minimum fee which militates against their usage for low-value items: the financial benefit to both seller and purchaser would be lost in the escrow fees. While it is possible to abuse the eBay reputation system by building up a good reputation and then committing fraud, this is still usually an illegal act and will generate police investigation if done on a sufficient scale. eBay's control mechanisms, dependent on identification via physical address, bank and credit card accounts, are sufficient to prevent all but the most dedicated serial fraudster, and such people have more lucrative options available such as advance fee fraud. The fact that the majority of people are naturally quite honest, particularly when there's a visible (though not necessarily enforced) honour system in place, is demonstrated by the success of eBay and other online auction systems. eBay has not only created a market based on the 'one man's junk is another man's treasure' principle but it has also allowed for the sale of virtual items from online computer games (see Chapter 3), thus creating completely new markets. A substantial number

of people have entered the trading market, particularly in specialist goods, through eBay and other online auction sites, many of them now entirely self-employed at such work. The online auction house has removed entry barriers for such trading and in fact the lower overheads of small traders can now compete with the economies of scale of large traders, leading to a more efficient market.

CONVERGENCE

In economics and business studies, analysts talk of two forms of integration: horizontal integration, which reduces the number of players in a marketplace or merges two related marketplaces, and vertical integration, which reduces the number of steps in the chain from raw material to eventual consumer. In this section on the convergence of commercial entities involved in new technologies, we present issues involving both types of integration, sometimes at the same time.

Content Producers and Distributors

One simple way to avoid transaction costs is to merge with a supplier. This is particularly effective where the supplying and consuming businesses deal solely or primarily with each other and do not 'play the field'. There may be other reasons, such as quality control, for consumers to wish to merge with suppliers. The biggest internal problems such mergers produce tend to be management difficulties in combining businesses which had completely different goals up to that point. In particular, companies which excel in business-to-business supply of material may find it difficult to cope with contact from individual consumers. Similarly the consumer-facing organization may not appreciate the difficulties faced by the supplying organization. This often leads to a 'local optimization' problem where existing structures (particularly the two formerly separate organizations) still try to maximize their separate benefits instead of global optimization for the company.

In the television business, there have been cycles of joint and separate production and distribution, differing between countries. *International sales of television*

programmes have also added to the confusing mix. As television technology advances towards more channels, often more specialized in their content, and Internet connections become faster, video on demand becomes a more and more compelling idea for the future of television. In expectation of this, content production and distribution companies have been jockeying for position. The biggest merger of this kind, and one of the largest corporate mergers ever to take place, was the AOL and Time Warner merger in 2001 (see 'The Biggest Media Merger in History' feature).

Government regulators are particularly concerned about such mergers because of the dangers of monopoly activity in production and distribution acting against the interest of the public which wants high-quality material sold at the lowest possible price. Vertical integration between large producers and distributors may give rise to market abuse and potential monopoly abuses. In other fields, some producers may be trying to bypass distribution companies, in whole or in part, by offering their products directly to the public through online sites. While this may seem an attractive option, it does have some difficulties: distributors tend to be unhappy at being undercut, or even competed with, by producers and may threaten to withdraw their custom, which can undermine the viability of the company in the short term; customers may expect lower prices when buying direct from the producer, particularly where retail prices have been justified in terms of distribution costs, such as in the music-publishing business.

The Biggest Media Merger in History

In January 2001, the largest US online service provider AOL bought media giant Time Warner in one of the largest mergers ever seen, paying over \$103 billion (see 'AOL, Time Warner Merger Announced' at www.pbs.org/newshour/bb/business/aol_time_index.html). Poised at the beginning of the home broadband Internet boom, the merger of a content-production and old-media distribution company (Time Warner) with the new breed of virtual distribution company (AOL) seemed a match made in

heaven. Two years later, the stock price of the new AOL Time Warner company had fallen by 90% and eventually, in late 2003, the company dropped AOL from its top-level name and reverted to Time Warner, although retaining the AOL subsidiary.

Was the move ill-fated from the start, was it ill-timed or did poor management doom a potentially revolutionary move in the media market? The collapse of the dot com bubble months before the actual merger should have rung alarm bells in the boardrooms of both companies. Founded upon a belief that new distribution methods for old and new content were on the horizon, the merger proved an expensive flop and dragged the new company's stock price well below even the spectacular falls in the high-technology stock market. There are startling similarities in the exuberant expectations of those involved in AOL Time Warner and those of the dot com bubble itself: unrealistic expectations of the ability of an economic market to change overnight. After four years of dismal results and heavy debt, the signs of the real digital delivery revolution in entertainment are just beginning to emerge: digital downloads of music have just begun to outstrip physical CD sales; Sony have announced a plan to make 500 of their back catalogue of movies available in digital download form and broadband access from home is finally reaching a significant minority of European homes at a price they can afford and are willing to pay. So, AOL Time Warner may have been on the right track but their expectations overestimated the capacity of the market to change.

Platform Producers and Content Producers or Publishers

The home video game console market is highly unusual in its structure. The dominant platform is currently the Sony PlayStation, despite only entering what was already a mature and very competitive market in 1994 (in Japan, 1995 in the United

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States and Europe). Key to success in this market (which is analyzed in more detail in Chapter 3) is the games, since it is the games that both provide the revenue stream (the consoles themselves are subsidized by the manufacturer) and create demand for a particular console because of the games available only on that platform. However, games production is very costly and quite a risky business – as risky as making movies. Console manufacturers therefore allow, indeed encourage, third-party publishers and developers to create games for their consoles although, in order to maintain the revenue stream from games, they require publishers to submit their games through quality assurance tests run by the manufacturer and to pay a licensing fee in order to get appropriate encryption codes which allow their games to be loaded onto the consoles. There are some remaining tensions, however, since the manufacturers are also developers and publishers of their own games and there are consistent rumours of the quality-control process, in particular, being used to gain an advantage in the games market, particularly where similar games are due to be released by both the manufacturer and a third-party developer around the same time.

There have been (sometimes successful) attempts in other markets to use similar business models. The problem with such models is that they tend to be fragile: a shift in the available technology or a new competitor can swiftly completely undermine market position and leave a company in very poor financial shape. An example is in the photographic-film market. While Fuji and Kodak dominated the market for ordinary film for decades by competing on price and quality against other manufacturers, Polaroid retained a strong position in the instant-camera market. Unfortunately for Polaroid, the rapid rise of digital cameras with display screens undercut their business model which was based on providing very-high-profit-margin, instant-developing film, protected by a number of patents.

Another example is in the computer printer market where some strange interpretations of the Digital Millennium Copyright Act (DMCA) have been presented in court in attempts to prevent third-party suppliers refilling, or creating alternative, cartridges for printers (www.theregister.co.uk/2003/01/10/lexmark_unleashes_dmca_on_toner/). The legal arguments have claimed that the chips in their printer cartridges that talk to the drivers via an encrypted communication protocol are a 'technological protection measure', bypassing of which is illegal under the DMCA.

In Europe, such arguments have been rejected at least partly due to environmental concerns regarding the huge amount of landfill material being produced by printer cartridges, typically produced in non-recyclable plastics.

Corporate Production vs Individual Creativity

The early days of many technologies are very often a time of great opportunity. Those who come into the market with the right ideas can become major players very quickly. This was true in the music publishing industry, where some of today's biggest players can be traced back to player-piano-roll makers. It was also true in the movie-making industry where MGM, Paramount and United Artists are still well known names, although now part of larger conglomerates. All of these generally still required fairly large investments of capital at the beginning in order to succeed. An interesting area which did not require such capitalization was the computer-games industry. As recounted in Steven Levy's *Hackers*, the early computer game market was full of people who had developed a business in their spare time and some of those companies are still big names in the market (Ultima started as a text-only adventure game and is now one of the best known massively multiplayer online role-playing games (MMORPGs)). Individuals in both the United Kingdom and United States continued to make big splashes on various home computer platforms throughout the 1980s and into the 1990s with such major hits as *Manic Miner* (for the Sinclair Spectrum) and *Lemmings* (for various home computer platforms) and even *Tomb Raider*. In the modern mature games market, however, breaking in with a major title is almost impossible. Part of the reason for this is the demands of gamers: they expect top quality in all aspects of the games, from story to interaction to graphics (both artistically and technically). In addition, the marketing of computer games is now on a similar scale to that of movies. In fact, the computer games industry now grosses more than cinema takings, although associated revenues for movies including tie-in game rights maintain a market lead for the movie industry overall. New delivery mechanisms such as downloading games rather than buying them from a store, would seem unlikely to break the hold of the big games publishers. However, other games sectors than the console and

home computer are showing signs of small scale development re-emerging. Games for mobile phones currently enjoy a similar level of graphics to the early consoles and computers, as do set-top boxes for digital cable and satellite television. In fact, many early console or home computer games are being re-released in these new formats, bringing old names, such as Atari, back into circulation and providing a resurgence of individual creativity in game production. Since handheld technology is becoming more and more powerful, and we are seeing convergence between television, home computer and other entertainment systems, this is likely to be a short-lived resurgence. However, the new distribution channels may lead to an advantage for smaller development-oriented firms providing new content for existing software platforms, such as 3-D game engines like Quake, Doom and Tomb Raider. A new business model similar to the console hardware–software market might even develop based on an engine–content split. Some small-scale versions of this already exist, with editors for various games being released in ‘update’ game packs allowing fans of a game to release their own extra levels.

Massively multiplayer online role-playing game (MMORPG): an online game in which a large number of players interact with one another in a virtual world

Market Sector Integration

As their existing markets mature, companies frequently seek to expand their profits by moving into other areas. Usually they concentrate on related fields. A prime example of this in the technology arena is Microsoft’s recent move into the video game console market with the Xbox. Following Sony’s lead of the mid-1990s, coming from nowhere to market leader within a few years, Microsoft have sunk hundreds of millions of dollars into their new venture. On occasion, the very success of their marketing has threatened the venture, with higher demand than anticipated for the consoles (which lose money in the short term) at times driving that division

of the company back to the central coffers for further funding. As the installed base of the console matures, Microsoft will expect to begin to see a return on their investment. However, the high basic cost of the Xbox hardware combined with the fact that Microsoft did not own the manufacturing facilities (unlike Sony who were already a major player in the general consumer electronics market) has led Xbox to be far less profitable than PlayStation for an equivalent installed base. The timing of the launch was not ideal, either, coming during a worldwide downturn in the economy which leads to a lower spend on luxury items, such as games consoles and games for them. Xbox has not made an operating profit for the parent company, even at the point where the successor platform (Xbox 360) was launched to keep up with Sony and their PlayStation 3 release. Microsoft, one of the world's biggest companies, has also dipped its toes into a number of other spheres, some more obvious than others: these include the mobile-phone-cum-PDA world, where they are competing with Symbian (the offspring of Psion), Palm and various companies pushing Linux-based machines. Since this is basically a market for small-machine operating systems, this is a fairly obvious move. Slightly less obvious is an attempt to move into the home entertainment electronics market, until one realizes that what Microsoft are trying to do is put a standard PC, running Microsoft software of course, at the heart of an integrated TV-DVD-audio entertainment system.

Many of the large manufacturing concerns of the Far East are already conglomerates in a variety of both technology and large-scale manufacturing or engineering markets. So, whereas Hyundai may be best known for cars in the West, in their home country of Korea they are known for everything from shipbuilding to machine tools, dominating the Korean manufacturing economy. This is due to the rapid development of an industrial base in such countries where there were no existing major local competitors for business and thus the largest corporations could easily move into other markets, but could frequently successfully export in only some of their areas of production. In some cases, it can be more difficult for a large organization rooted in one field to move into a new field than for an entirely new enterprise to enter that same market. This is due to organizational inertia and mistaken expectations within the original company. A new organization does not bring such baggage along.

Of course, there are also companies, or more commonly group brands, which specialize in moving into well-established markets and breaking the mould. The British entrepreneur Richard Branson, with his Virgin brand name, is one such example. This approach is typified by identifying a market in which the existing companies all operate in a cosy low-competition field and where few are willing to take risks. Consider the Virgin Mobile brand for instance. At a time when the major UK mobile phone operators were saddled with huge debts from 'buying' spectrum-broadcasting rights for 3G services from the UK government, Virgin bought up 'spare' bandwidth at wholesale prices from another operator and sold this on to customers at a very competitive rate. Their flamboyant advertising and cut-to-the-bone pricing has made them a significant player in the UK mobile phone market even without their own network of masts. The Virgin Mobile brand was later sold to the dominant cable television provider NTL along with the right to use the Virgin brand in Internet, cable television and landline and mobile phone services. This 'quadruple play' service provision is fast becoming a necessity for providers in the United Kingdom. Satellite television company British Sky Broadcasting bought a small ISP to add an Internet service to its existing telephone and television services, while links with Vodaphone may provide both the fourth element and a 'TV to mobile' service. Elsewhere, 'content' providers, such as Google and Earthlink, are also emerging into the access provision field with their municipal WiFi contract with the city of San Francisco, CA, United States (news.bbc.co.uk/1/hi/technology/4896104.stm).

Third-Generation Phones, First-Order Mistake?

When the so-called third generation (3G) of mobile phone services were defined, it was clear that the radio spectrum bandwidth used by existing digital, mobile-telephony services could not be reused and so new regions of spectrum would be needed. In what was regarded as something of a stroke of taxation genius at the time, a number of governments set up an auction

for licenses to the new spectrum. In some countries, such as the United Kingdom, Germany and Canada, the existing lucrative digital mobile-telephony market, combined with the late effects of the dot com bubble led to highly inflated bids, on the order of hundreds of millions of dollars (significant revenue even for a G8 nation). The perceived problem of being 'left out' or 'left behind' led to a bubble of investment in spectrum allocation. In economic and business terms, an auction should have been the correct method of determining the economic value of the licenses to use spectrum for 3G. Unfortunately, conducting an auction during an economic bubble is a recipe for an economically inefficient outcome. In a highly competitive market, this would not have caused significant problems but certain elements of the mobile phone market mean that it led to significant negative effects.

The worst aspect of it is the investment in infrastructure which was required for the development of widespread 3G access. When combined with the up-front nature of licensing fees, due well ahead of the associated revenue stream, the auction significantly delayed the rollout of 3G services. Having paid large amounts of money for the licenses, no telecommunications company with one of the new licenses had the immediate financial resources to make the appropriate level of investment, nor any incentive to sublicense the investment to competitors – there were, anyway, very few competitors who did not have a license (and the associated cashflow problems). As 3G phones have finally rolled out in the United Kingdom, these effects may have run their course but the overall economic competitiveness of the UK technology industries may have been crippled for a significant period of time (for instance, BT scaled down its global ambitions largely because of the debts incurred by the 3G license auction then mostly withdrew from the mobile phone market by selling off its mobile arm as O2: news.bbc.co.uk/1/hi/business/1323096.stm).

Did the UK government put short-term revenue generation ahead of long-term economic success and general public benefit from an up-to-date

mobile telecommunications infrastructure and should lessons be learned for future similar situations, or was this simply another element of the dot com bubble which will recur in future bubbles but which the government could not (or should not try to) avoid? More information can be found at news.bbc.co.uk/1/hi/technology/2198401.stm.

If it is deemed too much of a risk to enter a mature market, one option is to buy an existing player in the market and it is in this fashion that multimedia content production and distribution empires have tended to grow. Whereas book, magazine, newspaper, radio and television all used to be run by specialized organizations focussing on one or two of these areas, we now have groups that include multiple areas, such as Vivendi Universal (which includes European television company Canal+, Universal Music and Movie Studio, Universal Games and French telecoms) and News Corporation (which includes Fox and Sky television and movies, newspapers and book publishing). In previous decades, many Western countries have had strong regulation covering ownership of multiple channels of information dissemination but this has recently been relaxed, though not without opposition from people concerned with the concentration of power allowed by ownership of multiple 'trusted' channels of information.

Digitization

Particularly in the content-publishing industries, but also in the consumer-electronic industries, there has been a rush to 'digitization' as though moving from analogue to digital concepts is always an improvement. However, ask any hi-fi music buff and they will tell you that the best amplifiers available are still analogue ones. The main reason for this is that sound produced in speakers and heard by our ears is an analogue signal. There are sometimes benefits to 'digital' technology over analogue technology but, as shown by the (digital) telegraph and the (analogue, now finally going digital) telephone there are waves and cycles between analogue and digital

methods of information transmission. In the last two decades of the twentieth century there were a number of high profile moves across to digital technology, replacing widespread analogue technology. Each of these had well-publicized advantages, but there were also some negatives which were often ignored, and which must be considered as technology and society moves forward again.

Mobile phones

The move from analogue to digital mobile phones was the shift from first to second generation. The move to third-generation phones (high-speed data transmission) is now underway.

Advantages

Digital mobile phones require much less power to broadcast and receive their signals. Thus the handsets for digital mobile phone services were able to be smaller and lighter and also had much longer standby and connection times for the same battery size and weight. Digital signals can contain error-correction elements, allowing for fewer problems with interference from other radio sources. Smaller aerials also allowed the phone to become smaller and not to need a 'pull-out' aerial.

Digital signals can be encrypted much more easily than analogue signals, using public-key encryption protocols. Analogue mobile (and home-based cordless) phones were notoriously easy to eavesdrop on with readily available scanning equipment. While eavesdropping on digital mobile phone conversations is still possible, it is much more awkward and requires more expensive and bulkier equipment.

The lower power requirements for digital mobile signals also allowed for fewer phone masts to cover wider areas or for a larger number of masts to cover smaller areas which has the other benefit of increasing the density of maximum number of connections possible within the same geographical area – very important for high-density business areas, such as the City of London.

Disadvantages

Mobile phone infrastructure is very expensive to install: a mobile phone which is only usable within a small geographic area is not as attractive a product to the

consumer. In moving from analogue to digital services, mobile phone operating companies had to maintain their analogue service for existing customers at the same time as developing their digital service for the new customers. This created an entry possibility for new firms who could compete in the new digital segment of the market without the drag of maintaining an analogue service. This is often the case where major investment in infrastructure is required: there is a window of opportunity for new entrants into a market which normally has very high entry barriers.

In addition to the cost to operating companies of the new investment in transceiver stations, customers faced a cost in upgrading their handsets. In order to encourage take-up of the new digital technology, operating companies offered new digital handsets at subsidized prices (sometimes even 'free') providing customers signed up for a long-term contract with the company. This remains a standard practice within the industry but has become something of an albatross around their necks: no company has found it profitable to break ranks as it is deemed too risky a strategy. This has added to the financial burden of upgrading to a digital service, leading to operating companies building up large debts based on estimates of income. When these income streams failed to materialize at the levels expected, the operating companies (sometimes existing landline network operators) were crippled by the debts. The frequency of free or cheap handset upgrades is now a competition element between providers, but this almost certainly encourages more frequent upgrading of handsets than if the customer had to bear the cost directly (all customers bear these costs through higher call and standing charges). Replaced but working mobile phones are a significant source of waste electrical products in many countries now, although recycling of working handsets to developing nations is becoming more common.

Television

While only a minority of the population of the industrialized world had an analogue mobile telephone when digital services became available, analogue television reception was near universal. There are three main methods of broadcasting a

television signal, each of which has both a digital and an analogue version: terrestrial broadcast, cable delivery and satellite broadcast. Each television market has different proportions of the population using each type, due to market, geographic and regulatory factors. Moves towards digital provision of signal have moved at a much slower pace than the shift in mobile phone services.

Advantages

Digital television broadcasting shares the advantages of digital mobile telephone services in that error correction allows for higher quality transmission at lower power. The result of this, however, is much more noticeable in television than in telephony. In particular, the ability of a single mobile phone station to maintain more simultaneous connections is not of much interest to the average user, who can only make one call or message at a time (although the new data transmission ability in 3G does now have an impact). While the same is true of television (most people will only watch one channel at a time), the range of options is more important in a one-to-many broadcast system such as television, compared to a one-to-one communication medium such as telephone (conference calls still count fundamentally as one-to-one communication). The potential for encryption of digital broadcasts has also caused a significant shift in the potential of television broadcasts: multiple channel availability and subscription-based services have created a wide variety of services, as covered in other chapters, such as Chapter 3.

Disadvantages

As with digital mobile telephones, digital broadcast of television required a significant investment in new transmission and reception technologies. As with mobile telephones, operating companies have invested heavily in subsidized new equipment for consumers, which takes capitalization away from the production or purchase of content. The number of new channels allows for a much more specialized targeting of content but also spreads the resources of production companies much more widely. Advertising income from targeted channels may be higher

(due to their targeted nature) but is more often lower due to the reduced number of total viewers. In such a difficult market, commercial players are increasingly unhappy with subsidized state television services, such as the BBC and PBS, taking viewer share.

Television-based access to the Internet through set-top boxes was expected to become a major avenue of interaction but has so far turned out to be rather a limited proposition: the resolution of television screens is not sufficient for much of the Web content, and those used to using the Internet through computer have not changed their usage whereas those not used to use of the Internet have not found the limited television Internet experience to be any easier to follow.

Digital television services are still undergoing major changes although it will still be many years before any nation is completely digital. Some countries are pushing such services forward centrally. In the United Kingdom, the government plans to switch off analogue terrestrial broadcasting by 2010 (there are also moves to switch off analogue radio broadcasting). Judging by the experience of satellite broadcaster Sky, this date may be brought forward: Sky switched off its analogue satellite broadcast earlier than expected after the vast majority of its customers switched to their digital service quite quickly once the end was nigh for the old service.

Global Media, Local Regulation

Are there any truly global media players or are there simply national broadcasters who reach a global audience? A large proportion of the world's population may have heard of one or more of CNN, the BBC and Al-Jazeera, but a smaller number have viewed them and an even smaller number view them regularly. Multichannel television's market penetration is growing in both the industrialized and the developing world and so access to such services is growing, and indeed access to CNN, BBC and Al-Jazeera is often quoted as a driver for rollout of multichannel television. The introduction of English-language Al-Jazeera and the launch of the US Fox News channel

in the United Kingdom have led to a debate about the validity of national regulation of foreign services (particularly news) broadcasting substantially unchanged from another jurisdiction.

In the United Kingdom, specific standards of decency, lack of political bias, and public service broadcasting have been in place since the early days of radio broadcasting. As with many other areas, however, such as the Yahoo Nazi memorabilia case (see Chapter 4), the difficulties of applying national standards to the international communications arena have begun to impinge on television regulation. The UK approach has been to withdraw from many of its previous regulatory requirements for foreign broadcasters (though they still apply to national broadcasters) such as the public service and political balance requirements, but to retain other regulations such as decency and the limited censorship (mostly post hoc and aimed at issues such as incitement to violence). While television broadcasting flows through recognized and centralized channels such as cable and satellite, this is a sustainable approach, but as television broadcasting moves towards video-on-demand (whether satisfied instantaneously or after a delay and delivered via the Internet), this will become more problematic.

Music publishing

One of the early moves to digital publishing was the adoption of the compact disc digital audio standard for music, which replaced the decades-old, vinyl 45 rpm and 33 rpm record formats for the bulk of music publishing. Specialist productions are still available on vinyl distribution but it is a tiny proportion of the music market. The move to digital music was extremely successful – generating new revenues for publishers as consumers replaced their old vinyl with the new digital medium.

Advantages

Compact discs sound better to most people in most circumstances than vinyl records. It would probably surprise most to know, therefore, that on good-quality

equipment (high-end home systems, not even professional-level equipment) vinyl records actually have higher quality output than compact discs. The benefits to the consumer are not simply the move to a digital format, although newer digital formats such as super audio compact discs (SACD) and DVD-audio have raised the standard. The benefits include smaller size and less fragility (CDs are smaller and less easily damaged than vinyl records) as well as better value for the majority of consumers – cheap CD players do produce better quality output than cheap vinyl record players, due to the usual issues of error correction and digital rather than analogue reproduction of sound. In addition, a CD can contain significantly more music than a standard long-play vinyl record and no loss of quality is experienced, compared to the difference between a 45 rpm and a 33 rpm vinyl record.

Disadvantages

The primary disadvantage for the consumer has already been mentioned for the other technologies: replacement cost of both the medium and the player. A certain amount of collectible merchandizing was also lost with the move to CDs: every CD can be a 'picture disc' but they must be a standard size and shape (well, almost, since there are non-circular CDs but they are very rare).

For the music publishing industry, the main disadvantage of the CD did not appear for many years, until the format was well established as the primary medium: that of perfect digital copying and transmission. Making a vinyl record is a relatively expensive business. There have always been professional unauthorized copying organizations, but the individual was restricted to making an audio cassette copy which was lower quality and which degraded at each 'generation' of copying. With compact discs, once recordable discs using the same format as standard audio discs became cheap and writers became commonplace, then everyone could copy their CDs and pass them around as perfect copies to their friends. Copies of copies were no longer any worse than the original. This was, of course, nothing compared to the introduction of the MP3 format, which compressed compact disc tracks to such a small size that they were downloadable even at dial-up connection

speeds over the Internet. The music industry is now rather regretting its adoption of technology which it does not control and has been trying desperately in recent years to regain control of the technology by various means (see Chapter 3).

THE BIG CHALLENGES AHEAD

Technological changes almost always prompt social and economic changes as well. The introduction of the telegraph put the Pony Express out of business (increasing the speed and reducing the cost of transmission of letters but increasing the time and cost of sending small parcels quickly). Player pianos and sound recording and playback technology led to a significant decrease in musical training and sales of instruments and sheet music. Televised election coverage led to the election of actors to major political posts. The Internet is allowing small local businesses to compete with multinational companies on a more level playing field. It is not only each technology on its own that causes these changes but the synergy of multiple technologies feeding off each other creates the biggest changes. The world is simultaneously getting bigger and smaller: everyone now knows when a bomb goes off halfway around the world, within hours or even minutes of the explosion. The information one has about the daily lives of people in far away places makes each individual's world a bigger place: each person must come to terms with the knowledge of greater suffering elsewhere while continuing their own struggles in life. Yet the world is becoming smaller as well: contact with individuals anywhere on the globe is now possible: a solar-powered satellite phone can connect to the global information network from anywhere on the surface of the world, without any need for infrastructure development. The speed of technological change is still increasing. Economic decisions influenced by major technological developments are becoming more and more risky. Social pressures due to technology are becoming the subject of major policy debates and public lobbying, from privacy to content control to copyright. Whether technology will allow the few to control the many more fully than at any other time in history or whether the same technologies will lead to increased freedom, respect and democracy is the big question.