

# Corporation of London

## ICT Infrastructure Review

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## Foreword

The contents of this report were produced with the help of many people, including individuals from over 30 organisations who participated in interviews in person and by telephone.

The conclusions were presented at a Corporation of London seminar, "*Cable or Wireless: Is the City networking for you?*", chaired by Sir Brian Jenkins on Thursday 28 June 2001 at 10 Trinity Square. An audience of over 80 senior managers from City companies heard three short presentations from the PA Consulting Group of the study's main findings. A lively debate followed which provided comment and further insight, whilst also confirming the conclusions reached in this report.

We are very grateful to everyone who gave their time and input to this study without which the study could not have been completed.

## **1. EXECUTIVE SUMMARY**

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This report is the result of an intensive study into the effects of Information, Communications and Technology (ICT) in the City of London over the last and the next 10 years, with particular regard to the infrastructure around telecommunications and Internet datacentre provision, and the impact on business and future provisioning.

Over 30 interviews and telephone surveys were conducted with users and suppliers in the City, in addition to discussions with various Corporation departments and staff, and extensive desktop research. The respondents were overwhelmingly pleased to be a part of the Corporation's initiative as evidenced by the large number who made considerable efforts to take part at short notice, either in person or by telephone.

The following subsections summarise the main findings of the study and some of the recommendations.

### **1.1 NETWORK INFRASTRUCTURE**

- Cost-effective, available, high capacity, wire-based telecoms are vital for today's business. The City of London is particularly well served with a plethora of suppliers offering many different varieties of service. This is well appreciated by almost all users (and suppliers) surveyed in the City.
- The ever-increasing telecoms bandwidth user requirements can potentially be met with recent advances in transmission technology, which can greatly multiply the capacity of existing fibre infrastructure. This may have the welcome effect of reducing the need to dig up the increasingly full roads in the City, a problem that was cited by many respondents as being a particular nuisance. However, there are few incentives for the suppliers to upgrade their systems, given today's difficult market environment for telecoms companies.
- In spite of good overall telecoms supply, some buildings and small areas of the City may not be well served by suppliers for commercial and technical reasons, and even large companies like Merrill Lynch can struggle to get suitable provision. Alternative technologies such as fixed wireless may possibly provide some relief for users in these areas. Some companies are also attempting to fill this gap (e.g. HighSpeed Office). The Corporation may be able to use planning measures to encourage provision for SMEs within the City of London.
- The Corporation currently has no control over road digging, nor can it mandate the removal of redundant cabling. City users would dearly like the Corporation to have the authority and / or to provide some degree of co-ordination. In an effort to help, last year the Corporation invested money in the proactive installation of ducting in the City whilst trenches were being dug for other purposes. In 2001, more ducting will be laid. The Corporation could potentially act as a broker for redundant cabling and ducting, and ensure the provision of ducting routes as part of the planning approval process for future identification purposes.

### **1.2 WIRELESS INFRASTRUCTURE**

- Wireless telecoms are expected to become important in the coming years for many City companies. The City is particularly well placed to exploit the new third generation (3G) services currently being developed, with its high geographical concentration of businesses. The Corporation could usefully provide assistance and guidance to users, suppliers and third party providers to encourage the early

implementation and adoption of the new technology. e.g. by hosting user-supplier information exchange meetings.

- Health and safety concerns surrounding mobile masts and handsets were examined in the Stewart Report published in April 2000. Although no link has been proven between radiation and harmful effects, a precautionary approach has been suggested. It is important that the results of the Stewart Report are well publicised to prevent unnecessary concern and delay to 3G network implementation, particularly the Report's conclusion that, if anything, handsets are much more likely to be a problem than the masts. Unsurprisingly, suppliers in this industry are keen to see this happen.

### **1.3 INTERNET DATACENTRES**

- From the point of view of their users, Internet datacentres do not need to be located in the City of London. These companies base their choice of location on a variety of factors such as power feeds, telecoms links, skills availability and accommodation costs. Close proximity to users is not therefore likely to be a major factor if these needs are fulfilled.
- Consolidation of suppliers in the Internet data centre industry is very likely over the next few years.

### **1.4 ICT IN THE CITY**

- The City of London is rated favourably by the survey respondents in terms of technology, due to its competitive supply of ICT and wide availability of technical skills. Research indicates, however, that New York and Hong Kong may have a more coherent approach to ICT than London and that there may be lessons here for the City. Anecdotal comment from respondents indicated mixed comparisons with Paris and Frankfurt. Some people commenting that the two cities have clearer long-term objectives whilst others claimed that London is better than Europe as a whole. The Corporation of London should take an active role in promoting and integrating ICT in the City, including within its own organisation.
- Some suppliers in the City are aware of the role of the Corporation in the promotion of technology and rate the Corporation as supportive of their efforts. The majority of respondents, however, are not aware of the Corporation's role in this regard and would welcome communication on the subject. Following an extensive redesign, the Corporation is about to re-launch its website and is planning to enhance it further in the near future. This will act as a 'show case' for technology for the City and should be vigorously pursued, particularly in the light of the recent 'Government' directives.

### **1.5 OTHER SIGNIFICANT FINDINGS**

- Power provision appears to concern many respondents with one company specifically citing power supply problems as having driven it to relocate its data centre in a different area (Note, however, that some respondents also admitted that delivery has improved in recent years.) Lead times for service provision can be too long, from the user's perspective. However, London Power Networks (LPN) are obliged to consider all applications thoroughly, including many of which are speculative and never implemented. Regulatory pressures also limit the capital investment that can be made, making forward planning for the power infrastructure supplier very difficult. Given sufficient notice, LPN are confident they can meet demand where required and it is highly unlikely that the City will

have problems such as those currently experienced in California. The Corporation can take a role in facilitating the appropriate and timely interactions.

- Security is likely to become a board-level issue-if it is not already. Physical and logical<sup>1</sup> security of key ICT infrastructures such as power substations and telephone exchanges should be constantly reviewed in light of recent civil disturbances and threats. Regular security reviews should ensure that ICT elements are also included, and whilst it may not be appropriate to publicise the results, reassurances to City businesses would be welcome.
- Transport is universally detested by City users, although it is acknowledged that the City is well served compared to many other locations. This should be stressed in publicity material, particularly as the Underground investment programme is due to begin very soon to improve the situation.
- Investigations underway by the Greater London Authority indicate that ICT infrastructure development is unlikely to be funded by public bodies. Cross-borough co-ordination of infrastructure initiatives should continue to be encouraged, between local authorities and commercial companies.
- Users are keen that the Corporation take an active role in the promotion of user-supplier forums for dialogues about network provision (ducting and supply of broadband), power supply and many other topics.

More recommended practical measures for the Corporation to address the above issues are suggested in Chapter 6 of this report.

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<sup>1</sup> Physical security requires protective measures such as locked machine rooms, segregated or zoned areas and security guards. It protects against *physical* interference with systems. Logical systems security requires the implementation of software, hardware and process measures that protect against unauthorised usage of systems such as accessing personnel records. Logical systems access does not require physical presence near the computer system.

## **2. INTRODUCTION**

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This report is the result of a study commissioned by the Economic Development Unit of the Corporation of London in January 2001. The objectives of the work were:

- 1. To undertake a study looking at the developments in the field of information, communication and technology infrastructure in the last 10 years, how City business have taken advantages of these new technologies and how this has impacted on the infrastructure needs of the City.*
- 2. To gauge possible developments of relevance to the City in this field over the next 10 years, to assess how these may impact on infrastructure needs, and to identify what practical steps can be taken by the Corporation to help facilitate future delivery.*

Additionally, the Corporation is particularly interested in the infrastructure impact of network cabling, Internet data centres and wireless communications. (In this report, except where noted, wireless communication is taken to mean predominantly mobile telephony.)

To this end, the technology review sections, Sections 3 and 4, outline changes caused by information, communications and technology (ICT) to business and the City, along with details of the specific infrastructure topics above. The main drivers behind these changes are then described at a high level. (A more detailed analysis of the impact of technology on business and City infrastructure can be found in the appendices.)

As part of the research, comparisons were drawn between other major global financial centres, including New York and Hong Kong. These findings are presented in Section 5.

Section 6 draws all the comments, interviews and research together for conclusions, and drawing on the findings of the surveys, the interviews, the technology review and the seminar, it also suggests some practical measures that the Corporation of London can take to encourage the appropriate infrastructure development for the City.

Note that this report assumes the reader has only minor familiarity with the field of ICT. It therefore provides the reader with background to the development of ICT in the 1990s.

### **3. ICT IN THE LAST 10 YEARS**

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#### **3.1 SUMMARY OF KEY INFRASTRUCTURE CHANGES**

The main technology influences in the 1990s were:

- The increasingly criticality of good quality, high speed telecoms
- The rise of PC-based architectures
- The rise of the Internet

With regard to the infrastructure in the City, the key changes have been:

- The proliferation of cabling laying by many different companies, particularly for telecoms provision, to support dispersed teams and the exchange of electronic information in various forms
- The proliferation of antennae for mobile telephony coverage
- An increased need for power supplies in and around the City of London throughout the year, not just during the winter months
- The need for larger, open plan offices spaces, driven by larger teams requiring co-location, at least for the immediate future

The pace of change is likely to continue to accelerate throughout the next decade.

#### **3.2 CHANGES IN CITY BUSINESS IN THE LAST 10 YEARS**

At the start of the 1990s, most companies had very little of their corporate computing on their workers' desktops. The Internet was unheard of and mobile telephones were large, expensive and for executives only. To request information from colleagues usually required workers to have a meeting, make a phone call or write an internal memo. Sharing data was relatively slow.

However, at the end of the 1990s, the world of business was characterised by fast access to enormous data volumes wherever data happened to be, enabled by electronic mail, easily accessible file servers and ubiquitous PCs. Whether this data is accessed from a PC on a desk or a laptop on the move using a GSM mobile phone, to the Internet or just a corporate database, the ability to get information quickly has changed the way business works.

One of the key changes is that there are now many more suppliers of telecoms services in the City. This very healthy competition has been tremendously beneficial to business and driven down the price per Mbps enormously. An unfortunate side effect is the seemingly endless digging up of the roads to lay cables to meet the demand.

Working patterns have changed too. Technology has made possible rapid decisions and has raised the bar for all companies. Businesses now require more technical and IT skills than before to simply remain competitive, let alone leading edge, resulting in a skills shortage which is severe in places. However, the City is relatively well-placed due to its concentration of high-paying, technology-driven companies, which attracts skills from a wide area. This was acknowledged by City users in the survey, albeit ruefully because the intense demand is forcing salaries upwards.

As a result, outsourcing of IT systems has gained widespread popularity whereby companies can offload to a third party the problems of trying to compete with other companies for scarce skills. Outsourcing companies are then managed against contractual obligations and service levels to deliver a service. It should be noted however, that many outsourcing companies are only interested in large company contracts, leaving smaller companies at a potential disadvantage. Equally, some companies may retain particular IT systems in-house because the systems are deemed to be mission-critical to their business and outsourcing them is consequently deemed to be too risky.

A team and project culture has also become popular whereby companies form teams of varying skills for defined projects and then disperse them again after the project is complete. These teams are often geographically scattered and held together by technology such as audio and video conferencing, workflow systems, electronic document stores and on-line discussion forums.

However, conversely, in some areas the need for ever more rapid decisions has led to a centralising of teams in a single place, occasionally driven by large company mergers too. The result has been a need for buildings with very large floor plates in which companies can site hundreds of workers within earshot of each other. This concentration allows the teams to very quickly respond to changes in their business environment. e.g. volatile equity markets. A significant side effect of this is that power consumption per square metre is increasing rapidly, as more and more technology is squeezed into smaller and smaller areas, and air conditioning requirements soar.

The Internet has also lowered the barriers to competition very effectively in many marketplaces. For example, on-line equity trading is now possible in the UK without requiring the services of a traditional broker (e.g. [www.e-trade.com](http://www.e-trade.com) and [www.selftrade.co.uk](http://www.selftrade.co.uk)) and on-line retail banking is now common with new competitors entering the market without the need for large, expensive branch networks (e.g. Egg). Legal services are also available on the Internet. e.g. [www.NextLaw.com](http://www.NextLaw.com).

In the light of new competition from Internet start-ups, existing companies have had to change the way they work to ensure that they remain competitive. For example, they may be offering the same services themselves (at the risk of cannibalising their existing revenue streams), rationalising their office and branch networks, or redefining the services that they give individual companies (e.g. replacing the personal service bank manager relationship that they used to offer).

In business-to-business (B2B) commerce, new electronic exchanges are emerging driven by huge multinationals like Ford, International Paper, Boeing, Shell and others. The new forums threaten to disturb the status quo enormously by diverting billions of dollars of procurement expenditure. These exchanges are designed to allow companies to invite bids for their business from prospective suppliers (and vice-versa), thereby making the competition much more open and reducing costs. There are currently exchanges for power, chemicals, paper, automotive parts and energy, amongst others. Although their success has been limited to date, they will almost certainly succeed as a critical mass of companies participate, particularly in markets for commodities such as oil.

Summary of changes in the City brought about by ICT:

- Screen-based trading in the equity markets and the replacement of the 'open outcry' trading in LIFFE

- Bigger floor plate buildings required for some types of business
- Project and team cultures replacing hierarchical control to enhance flexibility and performance
- Many more suppliers of ICT services in the City
- Greater demands for power with reliable supply
- On-line exchanges for commodities
- Electronic documents replacing paper using corporate Intranets
- PCs on the desks of all staff, with multiple screens on some desks
- Electronic mail
- On-line share dealing without traditional broker services ('disintermediarisation')

### **3.3 NETWORK CABLING**

#### **3.3.1 Telecommunications**

Within the Square Mile, there are a multitude of companies laying cable for data and voice communications, in addition to gas and water supplies, and power cabling. The following telecoms companies are registered with the Corporation as permitted to dig up the roads:

- British Telecom PLC
- Cable & Wireless Communications (who are now part of NTL)
- COLT
- MCI Worldcom
- Energis Communications Ltd.
- Fibernet Group PLC (branded as TANet offerings)
- Cable London PLC (part of Telewest Communications)
- Global One
- General Telecom
- neosnetworks (formerly Inter Digital Networks Ltd.)
- Level 3 Communications Ltd.
- Thus PLC
- GTS (Global TeleSystems Europe BV)
- Metromedia Fiber Network UK Ltd. (MFN)
- Norweb Telecommunications
- Global Crossing (incorporating Racal and Frontier)
- Infolines Public Networks Ltd.
- New World Payphones Ltd.

A number of other companies such as 24seven Utility Services Ltd. (formerly part of London Electricity), National Grid Company PLC, Transco and Thames Water Utilities are also registered for road digging.

Note, however, that the registration of a company does not necessarily mean that they have laid any cable but merely that they are empowered to do so when they wish to. Equally, some companies operate fibre networks which have been laid by other companies or even third parties.

For example, Storm Telecommunications buy so-called 'dark fibre' from Telia whose cabling is, in turn, laid by a construction subcontractor. Storm also interconnect with companies such as FiberNet. AT&T buy 'raw' bandwidth from suppliers like BT and

COLT to run services over for their end users. Some suppliers sell their networks only to other telecoms companies or ISPs. Others operate under different brands (e.g. GTS market themselves as 'e-bone' for data services; Worldcom use UUNet in addition to their own name; MFN use AboveNet and PAIX) and have complex multi-company structures to legally and financially isolate components of their services.

Additionally, not all companies will serve all possible customers due to a variety of reasons, such as their strategy or cable paths. For example, neosnetwork provides very high bandwidth for other providers such as ISPs to then offer to end users and MFN provide dark fibre only under their corporate brand.

To add to the confusion of multiple channels to market, consolidation in the industry is also becoming apparent and will change the supplier list regularly as companies move in and out of niche segments.

Therefore, it is difficult to be sure who offers telecoms services to whom in the City at any point in time. However, it is clear that competition is extremely healthy in the City of London, far more than anywhere else in the UK. This fact is supported by the survey of City users and suppliers wherein many users commented on the extremely welcome reduction in bandwidth costs and the plethora of suppliers to choose from.

The following are known to offer telecoms services today in the City of London to end users:

- British Telecommunications PLC
- Cable & Wireless / NTL
- COLT
- Level 3
- MCI Worldcom
- Storm Telecommunications
- Energis Communications PLC
- UUNet
- AT&T
- Global Crossing
- Thus PLC
- Global One

This is not an exhaustive list and there may be others that will provide end user service offerings on a case-by-case basis.

Interestingly, OFTEL says that there is no broadcast cable franchise operator allocated for the City of London.

### **3.3.2 Road Digging in the City**

Many survey respondents would like the Corporation to have a co-ordinating role for road works which, unfortunately, is not possible today under current legislation. From the Corporation's perspective, they have few powers to prevent the digging up of the road with its accompanying disruption. Once registered, a company can dig the road up given the appropriate notice, which is usually 28 days (but it can be shorter, of course, for emergencies). Even if the Corporation refuse permission, a company can still pursue its plans under the New Roads & Streetworks Act, 1991.

From 1 April 2001, Section 64 required companies to notify a start and finish date for the roadworks, with fines for subsequent overrunning of the work. However, because there is no mandatory assessment of the accuracy of these dates, companies will clearly just push out the end dates to avoid paying any fines. Solutions like the proposal to charge rent for road space whilst digging it up ('lane rental') are being considered by the Government but are likely to take a few years to become law, if at all.

Whilst the Corporation is aware who is digging and where at any moment in time, details of the work are not available so it is not possible to assess the opportunities for sharing trenches, etc.

There is also only limited information on where ducting has been laid in the City, resulting in delays in some digging works. The Corporation could, in future, direct that the planning approval process requires provision of the ducting routes for identification purposes.

In order to try and provide some capacity in the ground to avoid more road digging and disruption, the Corporation recently funded the construction of some ducts alongside and at the same time as digging being done by other companies. Ducts totalling approximately 3.5km in length have been installed to date. How these Corporation ducts (a map of which can be obtained from the Department of Technical Services) will be utilised has not yet been agreed. Suggestions going forward to the Planning & Transportation Committee may include the ducts' sale to a single company for their sole usage or that control should remain with the Corporation (although there may be insurance liability issues if this is the case). This initiative has been extended into the 2001-2002 financial year.

The provision of new ducting in some areas is now nearly impossible due to the roads effectively being 'full'. For example, the very wide, complex road junction area by the Bank of England above Bank Station is completely full, from kerbside to kerbside. Elsewhere, even where room exists, the area under the pavement is invariably full and digging must be done in the road. As a result, cables are having to be laid around areas of difficulty, resulting in longer disruption and higher overall costs.

It is also not known how much of the cabling in the ground is redundant and could be therefore removed but there is currently no statutory requirement upon cable-layers to remove cabling when it is no longer required. One company interviewed commented that during a recent major building project, old power cabling was unearthed which delayed construction for a number of days whilst it was checked to ensure it was not live. Another company remarked that they would like suppliers to be forced to remove old cabling following considerable problems in their area caused by constant road works.

Clearly, if removal was possible, it would help the situation by freeing up space in ducts for other cables and would prevent unnecessary delays to other infrastructure projects. The Corporation could potentially act as a broker of redundant cabling and ducting.

### **3.3.3 Power Cabling**

Approximately a third of respondents to the survey mentioned concerns with power supply and reliability. Equally, many also acknowledged that quality of delivery had improved in the last few years.

Since the deregulation of the power industry, London Power Networks has become the power distribution asset owner in the City of London, although the actual operation of the assets is outsourced to a company called 24seven Utility Services. Suppliers like LEB are the companies that now own the relationship with the end users.

The widespread adoption of ICT has, of course, driven up power requirements in the City area over the last 10 years. A particularly interesting fact is that whereas previously summer was a relatively 'quiet' season for power consumption, now it is much the same as any other time of the year because air conditioning for computer machine room continues to operate 24 hours a day, all year round. This can cause maintenance scheduling problems when previously it could be done in the summer.

Buildings newly refurbished often drive up the power consumption per square foot too, with the inclusion of ever-denser IT systems and accompanying air conditioning requirements.

LPN is obliged to consider thoroughly all applications for power provision, regardless of whether they actually go ahead or not. The total project consumption of all the applications today represents about 50% of today's total power provision capability. Fortunately, most are speculative but each must be examined. LPN plans approximately 2-3 years in advance but is regulated by OFGEM and unable to over-invest. However, there are very few new sites in the City area nowadays and as a result, LPN generally only does renewal work on substation equipment.

Recent problems in California with interrupted supply and the bankruptcy of some key companies are unlikely to be duplicated in this country. In contrast to California, the UK has less stringent environmental pressures, shorter distances for power delivery and had (and still has) sufficient capacity in the system. The problems in California are perceived as having been caused by a bungled deregulation of the industry.

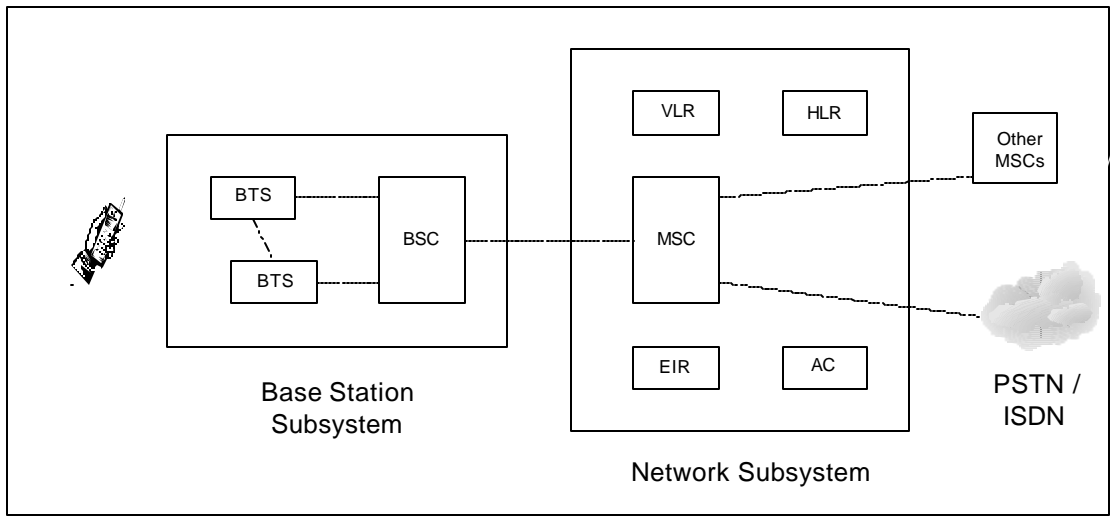
In order to ensure provision of supply in time, LPN require approximately 18 months notice for large or new requirements. LPN have worked closely with the Corporation of London in the past without problems to meet these goals and have recently completed equipment upgrades to double capacity in a number of power substations.

### **3.4 WIRELESS TELECOMMUNICATIONS**

#### **3.4.1 Wireless Infrastructures Today**

Mobile telephony is now ubiquitous but, considering its apparent simplicity, is remarkably complex 'under the covers'. Indeed, for the vast majority of the population, a mobile handset is by far the most sophisticated piece of electronics that they will ever own. As an indication, the GSM standard is over 8,000 pages long.

Greatly simplified, the architecture of mobile GSM infrastructure is illustrated in the following diagram.



As shown in the diagram, multiple BTSs can be supported by a single BSC and multiple BSCs can be supported by a single MSC. BTSs are usually linked to BSCs by radio links (e.g. microwave) and require a small rack or two of equipment co-located with the antennae, which are directional in nature. Microcells and picocells can be smaller still as their power requirements are much lower.

BSCs are larger (perhaps several racks in size) and approximately the same size as MSCs, though usually much more numerous. They are linked together usually by landlines (copper and fibre).

In terms of data communications, GSM is limited to just 9.6 Kbps due to the voice channel width of approximately 3.2 KHz. More often than not, in use, the maximum will be below 9.6 Kbps, confining the use of mobile data connections to very simple, plain text e-mail at best. This is a fundamental constraint of the circuit-switched architecture of GSM which is essentially aimed at supporting voice only. However, various transitional enhancements are possible by building upon the existing infrastructure using new standards - see Section 4.4 for more detail.

### **3.4.2 Antennae Siting**

As mentioned in the previous section, the capacity of a GSM network is essentially limited by the number of base stations. There are a number of strategies employed by the mobile operators to add capacity and ensure service coverage.

For example, an 'overlay-underlay' configuration can be used wherein a large, powerful mast geographically overlays many smaller base stations. By careful design, when one of the smaller bases is in full use, a handset will still be able to get a channel by picking up the larger cell base station overlaying the small stations. The operator thereby provides a fall-back for users in times of high usage such as rush hour. Clearly though, the installation of the large mast can be difficult in built-up areas due to planning regulations and the lack of suitable sites for the switching equipment.

The normal way of increasing GSM capacity is to add new BSCs in areas of high demand. The frequency maps required to ensure that adjoining cells do not interfere with each other are carefully planned, usually at network conception, on the basis of their expected growth because re-mapping the frequencies across the cells is a significant task, should it ever be required. Installing new BSCs is therefore ordinarily a matter of finding another suitable site for the antenna, back-links and equipment racks. Building owners often rent space on their roofs or in their buildings to the operators for this purpose. Farmers often rent a corner of their fields too.

For the City of London, clear guidance on the siting of external telecommunications equipment such as antennae and BSCs is available in *Planning Advice Note 5* published by the Department of Planning in the Corporation of London. This sets out what is likely to be allowed and what is not. It also contains advice and guidance on appearance, siting, reuse and the information required for a planning application.

The City of London contains over 600 listed buildings and 20 conservation areas and so can be particularly impacted by further installations of antennae. It is worth noting that the Department of Planning is the only department within the Corporation of London that has a remit with regard to the siting of mobile telecoms equipment, assuming sufficient bandwidth exists to interconnect BSCs with MSCs, etc.

### 3.4.3 The Stewart Report

Following widespread public concern on the effects of mobile phones and masts on users, the Government commissioned a team, led by Sir William Stewart, to investigate and report on the reality of the situation. His output, now commonly referred to as the Stewart Report, was published in April 2000.

The commission was asked to investigate whether there was any evidence that mobile phones and their associated equipment, such as antennas and base stations, were a threat to human health. They were also asked to make recommendations to reduce any such potential health impacts and to address perceived health concerns arising from mobile phones and their usage.

The primary finding of the report was that the balance of evidence to date shows that exposures to radiation from mobile phones or base station transmitters and receivers below NRPB (National Radiological Protection Board) and ICNIRP (International Commission on Non-Ionizing Radiation Protection) guidelines do *not* cause adverse health effects to the general population.

Any potential threat to health from mobile phone handsets is likely to be far greater than from base-stations, due to the handset's proximity to live tissue. i.e. to the handset user's brain. The output of all currently available handsets sold in the UK are within the NRPB and ICNIRP limits and, by implication, it is reasonable to believe that the majority of current mobile phone base-stations and antennas will be within these limits.

The report did, however, recommend a precautionary approach to mobile deployment and further study to determine more clearly any links between mobile phones and health. It also stated that it believes that the widespread use of mobile phones by children for non-essential calls should be discouraged because, if there are currently unrecognised adverse health effects from the use of mobile phones, children may be more vulnerable because of their developing nervous system, the greater absorption of energy in the tissues of the head and a longer lifetime of exposure. It is expected that the siting of mobile antenna near schools will therefore be discouraged, even though the comment relates to mobile phones, not the antennae. The small number of schools in the Corporation of London's borough suggest that this will not be a significant impediment to mobile operators.

A major recommendation, which may have an impact on the Corporation of London, will be the implementation of changes to the current rules for the siting and installation of base station equipment. New planning regulations governing the siting of masts and other equipment will come into use "at the earliest opportunity" (expected to be around 6 to 9 months), as follows:

- Macrocells - Base stations serving metropolitan or local areas and covering distances of up to 22 miles will require local authority planning permission regardless of antenna height. One important function of the planning permission process will be to consult with local people over the location of new sites. Where a macrocell is being placed on a building, only if the antenna height (including supporting structure) is 4 metres or over above the height of the building will planning permission be required.
- Microcells - Base stations which are designed to serve larger local areas - e.g. an airport or shopping mall - will require planning permission only where the base

station has a material effect on the external appearance of the building. If not, no planning permission will be required.

- Picocells - Base stations within a building will not be covered by planning restrictions since planning permission for development within a building is not required.

Where planning permission is required, the maximum time which can elapse before approval must be either given or refused by the local planning authority is 56 days. Beyond this period, approval is given by default if no response has been received from the planning authorities in order to ensure that delays in processing planning permissions do not unnecessarily slow down network implementations. The current timeframe for the planning process is 28 or 48 days, depending on circumstances, and hence the new rules represent a *potential* delay of 4 to 8 weeks over the current processing time.

Network operators have agreed to ensure that all new base stations will be within the guidelines for maximum transmitted power and that existing base stations will be brought up to the same standard. Such standards for macrocells will include the creation of a clearly marked 'exclusion zone' around each base station. Within this exclusion zone, excessive exposure to radiation may occur. Indications are that most or all existing base-stations already comply with this requirement, since the base-station is generally surrounded by fencing for physical security.

The Stewart Report also recommended that random, independent audits of base station sites should be carried out to ensure they are within guidelines. The government Radio Communication Agency has already started this task and in the small number of sites they have tested (11 in total), the maximum transmitter power was less than 0.2% of the guideline maximum.

Although microcells and picocells will not require the exclusion zone due to their lower power output, they will be required to carry a warning not to remove the cover while the unit is switched on.

### **3.5 INTERNET DATA CENTRES**

The rise of the Internet has led to the birth of a new type of company in the IT industry: The web hosting company. These companies essentially offer IT systems outsourcing services to companies wanting to develop a presence on the Internet.

The services offered by web hosters vary from sharing a small PC server on which a small application is run, through to fully outsourced and serviced application development, hosting, maintenance and support for the major players on the web such as Yahoo!, running on millions of dollars worth of hardware and software in bomb-proof bunkers.

Web hosting companies vary in size from one-man-bands through to IBM, the largest IT services company in the world. Some companies are purely web hosters. e.g. Exodus. Others, like IBM and BT, are more traditional IT and telecoms companies. Recent entrants to an increasingly crowded market include companies like Intel who are not traditionally seen as a service company.

They all have in common one fact - very few of them are making a profit at present from web hosting alone, a situation that has been exacerbated by the downturn in the technology and Internet industry in 2000.

In essence, what sets web hosters apart from 'ordinary' outsourcing companies is their connections to the Internet - any decent web hoster should have multiple, very high bandwidth Internet connections (i.e. multiple Mbps), preferably into a central Internet backbone switch somewhere in the world. In this way, users benefit from very fast access to and from the Internet for their websites and end users, with the minimum possible 'hops' between source and destination systems.

### **3.5.1 Web Hosting Infrastructure**

Ignoring the cheaper end of the market as inapplicable for City-type companies, web hosting companies usually build dedicated and very expensive web hosting facilities from the ground up. (These Internet data centres are also called web hotels and hosting centres.) The following is increasingly typical for a major facility:

- Large, open plan, raised floor areas for growth, cabling, etc.
- UPS and back-up power generators
- Fire detection and suppression systems, normally using gas
- Individually lockable cages and / or racks to separate customer equipment
- 24 hour support and operations monitoring from a control centre
- Highly trained staff in a wide variety of systems and software, from Microsoft through to IBM and Sun
- Extreme security measures - Smartcard badge locks; restricted access zones; palm readers (which also check for a pulse!) and/or retinal scanning kit; anti-ram barriers by exterior doors; CCTV; multiple network firewalls; built-up grass verges outside concealing concrete walls; 24 hour security with access allowed only for named and photographed users; no windows into the machine rooms (solid walls only); car park barriers capable of stopping lorries and more
- Multiple high bandwidth Internet connections and power supply feeds into different parts of the building (usually opposite ends) for resilience, from different suppliers if possible
- On-site storage of spare parts for emergency maintenance
- Service level agreements for performance of the network connections

Into this environment, users specify and often supply their own host system and web application.

There has been enormous investment in Internet datacentres over the last few years, amounting to billions of dollars globally and millions of square feet of machine room space. For example, Intel Online Services intends to invest over \$2 billion over the next few years in 12 world-wide datacentres. Global companies like IBM and Exodus are also investing heavily.

### **3.5.2 Locating Internet Datacentres in the City of London**

The basic premise of the Internet is essentially that users with the appropriate equipment can access companies' websites from wherever they are in the world, irrespective of the geographical location of the two participants.

For example, when users access the Corporation of London website ([www.cityoflondon.gov.uk](http://www.cityoflondon.gov.uk)), it does not matter whether it is hosted in London or in Glasgow. The only thing that matters from the user's perspective is that it works and it works well.

At a high level, factors that will influence this are the average network connection speed and latency<sup>2</sup> between the user and the website, the processing power of the system running the website, and the design of the website itself. Close geographical location of the user and the website is only of significance for the network latency factor and in most cases, millisecond latency times within country are the norm for the Internet.

It follows therefore that City-based web hosting datacentres are not necessary from the user's perspective and, indeed, some companies may believe that a reasonable distance between themselves and the hosting centre is actually highly desirable in case of disaster recovery situations. e.g. bomb threats, power cuts, etc., in their own locality. This presupposes, of course, that sufficient cost-effective bandwidth can be procured between the user's site and the webhoster's datacentre.

For developers and maintainers of websites, close location to the web hoster may be desirable, particularly in periods of high change when a physical presence at the hoster's site may be necessary. e.g. during the initial implementation of a website. Even then though, with a competent web hosting organisation (and the appropriate service contract), this is not a major issue for user companies. (It should be noted as well that development and maintenance of websites is often outsourced to specialist agencies too.)

It is possible that some web hosting companies may believe that they need to be near their prospective clientele, essentially to assist the marketing. However, the choice of location for an Internet data centre is more often driven by its availability and suitability for the development of a facility with the features listed in the previous section, plus of course, the accommodation costs. Different companies will weigh the factors differently to determine their chosen location.

Note that close proximity to an Internet exchange peering point such as LINX in the Docklands is not necessary. (An Internet exchange peering point is a physical location at which multiple Internet Service Providers - ISPs - interconnect their networks, usually into the major backbone routers of the Internet.) All a web hoster requires is suitable telecoms to link from their site to the exchange - and they decide what constitutes 'suitable'. As an example of some of the major players in the market who have determined this for themselves, Intel's Internet datacentre is in Winnersh, near Reading, and linked by multi-Gbps SONET rings to other providers like Cable & Wireless. One of IBM's UK Internet datacentres is in Portsmouth and Exodus's UK centre is in Park Royal, west London.

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<sup>2</sup> Latency is the summation of all data packet delays in the network, end-to-end. For example, it includes delays from congested backbone telecoms lines, network router processing and local link speeds.

## **4. ICT IN THE 2000S**

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### **4.1 SUMMARY OF KEY INFRASTRUCTURE CHANGES**

The main technology influences in the 2000s are likely to be:

- A multitude of new user interface devices with different forms and standards
- Enormous amounts of data which will require some sort of cost-effective filtering to make sense of it all
- An increasing focus on systems and telecoms security, both physical and, in particular, logical security

New and emerging technology trends will have the following effects on the City's infrastructure:

- Many more antennae will be required for good 3G mobile coverage. (Different estimates suggest between 4 and 10 times as many.) The shortage of cost-effective, suitable sites may hold back the roll-out in the City
- More wire-based bandwidth will be needed to meet the demand and to provide diversity in operators and routing for resilience, etc. This may result in even more congestion in ducts under the streets of the City although technology exists for greatly increasing the capacity of existing fibre networks. Some buildings and areas of the City may be poorly served by suppliers for commercial and technical reasons
- There may be a need for a co-ordinated approach to basic infrastructure security in the light of increased threats from pressure groups. e.g. anti-globalisation movements threatening telecoms exchanges and power plant
- The increasing globalisation of financial services will most likely result in the need for more larger office buildings in the City for the huge companies that result from mergers, etc. Without suitable sites and enabled by technology, there is a good chance that at least the bulk of these companies will leave the City, taking with them many smaller enterprises that support and service them
- Globalisation of business will continue which will demand support for a longer working day in the City, requiring amenities such as food and transport, eventually on a 24 hour basis

### **4.2 CHANGES IN CITY BUSINESS IN THE 2000S**

In terms of technology, the 2000s are likely to extend the themes begun in the 1990s. i.e. ubiquitous access to masses of data from wherever the user is, through a variety of different powerful devices. Central to it all will be telecoms and the Internet.

The main technology drivers or supporters of business change in this decade are likely to be wire-based telecoms and increasing microprocessor power, deployed in a much broader range of devices than today. Subsidiary but important factors will also be mobile telecoms and security requirements. Business changes will come from the application of combinations of technology, rather than quantum leaps in technology or major new discoveries.

The most significant technology advances at the high level are likely to be the following:

- Complete convergence of voice, video and data streams, facilitating unified messaging and delivered via wired and wireless telecoms
- The Internet will allow services to be offered at a micro-application level, wherein users can buy cheaply the services of small applications for one-time or continuous usage, enabled by a common, open framework for describing and accessing applications on the Internet. This is already starting on a larger scale with the emergence of Applications Service Providers (ASPs) and will allow businesses to take a potentially more effective approach to outsourcing, particularly for SMEs. Overall, companies will be better able to maintain control of their expenses
- Mobile-based telecoms based on 3G / UMTS will become increasingly important as compression improves, coverage extends, transmission speeds increase and security concerns are resolved. Users will be able to move out of the office and access information wherever they happen to be in a more effective manner than today's WAP, allowing them to service their customers quicker and better. The 'wireless city' may become a reality (of sorts)
- Quality of service issues on the Internet itself will be resolved (at least in areas of good telecoms service provision) with the implementation of sufficient backbone bandwidth, IP version 6 and broadband in the local loop. With the availability of high quality, end-to-end service levels and secure data encryption, the need for private networks will be reduced and costs cut

It should be apparent that the major requirement in business will continue to be for high speed, low cost and high quality telecoms bandwidth. It is highly telling that many of the developments that are being planned in ICT centre around networking and / or the Internet.

It is clear, too, that wire-based telecoms will remain more important for the majority of businesses for the foreseeable future - mobile will remain in niche applications due to its relatively slow data transmission speed.

A highly significant side issue will be security. As ICT becomes integral to business operations and public concern rises following well-publicised hacking incidents plus the inadvertent release of private data, companies will need to take a much more systematic approach to security than they do today.

At a high level, there are two sides to ICT security - logical and physical. Physically, servers will need to be secured in restricted areas and use protected utility feeds. Logically, companies will need to ensure that their data is safely locked away behind firewalls, encryption devices and, very importantly, excellent processes and procedures. They need to ensure that only their users and partners can reach their servers and even then, that they see only the data that they are allowed to see. E-mail viruses such as 'the love bug' are already common and must be guarded against to prevent major system problems and expense. Not surprisingly, security skills are in strong demand at present and the scarcity will get worse.

Aside from a company protecting its own assets, it will be important that infrastructure companies are aware of the dangers that they are exposed to from actions taken by such organisations as the growing anti-globalisation movement or more 'conventional' terrorists. Once proper security is in place for a company's servers, it is unlikely that these organisations can destroy a company electronically. However, they could certainly cripple companies with a well-placed bomb, simply by destroying some of the key network linkages or power substations. Business

Continuity Planning will need to be an essential element of every company's operating plan, not just the large companies or those mandated by the FSA.

A major infrastructure question remains to be answered - will the City office become redundant as users are enabled to work wherever they happen to be? The answer is likely to be "No" because there will always be a need for office space near clients, in order to facilitate face-to-face contact. However, by offering much closer integration with their own colleagues over longer distances, telecoms will allow non-client-facing staff to be moved to cheaper facilities (i.e. outside the City) and the consequent rationalisation of office space. This is already happening with back-office support (e.g. Societe Generale) and call centres.

As mentioned in the previous section, some extremely close-knit teams such as equity and foreign exchange traders who rely on their instincts and the 'buzz' around them, will need to remain co-located with each other. The ever-increasing size of financial services companies resulting from mergers and acquisitions will also drive the need for larger office space for teams such as these. They may not need to be in the City though - telecoms links to electronic exchanges will permit them to be outside the City as well.

### **4.3 NETWORK CABLING**

#### **4.3.1 Future Suppliers**

In terms of wire-based providers, there is certain to be a consolidation of the network suppliers world-wide. This is because there is a glut of companies seeking to put high capacity networks in areas such as the City of London, where they think demand exists.

Note though that the problem is not that there is insufficient demand - it is that many of these supplying companies are still in their start-up and build phases, with little or no significant revenue to cover their expenditure. In today's very tight investment market, second round financing for start-ups is proving very difficult to obtain and investors are beginning to withdraw, believing they will never see a return on their money. Telecoms companies have been particularly hard hit by this market change.

The result is that we are already seeing a shake-out happening, as evidenced by the recent bankruptcy of Aduronet and the Chapter 11 filings from Winstar, Teligent and Viatel. The most likely victims are those without serious heavyweight backing and/or late-comers to the market.

However, even with good backing, the future is not assured - Aduronet was backed by UBS, for example, to the tune of many millions of dollars. UBS decided that throwing good money after bad was not good business sense and everyone else agreed with them. Aduronet consequently closed down in February 2001.

Note though that even if those companies that are building their own network fold, their assets (i.e. their network infrastructures) are unlikely to be left idle as the remaining suppliers will certainly buy up their capacity (at fire sale prices) to build up and out their own networks more quickly. Users are highly unlikely to be left without a supplier, particularly in the City of London.

### 4.3.2 Increasing the Bandwidth

From the point of view of the user, bandwidth supply will, on paper, exceed demand. However, there are likely to be buildings and small areas in the City that will not be well served by the suppliers for a variety of reasons or where competition will not be strong enough to ensure good service. One survey respondent suggested a public 'naming and shaming' of errant telcos!

For example, installation lead times and maintenance may be poor in some areas. Also, multi-tenanted buildings, filled with small and medium sized enterprises, may not provide enough immediate revenue incentive to induce suppliers to lay cabling into the building for telecoms. Companies such as HighSpeed Office and Intellispac are attempting to fill this gap by offering added-value services, usually in conjunction with property developers and owners, and contracting with the fibre providers to implement the last few yards into the building.

Even large companies face difficulties in procuring sufficient bandwidth for their needs. Merrill Lynch has approximately 10 different suppliers, each of which has to dig up the road when they lay cable into the Merrill building. It would make good sense for property developers to consider dedicated routes for the ducting at the planning stage and the Corporation to ensure it is part of the planning permission.

Elsewhere, in areas of poor supply, companies have two alternatives:

- Pay a premium to ensure that they have good telecoms from a supplier
- Utilise alternative technologies such as Asynchronous Digital Subscriber Line (ADSL) or wireless technology like point-to-point microwave, laser and infrared links

ADSL is already available in the City of London from BT, although roll-out across the rest of the country continues at a frustratingly slow pace. (Statistics at the time of writing suggest 35% of the UK theoretically has ADSL within reach today but only 50,000 lines are actually in operation.) ADSL provides a high speed connection through existing copper wiring and therefore can potentially reduce the need to dig up the road to lay more cable.

BT's ADSL connects users to the Internet only - it does not support private network connections at present - and the availability of the service at a user's local exchange does not guarantee its availability at the user's site due to possible technical issues concerning the wiring between the two sites. Additionally, BT's ADSL service has no meaningful service level agreement guaranteeing availability and performance and as such, it is not suitable for many important business applications.

The process of local loop unbundling (which is the forcing of BT to allow other telecoms operators access to and use of BT's local loop wiring between end users' buildings and BT exchanges) is also going very slowly. Many competitive telcos see unbundling as critical to their own planned ADSL services in order to link customers into their own backbone networks. Without unbundling at the exchange and the provision by BT of co-location space for the siting of competitor's termination equipment (to allow competitive operators to connect across the floor of the exchange to their own backbone networks), the cost-effectiveness of alternative services appears to be suspect. As a consequence, very few companies have their own ADSL service and BT is almost the only company that offers ADSL today in the UK on a widespread basis.

See Section 4.4 for wireless alternatives to the local loop.

There may also be small areas where demand exceeds supply. Fortunately, technology is available which can extract greater bandwidth from today's fibre. Dense Wavelength Division Multiplexing (DWDM) is an optical fibre-based technology which greatly increases available capacity by lighting single fibres with multiple lasers on different wavelengths. Up to 150 different lasers on a single fibre have been proposed which could support 1 terabits per second of data. i.e. 1,000 Gbps. Given that each cable laid can have 800 or more single fibres, the bandwidth gains possible are enormous.

In order to exploit this technology, the termination equipment and network switches would need to be replaced but, in general, the fibre in the ground would not need to be changed. In that regard, DWDM offers a relatively non-disruptive upgrade path for the City of London.

Looking further into the future (but already deployed by some providers like Storm Telecommunications), optical switching will increase provision and flexibility still further by removing the limitation imposed by physical configurations using Synchronous Digital Hierarchy (SDH) or Synchronous Optical Network (SONET) systems. Again, just like DWDM, this is a relatively non-disruptive upgrade to existing fibre networks.

However, the current instability and financial market's low opinion of telecoms companies does not offer an incentive for investment in DWDM equipment or widespread optical switching at present. Existing companies that are making no profit from their infrastructure today are highly unlikely to be willing to invest in expensive equipment in areas of oversupply and simply add to the glut of fibre, particularly at the expense of their existing revenue stream. New companies are also unlikely to enter areas where there is more than one incumbent supplier because they are unlikely to make a profit there.

Predicting the needs for City users at a micro-level is impossible without considerably more information and a case-by-case analysis. Requirements are always driven by company-specific factors such as:

- Business type - e.g. equity traders may each require multiple voice and data lines whereas office workers may require only a single voice line and LAN connection
- Number of users
- Type of application - e.g. equity trading requires dedicated, resilient high speed telecoms whilst browsing the Internet for research data and news could easily be accomplished through company-wide shared lines
- Pattern of usage - e.g. high activity periods may require more capacity on demand
- Building structure - some buildings are simply unable to accommodate wiring for extensive network infrastructures
- Cost - how much is the company prepared to pay

Typically, a medium or large company (or building) will have at least two network connections (e.g. bearer circuits) for resilience and capacity growth, though not necessarily from separate suppliers. Again though, this is dependent upon business requirements and may be limited by supplier choice and / or indifference.

### **4.3.3 Other Options**

The options for network provision available to users depend upon the bandwidth that the users require, driven by their business requirements. These could include, for example, service levels, customer support and, of course, cost, plus many others.

For small companies with limited bandwidth requirements, sub-megastream circuits may be sufficient. e.g. 512 Kbps or less. Cost-effective solutions exist today and include ADSL or leased circuits from a variety of suppliers such as AT&T or UUNet, plus dial-up solutions such as ISDN. Note as above though that ADSL solutions are not appropriate today if private network configurations and service level agreements are required.

All these options are available to larger companies too, with additional options such as microwave, laser or radio links (see the next subsection), fibre optic links (dark fibre and managed) and Internet-based VPNs.

In terms of infrastructure in the City of London, all the land-based communications networking requirements may be met from existing or planned network connections either with today's laid capacity or using the new technologies outlined above.

The main difficulty for users is likely to be gaining access to the infrastructure which may be just yards away but still not reachable due to commercial factors, as mentioned previously.

## **4.4 WIRELESS TELECOMMUNICATIONS**

### **4.4.1 Transitional Technologies to 3G Mobile Services**

As previously explained, GSM is limited to a maximum of 9.6 Kbps by its inherent voice channel, circuit-switched architecture and is classified as a second generation (2G) system. (First generation was the original analogue service - GSM is digital.) This is sufficient for simple text messages such as Short Message Service (SMS) text, but not for the rich multimedia content of today's applications.

stations. It is therefore more costly than GPRS but considerably cheaper than UMTS. It is unlikely to be implemented.

GPRS appears to be the preferred standard for the transition to 3G and, judging from some opinions, for some parts of the UK will be the closest they get to 3G systems for many years to come.

#### **4.4.2 Third Generation Mobile Phone Systems**

A new standard has been defined which offers a step-change in data throughput and the change to a packet-switched ('always-on') capability. It is called the Universal Mobile Telecommunications System (UMTS) or the so-called third generation (3G) mobile system. In theory, UMTS will offer packet-switched services at up to 2 Mbps though in practice it will probably be closer to 384 Kbps and will vary depending on cell load, whether the handset is moving or not, and other environmental factors such as antenna positioning.

The journey to 3G phone systems has recently begun in the UK with the Government's award in April 2000 of 5 new UMTS licences to operators at a combined cost of over £22 billion. This extraordinarily high cost, however, is raising significant doubts that the licence operators will ever see a return on their investment because the companies still need to invest significant sums (perhaps as much again) in building the networks themselves, which require new infrastructure. There are suggestions that operators will be permitted to share infrastructure (as recently agreed in Germany) but OFTEL may prohibit this on the grounds that it is unfair to incumbent suppliers who have already invested billions in their 2G systems.

Equally seriously, the operators have yet to convince the public that there will be sufficient new information services ('killer apps') that merit the expected relatively high cost of the service. Handsets and input devices are also not available yet that overcome the limitations of a mobile's small screen size today.

Furthermore, serious issues with billing have yet to be resolved. For example, if a user browses an information database and finds a document he wants to read, how will he know how much it is going to cost him to download it? On an 'always-on' network like UMTS, how will operators price voice calls which are traditionally charged for by the second? How will third party information providers get their bills to the users - directly or through the mobile operator bill? The billing systems will clearly have to be very flexible.

The new infrastructure will be similar in architecture (at a very high level) to GSM's except that it is estimated that the antenna coverage will need to be between 4 and 10 times as dense as today's to provide the high speed coverage envisaged. UMTS cells 'breathe' as they work, varying their reception radius as load goes up and down to preserve quality for users.

Clearly then, the identification of new antenna sites will be very important and at this stage, it is impossible to say whether the base station equipment will be smaller, the same or bigger than today's GSM kit, mainly because they have yet to be developed significantly beyond the laboratory. Similarly, positioning of antennae on the roofs or side of buildings is uncertain at this stage.

Combined with the factors outlined in Sections 3.4.2 and 3.4.3, this means that the Corporation may have to process many more applications for antennae sites, all of which may require more consideration of the health issues, thereby considerably

delaying the roll-out of the new services. The Corporation planning process may need to be revisited to ensure this does not occur.

BT Cellnet recently postponed the launch of their trial 3G network on the Isle of Man which had been scheduled for the end of May 2001. They cited problems with the software in the new handsets and have now delayed the trial until later in the year.

In general, however, it is expected that most operators will not be ready to launch their services for some years on the UK mainland and it is highly likely that, even then, 3G services will be confined to dense urban areas with significant business user population.

So, whilst the future of UMTS is not assured, the City of London is perfectly placed to embrace and encourage 3G, should it choose to do so when the operators are ready.

#### **4.4.3 Other Wireless Solutions**

There are alternative wireless technology solutions available or in the offing. The significant ones are:

- Microwave, laser or infrared point-to-point links (also known as fixed wireless)
- Wireless Ethernet LAN (IEEE802.11)
- Bluetooth

However, each effectively operates in its own geographical zone with its own advantages and disadvantages.

Microwave, laser and infrared links are the only options in the above list that compete with UMTS for wireless wide area networking links. They require line of sight connections which can be difficult to find in built-up urban areas. They do not require the broadcast use of the radio spectrum though, being unidirectional, and are relatively quick to install with high bandwidth available (2 Mbps or more). Suppliers such as Teligent provide small dishes or lasers and receivers that are installed on roof tops and the sides of buildings where possible.

However, Winstar, a large US company, recently took Chapter 11 protection to allow it to restructure its operation in the face of financial difficulties. Teligent also recently followed suit although it currently is confident of emerging from Chapter 11 in better financial health.

In spite of this, fixed wireless is a viable alternative in areas where competitive wire-based high bandwidth is not available.

Wireless LAN is a relatively new technology designed for in-building computer roaming, operating at up to 11 Mbps. It supports data transmissions only. Being based on radio, bandwidth is shared by the users of the LAN and significant limitations exist with base station numbers and configuration issues - contrast this with wired, switched Fast Ethernet LAN connections of 100 Mbps to every desk, which are becoming commonplace in City offices. It is clear that wireless LAN's usage will be confined to offices that require considerable mobility of their workforce or which have uniquely difficult wiring conditions (perhaps in a listed building). Wireless LAN can, however, be considerably faster than UMTS.

Bluetooth is a technology that has the potential to 'wire the consumer world up' and has been categorised as a 'Personal Area Network' technology. Cheap Bluetooth

semiconductor chips sets are being planned which will allow their cost-effective implantation into an enormous range of devices, from fridges and DVDs, to wristwatches and Personal Digital Assistants (PDAs). The bandwidth available, however, is just 781 Kbps which means it is unlikely to be adopted by computing devices much more complex than a PDA. Its range is limited to tens of metres too and so will probably make its presence felt only in the home market.

An added complication is that wireless LANs and Bluetooth devices use the same radio spectrum and so may interfere with each other. Bluetooth devices are likely to lose out in this environment due to their lower power output.

#### **4.5 INTERNET DATA CENTRES**

There are many thousands of suppliers of web hosting today, from very large to very small, and across many industries. For example, although web hosting is essentially IT systems hosting, many telcos without systems hosting experience jumped on the bandwagon in order to reach higher up the value chain so as to increase their margins which are being eroded in their own highly competitive industry.

As mentioned in Section 3.5, a common factor for all web hosters is that very few, if any, are making a profit from their web hosting activities alone and they are either relying on their other business streams to underwrite their web hosting business (e.g. IBM and Intel), or are relying on investors to fund them as they build their business (e.g. Exodus and Digex) in the apparent hope that the last man standing will win the game and pick up all the others' business at higher margins.

The crash of investor confidence in Internet companies has led to a huge number of Internet companies folding. They were the principal users of the web hosters, who are, after all, simply service organisations for the Internet industry. Given that high technology remains in the doldrums, it is likely that, like the telecoms companies mentioned above, there will be casualties, leading to consolidation in the industry.

This is already starting to happen as shown by Global Crossing's sale of its web hosting facilities to Exodus in January 2001 and Worldcom's recent purchase of Digex. This trend will continue and accelerate as investors withdraw from the market.

From the point of view of City users, it will therefore be important that they choose a web hoster that will be around for the long term. Although it is often possible to move suppliers relatively easily due to the nature of the service contracts, the reconstruction of sophisticated websites is not simple and any website facing the public that fails to work well during or after such a move could damage a company's credibility.

The likely winners in this marketplace are likely to be the IT companies at the top of the value chain (e.g. IBM), companies with early-mover advantages (e.g. Exodus) or companies with significant (and credible) co-supplier partnerships (e.g. UUNet with SiteSmith).

## **5. COMPARING LONDON WITH OTHER FINANCIAL CENTRES**

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This section summarises the qualitative analysis of New York and Hong Kong carried out using publicly accessible information and input from the surveys.

### **5.1 SUMMARY OF MAIN FINDINGS**

- New York has an outward-facing city department dedicated to encouraging ICT right across the whole city of New York
- New York has control over the appointment of telecoms operators
- The New York City Council is an active user today of new technologies such as artificial intelligence, handheld terminals and Intranet applications
- There is a perception that New York companies are more innovative in their adoption and use of technology in business, perhaps up to 18 months in advance of the City of London
- There is a perception that there are more service-orientated suppliers with more competitive pricing in New York
- The nature of the state in Hong Kong with its compact size makes broad initiatives much easier to action than in London
- Hong Kong claims to have the most business-friendly tax regime in the world by being simple and low
- Hong Kong recognises explicitly that SMEs are the backbone of their economy and provides services to support them. e.g. providing promotion and insurance of their activities
- Hong Kong has many telecoms operators in a relatively small area, promoting intense competition and leading edge technology adoption
- Since 1994, Hong Kong has committed over US\$600m to its Innovation and Technology Fund to support projects which contribute to upgrading local industry
- Hong Kong has recently revised its strategy to ensure it remains competitive and will ensure that the Government leads by example

### **5.2 NEW YORK CITY**

#### **5.2.1 Tax**

There is a tax reduction programme from 2001 to 2005 of \$1.2 billion. This is designed to help New York City's (NYC) economy produce new private sector jobs. Highlights include:

- Phase-out of Commercial rent tax
- Extension of co-operative / condominium property tax relief
- Introduction of City-earned income tax credit
- Reduction in business tax rates

The finance department works with product and service suppliers interested in doing business with the *Department of Information Technology and Telecommunications* (DoITT).

### 5.2.2 Telecommunications Services

The City has 14 local broadband telecoms services franchises encompassing the 5 boroughs of the City of New York. A broadband franchise grants a franchisee the non-exclusive right to install, operate and maintain cable, wire and fibre around the property of the City of New York, to provide telecoms services.

The *Office of Franchise Administration and Planning* develops and administers telecoms policies, plans and programmes, and administers and maintains telecoms franchises and other agreements to ensure the City's voice, data and other infrastructure is diverse, competitive, accessible, reliable and meets the demands of NYC residents, businesses and governments.

Telecoms franchises and other agreements that are negotiated and administered by DoITT on behalf of the City of NY include: Cable TV, local high-speed telecoms services, mobile telecoms services and open video system agreements.

### 5.2.3 Support for Technology

The City of New York has had a *Technology Steering Committee* (TSC) since October 1998. The *Office of Technology* was created within DoITT to provide the TSC with staffing assistance in performing its mandated functions, such as recommending to the Deputy Mayor for Operations IT spending priorities for all City agencies, developing the city-wide IT strategy and sponsoring city-wide technology initiatives.

The Office seeks to identify IT best practices found in the public, private, and non-profit sectors and to implement them city-wide when appropriate. In this way, it operates as the city-wide clearing-house for IT-related issues. For example, it helps City agencies find information about specific technologies, discovers what other governments are doing with technology and co-ordinates efforts among City agencies interested in similar technologies such as document imaging and geographic positioning systems.

The TSC members are senior executive members:

- The Commissioner of the DoITT
- The Director of the Office of Management and Budget
- The Director of the Mayor's Office of Operations

New York also has a forward-thinking department known as the Advanced Technology and Systems Development (ATSD) division. It includes four units: Advanced Technology; Systems Development; Information Sharing Technologies; and Forums and Training.

- The *Advanced Technology* unit of ATSD researches and evaluates emerging technologies and seeks to match these with City agencies. The most successful of these projects has been Tow Eligibility Interrogation Terminal (TOWIT), a palmtop PC-based system used by the Sheriff and City Marshals for checking license plates. Other technologies that have been evaluated include: Kiosks (which culminated in the CityAccess project); smartcards; voice recognition (currently in use by the Law Department for word processing); voice over Inter/Intranet; artificial intelligence (being used by the Department of Finance);

virtual reality; robotics; telephone management systems; intelligent transportation systems; bar coding; and knowledge management.

- The *Systems Development* unit with responsibilities that include the utilisation of the latest technologies to develop state-of-the-art computer systems for internal use by various DoITT divisions, as well as city-wide Intranet applications accessible via a standard web browser. For example, the Criminal Justice Data Sharing (CJDS) system has been implemented, which allows 14 City and State agencies to share vital data. Employees at any City agency can now use web-based applications to update a database that contains information about computer professionals throughout the city or browse a list of computer systems at an agency of choice. Also, divisions within DoITT now track cable TV complaints from NYC residents and complex financial data of private sector consulting companies doing business with the City of New York, all with ATSD-developed computer systems.
- The *Information Sharing Technologies* unit of ATSD evaluates and pilots technologies that enhance system development and simplify data sharing amongst City agencies and their contracting partners. E-commerce technology solutions are evaluated and piloted to facilitate information sharing. Application development tools that integrate business rule engines are examined as potential productivity enhancements.
- The *Forums and Training* unit sponsors user groups and forums. These currently consist of Records Management and Case Tracking forums and a PowerBuilder users' group. At these meetings, City employees can explore successful applications in use at various agencies and have the opportunity to seek peer advice concerning issues that they face. In addition, this Unit offers training opportunities for DoITT personnel including comprehensive project management skills programmes. DoITT personnel also attend management and professional seminars offered by independent vendors.

### **5.3 HONG KONG**

#### **5.3.1 Tax**

Hong Kong claims to be the most business-friendly tax system in the world by being simple and low:

- Taxes are levied on three types of income only - on profits, salaries and property. There is no value-added or sales tax nor any capital gains tax. Only income sourced in Hong Kong is taxable.
- Profits are taxed if they arise in or are derived from Hong Kong as a result of a trade, profession or business. The tax rate is 16% for corporations and 15% for other businesses.
- Everyone with a Hong Kong income arising from any office, employment or pension is liable to salaries tax. The rate of tax after deductions and allowances is applied on a graduated scale but the total salaries tax charged will not exceed 15% of a person's total assessable income.
- Owners of land and / or buildings in Hong Kong are charged property tax, which is based on the property's rental income. The rate of tax is 15% on the annual rent receivable less a statutory deduction of 20% for repairs and out-goings.

### 5.3.2 Telecommunications Services

Hong Kong has one of the most sophisticated and successful telecoms markets in the world. Firms in Hong Kong have access to inexpensive, reliable and technologically advanced telecoms and data communication services. For example, calls from Hong Kong to the US recently cost about 30 Hong Kong cents per minute, less than 4 US cents per minute or about what it costs to call between different states within the US.

Hong Kong's broadband network is rolling out rapidly. Figures from Feb 2000 show that 80% of all households and 100% of all commercial buildings were covered by the broadband network. 56% of all households are also covered through optical fibre cable to the building directly. Cable and Wireless HKT division has installed 1.5Mbps connections throughout much of the territory. With numerous ISPs, high speed data links including DSL lines and fibre optic cable coupled with private data pipes to Japan, the US and Europe, communications services are very good.

As at April 2000, there were some 4.48 million subscribers of cellular phone services offered by six operators - the penetration rate of more than 64% is the highest in Asia.

Following the expiry of the Hong Kong Telephone Company Limited's franchise on June 30, 1995, three more operators - Hutchison Global Crossing Limited, New T & T Hong Kong Limited and New World Telephone Limited - were licensed to compete with the incumbent operator in the local fixed telecoms market. The Government fully liberalised external telecoms services market on 1 January 1999. As at June 2000, 157 external telecoms services operators had been licensed to operate. Competition is keen and Hong Kong's telephone and ISP charges are amongst the lowest in the world.

The Government further liberalised the external telecoms facilities market from January 1, 2000. From then, the 3 major telephone firms in Hong Kong have been allowed to provide all types of external facilities. In addition, 14 successful applicants will be invited to operate non-cable-based external telecoms facilities and 14 to operate external telecoms facilities based on submarine or overland cables. Moreover, licences will be issued for the operation, with effect from January 1, 2003, for external telecoms facilities based on submarine or land cables.

The Government has introduced further competition in the local fixed telecoms market as well. Hong Kong Cable Television Limited was licensed to offer telecoms services over its hybrid fibre coaxial cable network. Five licences have also been issued for the provision of fixed telecoms services using wireless networks. Additional licences for fixed telecoms network services covering the construction and operation of new fixed wire-based networks will be issued for operation from 1 January 2003.

Greater competition in the local fixed telecoms market will result from the new services to be provided by the five new wireless FTNS licensees. All the five networks will be allowed to offer broadband services. They will roll out their networks covering different districts throughout Hong Kong. The enhanced competition is expected to lead to improvements in the quality of service, bring innovation and provide choice to customers.

### 5.3.3 Support for Technology

In an effort to foster technology development, the Chief Executive of Hong Kong appointed the *Commission on Innovation and Technology* in March 1998, which released its final report in July 1999. The Commission's role is 'to spearhead Hong Kong's drive to become a world-class, knowledge-based economy'. Amongst their responsibilities is the facilitation of the provision of infrastructure and development of human resources to support innovation and technology.

The Commission made recommendations on four major areas, namely the institutional arrangement (including the establishment of a policy group to set and co-ordinate policies), building up human capital (including quota-free admission of mainland talents to work in Hong Kong), fostering an innovation and technology culture (including the introduction of funding schemes to assist small entrepreneurs), and creating an enabling business environment (including further exploration on the feasibility of setting up a co-investment scheme providing government venture capital).

The government's HK\$5 billion *Innovation and Technology Fund* was also opened for applications from November 1999. The Fund was established to increase the capacity of local businesses to innovate and to stimulate technology development and application in Hong Kong. A recent revision of the strategy was announced in February 2001, launching the 'Digital 21 IT Strategy' to capitalise on their early successes. One of the key aims is to ensure that the Government leads by example.

A 'Cyberport' will also be developed in partnership with the private sector at a cost of HK\$13 billion. Indicative of Hong Kong's improving business environment for technology-based enterprises, a number of high technology companies, including Motorola, Nortel, StarTV, Sybase, 3M and Vtech, have also announced plans of investment in Hong Kong over the next few years.

## 5.4 OTHER COUNTRIES

Some survey respondents had direct experience of other countries or cities, in addition to New York and Hong Kong. Whilst this report has not researched other cities, their comments are included here for completeness.

- London is cited as better than Europe overall, particularly Paris and Tokyo, although one respondent suggested that the public perception of Tokyo was more advanced and business-like
- Some cities have metropolitan area networks. For example, Frankfurt, Stockholm and Singapore
- Singapore, as a city-state, was seen to be more progressive and able to mandate technology adoption. For example, every building in Singapore is required to have a broadband connection
- One respondent suggested that Paris and Frankfurt have clearer long-term objectives than the City of London
- Canary Wharf was seen as more friendly towards people and business

## **6. CONCLUSION**

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This report has investigated the development and importance of ICT infrastructure in the City of London with particular regard to Internet datacentres, wireless telecommunications and network cabling.

In addition to desktop research, input was taken from a wide variety of sources including over 30 suppliers and users in the City and the Corporation itself. A high-level, qualitative comparison of London against Hong Kong and New York was also attempted.

The main conclusions are summarised as follows:

1. Wire-based telecoms is (and will remain) extremely important for City users but at a high level, sufficient capacity exists or can be made available using new technologies as and when required. However, there are likely to be some areas of the City where access to the bandwidth is difficult due to environmental and supply factors, and the structure of the telecoms industry makes it very difficult to know what companies offer appropriate services. Additionally, there is likely to be some consolidation amongst the suppliers in today's difficult investment environment and there is little very incentive for investment in the new equipment that could greatly increase capacity in an over-supplied marketplace.
2. Network cabling is not under the control of the Corporation and there are areas in the Square Mile in which no more cabling can be laid. No powers exist to force companies to remove redundant cabling today, which would clearly be desirable in places. Whilst the Corporation is aware of which streets are being dug up at any time via the notification process, there is no way to control or co-ordinate this activity today in order to reduce disruption to City users.
3. Wireless telecoms is not important for City users at present but will become so over time. However, significant technical and commercial issues remain with 3G systems generally and only time will tell if they can be resolved.
4. The Stewart Report into the effects of radiation on humans from mobile telephony equipment concluded that no scientifically proven link exists today between radiation and harmful effects, and that handset radiation would represent a greater risk than mobile systems antennae, if any does exist. However, it recommended a cautionary approach which has changed the approval process for new antennae site applications. In addition, 3G systems require considerably more antennae to provide the much-talked about high speed data capabilities (perhaps up to 10 times as many). Combined with the City's unique skyline and historical buildings, this could be a major barrier to the implementation of 3G services in what would be a very desirable geographical area for the 3G operators.
5. Internet datacentres are not a priority for City users and do not need to be located in the City. For example, the Corporation of London uses COLT to host its website whose datacentres are in Wapping and West London. Indeed, it may be desirable for the datacentres to be geographically distant from the City in some circumstances. Web hosting companies use a wide variety of factors to choose their facilities' locations and not just cost, Internet peer node proximity and power supply. There is also likely to be some consolidation amongst the suppliers in today's difficult investment environment with only the major players surviving.

6. Power supply was cited by a third of respondents as being of concern to them. However, London Power Networks do not believe that there is anything fundamentally wrong today and have invested heavily in supporting infrastructure over the last few years. The Corporation may be able to help with a communications programme to disseminate appropriate information and bring parties together in a timely fashion.
7. The City of London is rated favourably by those respondents who had an opinion on technology, with particularly competitive telecoms in the Square Mile and access to a large pool of leading edge technical skills. However, a third did not know how the Square Mile compared with other cities, suggesting that the Corporation could usefully promote this highly positive facet of the City's business environment.
8. A few suppliers are aware of the Corporation's role in promoting technology in the City. However, the majority of suppliers and users do not know what the Corporation does in this regard suggesting a role to be filled.
9. Hong Kong and New York appear to have more coherent cross-city/state strategies for ICT, compared to London.
10. Transport in and out of the City is universally cited as a problem although acknowledged as still superior to many other centres.

There are plenty of actions that the Corporation of London can take to meet the challenges of ICT in the coming years. The next subsection suggests some next steps. Principally, the Corporation could take the lead in providing forums for information exchange and service development in the ICT arena.

## 6.1 PRACTICAL NEXT STEPS FOR THE CORPORATION OF LONDON

The findings of the study indicate a number of potential areas for attention. These are summarised in the following table.

Issue	Effect	Suggested Solutions
Lack of awareness of the Corporation's role in technology in the City	The City is unaware of what the Corporation can help them with regard to technology and may make inappropriate decisions without full information	<ol style="list-style-type: none"> <li>1. Make exploitation of technology an essential piece of all the Corporation's departmental strategies at least. For example: <ul style="list-style-type: none"> <li>• Systematically develop and implement electronic web-based systems for as many processes and services as possible</li> <li>• Vigorously pursue the recent upgrade and enhancement program of the Corporation's website</li> <li>• Implement leading edge solutions wherever possible</li> <li>• Make as much public information available on-line as possible</li> </ul> </li> <li>2. The Corporation of London should take an active role in promoting and integrating ICT in the City. This should include activity within its own organisation to disseminate and promote understanding of the importance of ICT to the City</li> <li>3. Open up Corporation buildings to third party suppliers, perhaps in partnership for technology demonstrations</li> <li>4. Provide a regular (e.g. monthly) <i>community</i> electronic newsletter, sponsored by Judith Mayhew, offering news, views, etc. Publish hardcopy of the same and post it to all the players in the City</li> <li>5. Provide kiosks at strategic public points in the City for user interaction. For example: <ul style="list-style-type: none"> <li>• Offering an electronic bulletin board service for input and comments on appropriate things</li> <li>• Requesting information from the Corporation website</li> </ul> </li> </ol>

Issue	Effect	Suggested Solutions
		<ul style="list-style-type: none"> <li>• Travel news</li> </ul> <ol style="list-style-type: none"> <li>6. Lead and sponsor roadshows to demonstrate Corporation capabilities. e.g. at railway stations and major conferences</li> <li>7. Provide Corporation-branded 'City Club' out-of-town serviced offices with full technology support for drop-in meetings, etc.</li> <li>8. Sponsor, form and / or run internally- and externally-focussed user groups for various technology issues, focussing on the identification of solutions for the problems and issues noted. For example: <ul style="list-style-type: none"> <li>• The development of 3G services with operators and users</li> <li>• Encouraging mast and infrastructure sharing where allowed by OFTEL</li> <li>• Demand forecasting for power and telecoms growth and provisioning</li> <li>• Interest groups by City company size. i.e. groupings for large companies, SMEs, suppliers, etc.</li> <li>• Co-ordination of road digging, perhaps by acting as a market-maker for those services</li> </ul> </li> <li>9. Act as a broker by providing and running for the City community an on-line business-to-business exchange for services like road-digging/cabling, office supplies, telephony services, etc., and use it in-house</li> </ol>
Lack of understanding of 3G mobile technology in the City	Delays the adoption of leading edge technology for the City's advantage	<ol style="list-style-type: none"> <li>1. Lead the education of City users in conjunction with suppliers and information service providers to demonstrate what it can do and why they should use it</li> <li>2. Encourage the provision of the services. For example: <ul style="list-style-type: none"> <li>• By proactively identifying and approving mast sites</li> <li>• Defining, publicising and streamlining the application process</li> </ul> </li> </ol>



Issue	Effect	Suggested Solutions
Amenities are not 24-hour	Expense is incurred by companies working 'global' hours for employee food and travel	<ol style="list-style-type: none"> <li>1. Allow development of more retail space in the City, with wider hours of operation</li> <li>2. Encourage Transport Authorities to run later services</li> </ol>

City power supply is not as stable or provided as timely

Companies are using UPSs

1.

2.

f

c

### **A.1 MAIN DRIVERS AND TRENDS**

Information, communications and technology (ICT) in the 1990s was influenced by a number of major factors:

1. A massive increase in *semiconductor* capabilities (driving huge increases in processing power and storage capacity per dollar) and allowing the creation of new, sophisticated applications and devices.
2. *Digitisation*, allowing a convergence of previously separate media types - voice, video and data - into single streams of information.
3. An increasing reliance on *telecommunications* bandwidth for all types of business.
4. The emergence of the *Internet* as a global force for change, destabilising many industries.

This resulted in a number of identifiable trends which have changed the way the world of business works today.

#### **A.1.1 PC-based Systems Architectures**

The introduction by 'Big Blue' in the 1980s of the IBM PC, based on the Intel microprocessor and an open hardware architecture, led to a legitimisation of the concept of microcomputers on every desk. However, it was the widespread adoption of Microsoft's first successful graphical user interface (GUI) operating system, Windows 3.0, introduced in 1990, that really caused a major shift in the office politics of computing. As the PC was within the purchasing authority of many business departments and the operating system software made it much easier to use, power effectively shifted from the old Data Processing Department to the end user as business departments diverted their expenditure.

Additionally, as applications became available for the PC (enabled by the increasing microprocessor power) which previously had been the province of the mainframe or mid-range system, yet more IT spend was redirected away from large central systems and IBM's dominance began to wane whilst Microsoft and Intel's began.

Microprocessor power increased throughout the 1990s following Moore's Law. (Moore's Law is not a scientific law but a popular maxim from Gordon Moore who, in 1965, stated that microprocessor power doubles roughly every 18 months. For the last 25 years, Dr. Moore has been proved right.) Central systems in many areas were replaced by large Intel servers with Microsoft Windows software (a combination referred to as 'Wintel'), connected by local area networks (LANs). PC clients accessed data and application on the server - the client-server architecture was born wherein data was retrieved from and stored in the server but most processing was done on the PC client.

Microsoft updated their operating system in 1995 with the introduction of Windows 95 and then in 1998 with Windows 98. Along the way, they also introduced their first real attempt at an enterprise-class operating system, Windows NT ('Next Technology') which became popular in the late 1990s.

The combination of powerful desktop PCs with LANs and large, central servers with plenty of storage, all at a considerably lower capital cost than the mainframes of IBM

and Digital Equipment Corporation, also drove the software application development industry to produce today hundreds of thousands of widely-varying types of 'Wintel' applications for every type of industry and niche. (The realignment towards the PC was underlined when Digital were bought by Compaq, the world's largest PC manufacturer today.)

The most popular PC application is, of course, electronic mail (e-mail). Today, almost everyone uses it from the President of the United States of America to pensioners. It is cheap (often free from the ISPs), fast and easy to use. Its enormous popularity has driven server sales growth and telecoms requirements throughout the 1990s and e-mail is now considered essential for business in the same way as the telephone and fax are.

### **A.1.2 Telecommunications**

Throughout computing history, telecommunications has played a part. Even inside the 'glass house' of the Data Processing Department, where large mainframes were operated, there has been a need for wiring to connect input/output (I/O) devices to the main processing unit(s). From simple card readers and VDUs to large printers and tape storage devices, all have been wired to the central system.

As access was granted to users outside the mainframe 'glass house', a need for telecommunications lines over longer and longer distances arose. Initially, a number of proprietary telecoms network protocols and architectures were designed to provide this reliability over long distances and poor quality lines (e.g. Systems Network Architecture, SNA, from IBM) using centrally managed, hierarchically structured network management software. Open specification network protocols of lower complexity were developed too by international standards bodies such as the International Standards Organisation (ISO), the most popular of which was X.25, a packet-switched network protocol, part of the Open Systems Interconnect (OSI) architecture.

However, even in the 1980s, data telecommunications very quickly became reliable as the quality of network infrastructures increased following massive investment from competing operators in digital, fibre backbones and switching equipment. The need for network protocols with large overheads dedicated to error correction was subsequently reduced.

As the popularity of the client-server architecture increased on LANs where network error correction was rarely needed, and the idea of a central, controlling network processor was anathema, the proprietary nature and excessive overhead of network systems like SNA was rejected in favour of a peer-to-peer protocol like Transmission Control Protocol/Internet Protocol, commonly referred to as 'TCP/IP' and often just 'IP'.

TCP/IP was developed on behalf of the US Department of Defense and quickly became the *de facto* network standard for non-mainframe, wide area network (WAN) communications to link servers together. (It is now also the standard LAN protocol too.) TCP/IP has the advantage that there is no single computer in control of the network so that in the event of a server outage or a telecoms link failure, the network can continue to operate by routing around the problems. Indeed, the widespread adoption of IP necessitates routers and as a result, Cisco, one of the first router manufacturers, is today one of the largest companies in the world.

TCP/IP also has a number of disadvantages, not least of which is a universal network addressing scheme that is running out of numbers and, being packet-switched in the WAN rather than circuit-switched, it is not able to handle time-sensitive data packets very well. (Both these issues are being addressed in IP version 6.)

For both the mainframe and the client-server architectures, users invariably need to use data stored on the servers. In the hierarchical mainframe world, this normally means that users are connected in a star or tree-like network, with the mainframe at the centre or top, where the data is. In the client-server architecture, users may need to access data on any of the servers in the network and so a mesh network is more efficient for this peer-type configuration. In either case, the need for telecoms links between users and data has increased.

Client-server architectures, IP and numerous Wintel applications such as e-mail are all commonplace today. Consequently, there has been an enormous demand for bandwidth to support the any-to-any networking required.

Additionally, mobile telecommunications exploded in the 1990s as the underlying infrastructure moved from analogue to digital systems and encouraged by healthy competition between innovative infrastructure operators. Within about 3 years in the mid-1990s, mobile phones changed from being an expensive, business-only tool to being more commonplace than the car. Today, over 67% of the UK population is believed to own a mobile phone, enabled by operators heavily subsidising the handsets and the introduction of pay-as-you-go tariffs.

Support for mobile data was also enabled by the implementation of digital mobile telephony using the GSM standard in Europe. Laptop computers can be equipped with GSM cards that allow them to link into a standard mobile handset for dialling into a network remotely. However, at a maximum of only 9.6Kbps, throughput remains slow and, as a result, mobile data is still a niche application for mobile telecommunications. Wireless Application Protocol, introduced in late 1999, has also been a disappointment to many because of the excessive connection times associated with slow speeds and the restricted screen interface to display the information.

### **Laptop mobile GSM Data Card**

Overall, however, the mobile phone's impact on business has been huge and along with e-mail, it has changed the way we work today.

### **A.1.3 The Internet and Digitisation**

Although it had been in existence for many years, it was only towards the middle of the 1990s that the Internet became general public knowledge. With astonishing speed, the Internet has been adopted as a central part of many companies strategies and no business can afford to ignore it.

The open, de-centralised, peer-based architecture and the *de facto* network standards used (TCP/IP) made it relatively simple and inexpensive for companies to participate. The rise was fuelled by a combination of initially cheap browser software and Internet Service Providers (ISPs), companies who provided connections into the global Internet backbone, first created as DARPA NET by the US Department of Defense to survive a nuclear war.

As competition intensified, the browsers were given away free by the two main players (Netscape, now owned by AOL, and Microsoft). In addition, ISPs began to offer free connectivity with no monthly 'membership' fees. Nowadays, members of the public seldom pay for more than their dial-up telephone charges to connect to an ISP.

In the late 1990s, the browser software also became more sophisticated, with modular extensions added to the free browsers to support multimedia applications which, for example, stream video and sound to the desktop and allow users to interact in real-time with each other (limited only by the speed of their Internet connections).

The addition of attractive graphics and the realisation that the Internet could fundamentally change many industries led to an explosion of consumer web sites and, briefly, the 'dot com' madness of 1999-2000 in which many millions were poured into business-to-consumer (B2C) companies who had dubious business plans to conquer the world from a single website. The bubble inevitably burst leaving many people out of pocket. However, a number of quality companies with sound business strategies and plans remain, and there is no doubt that they will change the way business is conducted in their target marketplace.

Today, almost every company has its own website and the Internet is used in the developed world by millions of people every day, having come from nowhere only 6 years ago. It is, without doubt, the fastest adoption of a new technology the world has ever seen.

### A.1.4 City Business and Infrastructure Effects

The following table summarises the major technology trends identified from the 1990's. It should be noted that some of the factors may overlap and / or interact, but they have been separated within the table for simplicity. For example, the rise of the Internet has enabled the proliferation of e-mail and PC viruses, as well as driving up the need for telecommunications bandwidth.

Development	Effect on Businesses and the City Infrastructure
<p>The PC truly arrived as prices came down rapidly and performance went up by a factor of roughly 100</p> <ul style="list-style-type: none"> <li>• <i>Computing moved out of the datacentre 'glasshouse', from the mainframe to the end-user, with the wholesale adoption of the PC</i></li> <li>• <i>IBM lost \$10bn in 1992 as the industry readjustment hit home and Microsoft began its domination of the desktop and server software market</i></li> <li>• <i>The 'client-server' architecture was born</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Computer costs reduced but overall total cost of ownership increased due to more support requirements driven by complexity and coverage of the PC</i></li> <li>• <i>Many new and innovative applications became available enabling faster, better decision-making. e.g. spreadsheet software</i></li> <li>• <i>Increased cost and complexity of internal building wiring (initially)</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Some increased power requirements</i></li> </ul>
<p>The Internet arrived</p> <ul style="list-style-type: none"> <li>• <i>Whilst it had been around a long time as ARPANET and then NSFnet, it only came to public attention when it passed into private hands in the mid-90's</i></li> <li>• <i>The take-up in developed countries has been extremely fast, well in excess of radio and television</i></li> <li>• <i>Now it is impossible to read a newspaper without an Internet reference somewhere</i></li> <li>• <i>However, the 'local loop' to the consumer or business from the Internet backbones remain relatively expensive or slow</i></li> <li>• <i>Cisco - producer of the network router - emerged as the world's</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>New channel to market for products and services with first mover advantages apparent</i></li> <li>• <i>Slow 'local loop' connections can limit practical usage of the Internet however</i></li> <li>• <i>New businesses / processes enabled &amp; created requiring decisions to be made far more rapidly than before</i></li> <li>• <i>Lowered barriers to entry and increased competition in many areas. e.g. Internet-only retail banking, Amazon bookstore</i></li> <li>• <i>More IT systems required to provide secure, protected gateways to the Internet ('firewalls')</i></li> </ul>

Development	Effect on Businesses and the City Infrastructure
<p><i>largest company, driven by the widespread adoption of the Internet data protocol, TCP/IP</i></p>	<ul style="list-style-type: none"> <li>• <i>Shortage of 'e-business' skills and need for more and better infrastructure to meet the challenge, driving up IT costs</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Greatly increased demand for wide area bandwidth (i.e. bandwidth external to buildings)</i></li> <li>• <i>Power supply requirements increase for many companies, including web hosting companies</i></li> </ul>
<p>Mobile phones became ubiquitous</p> <ul style="list-style-type: none"> <li>• <i>The plunging price of handsets coupled with intense competition, operator subsidisation and new 'pay as you go' pricing models, has led to mobile phone ownership in the UK of approximately 67% (at Jan 2001)</i></li> <li>• <i>Reception coverage of the UK rises to about 99% of the population</i></li> <li>• <i>Short Message Services (SMS) has seen a particularly rapid rise in usage with 750m messages per month sent today in the UK, up from only 4m per month in 1999. i.e. 180-fold increase in just over 12 months.</i></li> <li>• <i>However, mobile internet access with Wireless Access Protocol (WAP) in late 1990's was / is unimpressive and has not been used as a real business tool yet</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Many employees are provided company-owned mobile phones in order to support their work - again, for faster, better decisions but with accompanying increased costs</i></li> <li>• <i>SMS is beginning to be used for business purposes but mainly in the retail and entertainment sectors. e.g. advertisement of special sales offers or football scores.</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Antenna and base stations proliferating to support high concentration of users in the City</i></li> </ul>
<p>E-mail and voicemail exploded in usage</p> <ul style="list-style-type: none"> <li>• <i>The adoption of PCs and the installation of easy-to-use e-mail applications, all connected to the Internet with free e-mail forwarding by the Internet Service Providers (ISPs), has led to an explosion in the volume of e-mail sent and received ...</i></li> <li>• <i>... But along with e-mail everywhere came the PC virus</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Increase in need for virus protection, somewhat limiting the PC power that could potentially be exploited by developers due to necessity to stop damaging, active viruses. e.g. the 'love bug'</i></li> <li>• <i>Increase in computer hardware, software and telecoms to support e-mail systems</i></li> </ul>

Development	Effect on Businesses and the City Infrastructure
<ul style="list-style-type: none"> <li>• <i>Voicemail systems on Direct Dial Inwards (DDI) lines offer yet another asynchronous means of contacting people</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Need for e-mail (and Internet) codes of conduct for staff to avoid potential legal issues</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>More fixed line telecoms bandwidth required</i></li> <li>• <i>Internet service provision required, though not necessarily serviced from within the Square Mile</i></li> </ul>
<p>Voice Direct Dial Inwards (DDI) became widespread and Caller Line Identification (CLI) was installed by the national telcos</p> <ul style="list-style-type: none"> <li>• <i>Enabled by digital exchanges, the broad adoption of a DDI line for everyone in a company offers another way of ensuring callers get through to the right person directly</i></li> <li>• <i>CLI facilitated computer-telephony integration (CTI) applications which allow, for example, call centre staff to identify callers even before they answer the call, give automatic access to the caller's records, etc.</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>More sophisticated private automatic branch exchanges (PABX) required with skills to support them</i></li> <li>• <i>Reduction in numbers of switchboard staff to connect callers inwards</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Local exchanges needed to be changed from analogue to digital but this was not a problem as the digital exchanges are smaller and more efficient than the old analogue ones. Underground cabling is generally unaffected although telcos also installed fibre where possible for projected increases required in capacity</i></li> </ul>
<p>IT skills shortage experienced</p> <ul style="list-style-type: none"> <li>• <i>The increasing dependence of business on IT and its rapid evolution and increase in complexity has led to a shortage of skilled personnel across the world</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>General across-the-board shortage of IT skills but in some particular skills areas (e.g. e-business and security), shortages are particularly acute; in the face of the shortages, contractors and consultants are often the only way to get things done quickly</i></li> <li>• <i>IT salary costs have risen rapidly</i></li> <li>• <i>Projects are having to be delayed, impacting business growth</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Similar to the businesses in the City. i.e. lack of qualified and</i></li> </ul>

**Development**

**Effect on Businesses and the City Infrastructure**

Development	Effect on Businesses and the City Infrastructure
	<p><i>appear to fill the gaps. e.g. HighSpeed Office, Regus, IntelliSpace</i></p> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Some telecoms requirements though not significant as many outsourced systems and staff remain on company sites</i></li> </ul>
<p>Structured cabling arrives</p> <ul style="list-style-type: none"> <li>• <i>Enabling LAN-based delivery of information such as TV and voice to desktops (reducing cabling in buildings and screens on desktops)</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Wholesale (and expensive) re-wiring required in buildings, although maintenance cost reduction possible thereafter due to fewer separate cabling systems and ducts to maintain</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>No significant effect - internal effects only</i></li> </ul>
<p>Businesses use predominantly land-based, private computer networks</p> <ul style="list-style-type: none"> <li>• <i>Medium and large corporates, wary of security risks to their data and sensitive to their business systems performance, shun the Internet for business applications</i></li> <li>• <i>Only relatively small usage of satellite and wireless data networks in specialised roles. e.g. delivery truck tracking and despatch, specialised broadcast TV channels such as horse racing</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Multiple network connections and corporate networks to support voice, video and data to multiple clients and / or suppliers, with multiple service level requirements. Consequently, high telecoms overhead costs and management complexity</i></li> <li>• <i>Many larger corporates outsourced their networks due to complexity and scarcity of skills to large multinational telcos like Concert or Global One</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>More telecoms bandwidth required</i></li> <li>• <i>Some machine room property requirements for new entrants to the market in the City</i></li> </ul>
<p>Multiple WAN and LAN data protocols existed - SNA, X.25, IP, NetBIOS, IPX - but converged on IP towards the end of the 1990s</p> <ul style="list-style-type: none"> <li>• <i>Networks were often complex, having to carry various protocols</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Multiple data protocols resulted in increased skills requirements and consequently higher costs for networks and applications</i></li> </ul>

Development	Effect on Businesses and the City Infrastructure
<p><i>and data types</i></p> <ul style="list-style-type: none"> <li>• <i>Applications were generally written to support only one network access protocol causing greater expense and integration costs / inefficiencies</i></li> <li>• <i>The emerging dominance of IP, an open protocol used on the Internet, drove the other protocols into niche areas and extinction in some cases</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Businesses often ran separate networks (either physically or using multiplexing techniques) to ensure manageability, resulting in higher bandwidth requirements and attendant costs</i></li> <li>• <i>As IP became the de facto standard, other protocols were either encapsulated or, more often, eliminated (usually dependent upon the target application being accessed). This resulted in a rationalisation of telecoms connections and cost. However, increased demand for new applications and the Internet has meant bandwidth capacity requirements have rarely been reduced in total, except in the short-term</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>In theory, less telecoms bandwidth required as rationalisation and line sharing is possible. In practice, new applications and the Internet has meant this effect is rarely apparent</i></li> </ul>
<p>Multiple access methods and information sources, each with their own devices - PC / web, TV, Personal Digital Assistant (PDA)</p> <ul style="list-style-type: none"> <li>• <i>Increasing numbers of data sources and delivery devices exist, each with their own advantages and disadvantages, increasing complexity for business and IT</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Apart from increased support requirements and costs, multiple access methods often each require different coding and presentation methodologies on the delivery systems to ensure correct operation. e.g. the same data for a PC screen must be reformatted for display on WAP devices or PDAs</i></li> <li>• <i>More skills and costs with complex management by both systems departments and end users</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>No significant effects</i></li> </ul>
<p>Word-processing &amp; spreadsheets widely adopted with some basic programming built-in</p> <ul style="list-style-type: none"> <li>• <i>Leading to the empowerment of the end user over the old, slow 'DP department'</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Proliferation of end user-developed applications has enabled faster analysis and decision-making</i></li> </ul>

Development	Effect on Businesses and the City Infrastructure
	<ul style="list-style-type: none"> <li>• However, end user support requirements have increased as the ability to damage PCs is far greater</li> <li>• Some administration roles have been eliminated (e.g. the 'typing pool' support)</li> </ul> City Infrastructure: <ul style="list-style-type: none"> <li>• None</li> </ul>
Audio- and video-conferencing becomes generally available <ul style="list-style-type: none"> <li>• Specialised companies offering dial-in audio-conference facilities have been created that allow teams of people to communicate wherever they are in the world</li> <li>• Video-conference equipment drops in price to become affordable for many companies but still requires specialised (though increasingly common) telecoms infrastructure</li> </ul>	Businesses: <ul style="list-style-type: none"> <li>• The ability to conduct meetings remotely has enabled a reduction in travel expenses for widely scattered teams</li> </ul> City Infrastructure: <ul style="list-style-type: none"> <li>• Video-conferencing requires relatively large and dedicated digital bandwidth. ISDN-2 is the minimum and has driven up demand for telecoms to support it</li> </ul>
e-Business the 'next big thing' at the end of the 1990s <ul style="list-style-type: none"> <li>• Huge investments made in 'dot com' firms for business-to-consumer (B2C) and business-to-business (B2B) in a 'gold rush' for pole position</li> <li>• Thousands of new start-ups entering traditional markets, causing significant disturbance to old incumbents</li> </ul>	Businesses: <ul style="list-style-type: none"> <li>• Almost every business is now expected to articulate how it will rise to the challenge of e-business in order to survive</li> <li>• Many businesses have invested significant sums of money in web hosting operations, either in-house or through an external outsourcer</li> </ul> City Infrastructure: <ul style="list-style-type: none"> <li>• Demand for more space to house the necessary IT infrastructure, including raised flooring, air conditioning, power and telecoms</li> <li>• Outsourcers require huge amounts of bandwidth, cooling and power in relatively small floor foot prints</li> </ul>
Telecoms suppliers investing heavily in infrastructure - COLT / Level	Businesses:

Development	Effect on Businesses and the City Infrastructure
<p>3, MCI Worldcom, BT, Thus, 3Com in the City of London</p> <ul style="list-style-type: none"> <li><i>The granting of operating licences to many companies, particularly in areas of high concentration of wealthy, bandwidth-hungry users such as in the City, has led to strong competition and falling prices</i></li> <li><i>Many are laying fibre in anticipation of high bandwidth requirements and convergence of media and data types</i></li> <li><i>However, non-business areas are relatively poorly served and telecoms remains a significant issue for many companies unable to take advantage of increased availability, wider services and competitive pressure</i></li> </ul>	<ul style="list-style-type: none"> <li><i>Wide availability of cheaper and much larger bandwidth in a very competitive market from multiple suppliers</i></li> <li><i>However, to benefit, companies need to be in these competitive areas leading to a concentration and high demand for space</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li><i>Congestion on the roads as all the suppliers dig them up to lay cables</i></li> <li><i>Multiple ducts, usually unmapped, under the roads</i></li> </ul>
<p>Digital data drives convergence of media</p> <ul style="list-style-type: none"> <li><i>Software technology with powerful PCs can now store and use digital data from media that was previously stored separately. e.g. sound and image</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li><i>Multimedia is a reality on today's average business PC, requiring businesses to plan for yet another delivery / presentation channel for their products and services</i></li> <li><i>Digitisation of information has potential to significantly rationalise infrastructure elements by removing need for separate systems. e.g. voice over IP, PC server-based PBXs</i></li> <li><i>Copyright issues become apparent and legal rights significantly harder to enforce. e.g. Napster's infringement of record companies copyrights</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li><i>No significant effects</i></li> </ul>
<p>e-Commerce meant Electronic Data Interchange (EDI) and EDIFACT / X.12 until the late 1990s</p> <ul style="list-style-type: none"> <li><i>EDI is seen as an enabler for electronic business transaction processing only, to eliminate paperwork and delays</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li><i>Reduction in time to market and cost of new applications that can speed new processes and services</i></li> <li><i>Removal of the 'middlemen' of EDI, the value-added network</i></li> </ul>

Development	Effect on Businesses and the City Infrastructure
<ul style="list-style-type: none"> <li>• <i>It took many years under the auspices of the UN to define electronic versions of common business documents such as orders and invoices. Even now, there are not many documents defined</i></li> <li>• <i>Relatively high entry costs, driven by legacy application integration difficulties and proprietary software and networks, meant that only the big companies used EDI in anger, often subsidising its use for their smaller suppliers</i></li> <li>• <i>With the appearance of the Internet, with its standard, open application interfaces (eXtended Markup Language, XML), common interfaces (e.g. Internet browsers) and network protocol, e-commerce became much easier and cheaper as entry barriers were lowered dramatically</i></li> </ul>	<p><i>suppliers such as GEIS, and their replacement by direct connectivity, business to business, based on public networks, thereby reducing costs</i></p> <ul style="list-style-type: none"> <li>• <i>Criticality of reliable systems operations increased for many businesses as IT moves to the centre of the value chain</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>No significant effects</i></li> </ul>
<p>Call centres appeared</p> <ul style="list-style-type: none"> <li>• <i>Characterised as the modern day sweat shop, in fact call centres offer companies many varied services which they could not afford to provide themselves on an expensed basis. i.e. to pay per call made or received. Examples of services offered today are telesales and customer help desk support</i></li> <li>• <i>Today's call centres are enabled by highly sophisticated telephone PABXs, allowing companies to monitor closely the activities of their staff and automatically route in-coming calls to the right person for handling</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Call centre enable businesses to cut costs by allowing others to do the work on a per-call basis, eliminating the need for staff such as telesales and releasing office space to more business-critical needs</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Call centres are often found in areas of relatively cheap land and high unemployment to maximise the cost-efficiencies. They are unlikely to be found in the City of London but if they were to be located there, they would need highly resilient, large capacity telecoms links with good, redundant power supplies</i></li> </ul>

### **B.1 MAIN DRIVERS AND TRENDS**

It is notoriously difficult to predict the future of technology in an industry that changes so rapidly, when a breakthrough can, almost overnight, completely alter the competitive landscape and render useless previously dominant technologies and companies.

The Year 2000 bug slowed technology uptake towards the end of the 1990s as companies concentrated on ensuring that their existing systems would work on 1 January 2000. However, now that challenge has passed, technology uptake will doubtless remain as rapid as it was prior to the slowdown.

A number of technical factors are clear for the decade ahead:

1. *Processing power* will continue to increase, whilst reducing in size and cost, at least for the first half of the decade. The availability of faster systems with plenty of storage will result in huge data stores which can hold enormous customer information for analysis.
2. The *demand for bandwidth* will continue to grow, centred around Internet applications and a growth in the numbers of information sources. New optical switching systems and multiplexing/encoding techniques will allow the exploitation of existing fibre infrastructure far more efficiently too, permitting service levels to be significantly increased and even guaranteed on the Internet.
3. *Mobile data* will become a practical reality with the implementation of 3G / UMTS networks, specialised handsets and Bluetooth networks. Some wireless networks in the office and home will also be implemented.

Therefore, the next decade will see a continuation of the themes of increased connectivity and computing power, with ubiquitous access to the Internet (at least in the developed world).

Major themes for the coming decade are outlined in the following subsections.

#### **B.1.1 Multiple Device Types**

The increasing computing power will filter down into smaller, cheaper devices with embedded microprocessors performing more specialised tasks. Personal Digital Assistants (PDAs) are already appearing which have hybrid functions. For example, there are GPS, digital camera and mobile phone snap-on devices for the Handspring PDA. The Blackberry device is due to be introduced in the UK in July 2001 by BT to offer wireless e-mail and calendar updates, synchronised to remote servers. A wristwatch running Linux was demonstrated by IBM's Wearable Computing Program Division at CeBIT trade show in March 2001. The Trium Smartphone concept illustrates the type of devices that will appear which will combine a PDA with a mobile phone.

## **A Snap-On Modem with a Palm Pilot**

The many widely different end user devices will provide a major integration headache for the IT department, as users demand support and integration with their existing (and multiple) systems. The IT department will struggle to ensure data is updated correctly and securely over different connection media. To make it manageable, IT departments may have to take a leading role in evaluating technologies proactively to recommend the use of the best ones for the business.

Wireless connectivity systems like Bluetooth will also have a role in allowing the multitude of devices to mesh together relatively easily. However, wireless is unlikely to replace wired connections for the office, except for devices that do not need high speed connectivity such as today's PDAs.

### **B.1.2 Making Sense of the Data**

With the potential to store cheaply many gigabytes of customer data, the major challenge in IT and business towards the end of the decade will become how to make sense of all the data presentable to users.

It is possible that towards the end of the decade, simple artificial intelligence will become widespread, embedded in applications and devices, capable of selecting important information from the ocean of data and facts available. It will also make 'intelligent' decisions as to how it should be displayed to compensate for functionally restricted devices.

Along the way, industry programs like the Universal Definition and Description Initiative and .NET will attempt to allow systems to make decisions about the *meaning* of data that they access. This will certainly help but will not provide the whole solution.

### **B.1.3 Security**

A company's data must only be accessible by those permitted to access it. Legislation such as the Data Protection Act places an obligation on companies to protect data and only release or use certain elements of it. Management of the data will get much harder as companies seek to leverage their customer information and web-enable many elements of their customer relationship management. Cross-border issues will also be a problem with widely differing privacy laws in the EU and the USA, for example.

Data will have to be encrypted before it is transmitted across the Internet to avoid eavesdroppers. It may even need to be encrypted on company servers if they are reachable from a network.

Fortunately, encryption is available freely on the web using algorithms that have proved to be all but unbreakable. Attempts by governments to insert 'backdoors' into such software on the pretext of national security have also been resisted (although not before the US Government tried to prosecute Phil Zimmerman, the creator of PGP (Pretty Good Privacy) for exporting encryption technology without a licence).

Aside from access control, authentication of identity over the Internet will be enabled by the adoption of Public Key Infrastructure (PKI) systems. Legal status will be given to electronic documents and signatures for binding contractual agreements. Companies will therefore need to manage very carefully the issuing and storage of PKI certificates for obvious reasons.

In addition to the technical precautions that a company can take to protect their data, their security systems management processes must be comprehensive and applied continually without exception. For example, most hacking involves break-ins through known 'holes' in the security software so companies need to be vigilant and apply all fixes that are issued as soon as practically possible. They may also need to actively monitor hacker websites and industry bulletin boards. Staff with access to the most critical data must also be carefully monitored - most theft occurs from the inside of a company and computer data is no exception.

Specialist companies exist that will attempt to hack into a company's system to test their defences (this is known as 'ethical hacking'). These companies do not just rely on electronic means - they will even telephone companies and pretend to be a staff member to get ids and passwords reset, for example. This emphasises that it is not just a case of some software and a few processes - security will have to be inherent to a company in the future.

### B.1.4 City Business and Infrastructure Effects

The following section summarises the major technology trends predicted for the 2000's. It should be noted that some of the factors may overlap and / or interact, but they have been separated within the table for simplicity.

Development	Effect on Businesses and the City Infrastructure
<p>The Internet bubble bursts - reality returns</p> <ul style="list-style-type: none"> <li>• <i>The 'dot com' rush vanished almost as quickly as it arrived, leaving a trail of companies without any customers or cash</i></li> <li>• <i>The survivors will be the ones that have a sound &amp; profitable business model, with strong brand recognition in their marketplace</i></li> <li>• <i>However, it remains unpredictable today which Internet companies will survive, especially those without the backing of a 'bricks and mortar' company. i.e. the backing of a company making real profits to fund the web operation</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Some suppliers will disappear or be swallowed up. Competition may decrease in some areas resulting in interrupted service and rising prices</i></li> <li>• <i>However, stability and sobriety will ultimately leave 2 or 3 of the 'best in class' suppliers in most cases (judged on more than technical skills)</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Some office and machine room space will become vacant and power consumption may drop but overall this will not be significant as most start-ups are small and even datacentre operators, like the web hosters, will most likely be relinquishing largely unpowered space</i></li> </ul>
<p>Business uses the Internet in new ways, rather than as an automation tool for old processes or a new sales channel</p> <ul style="list-style-type: none"> <li>• <i>For example, technology will break down barriers to entry forcing organisations to enter into joint venture to survive. e.g. complementary mergers (like LIFFE with LSE) and/or geographical with US or Europe companies</i></li> <li>• <i>On-line B2B exchanges may be formed which cut across existing, traditional arrangements. As their advantages become apparent, a momentum to use them will evolve</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Profound changes are possible with complete replacement of traditional marketplaces and working patterns. Once a momentum builds to convert to an electronic marketplace, for example, it will be unstoppable.</i></li> <li>• <i>Knock-on effects will be a need for more and reliable telecoms, more IT power and infrastructure in buildings but possibly a vacation of space as companies relocate away from expensive offices in the City</i></li> </ul> <p>City Infrastructure:</p>

Development	Effect on Businesses and the City Infrastructure
	<ul style="list-style-type: none"> <li><i>If companies choose to remain in the Square Mile, there will be a need for more telecoms and possibly more power to supply new critical systems</i></li> <li><i>However, if the changes allow companies to reduce their expensive office space in the City, there may be a negative effect on the same infrastructure</i></li> </ul>
<p>Complete convergence on IP as the only LAN and WAN protocol around. The shortage of IP addresses is lessened as IP v.6 (aka <i>IP Next Generation</i> or <i>IPng</i>) arrives</p> <ul style="list-style-type: none"> <li><i>The ubiquity of IP, used end-to-end throughout network infrastructures, will allow tighter integration of business processes and chains, inside and outside a company's own systems, across an enormous array of devices at a lower cost</i></li> <li><i>IP v.6 allows many more IP addresses, and adds security and elements of 'quality of service' to the protocol. Intermediate technologies such as proxies, deployed to efficiently allocate and use IP addresses, are therefore no longer required for their original purpose. (However, they will probably remain in place for management and security purposes.) The major consumer of new IP addresses will become smaller, networked devices, including mobiles</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li><i>Legacy networks and applications disappear as IP becomes all-pervasive, saving significant cost and manpower</i></li> <li><i>Application development will become relatively less costly</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li><i>No significant effects</i></li> </ul>
<p>LANs upgraded to switched gigabit speeds</p> <ul style="list-style-type: none"> <li><i>To deliver voice, video and data to the desktop to exploit the ever-increasing power of the PC, without creating bottlenecks that deployment, will require the upgrade of LAN infrastructures in buildings</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li><i>For many companies, to exploit a new generation of applications on the desktop will require a rewiring of their building and replacement of some or all of their LAN switches and hubs. This will be costly</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li><i>Once the enabling infrastructures are in place, the need for</i></li> </ul>

Development	Effect on Businesses and the City Infrastructure
	<p><i>bandwidth external to the building will be driven up as companies begin to exploit the new capabilities between buildings and their clients</i></p>
<p>PC power increases - but without applications to utilise it</p> <ul style="list-style-type: none"> <li><i>Processor power will continue to climb as semiconductor capabilities are stretched to their theoretical limits and new technologies are implemented. e.g. copper on silicon</i></li> <li><i>However, 'killer apps' may not appear to use the power available on the desktop (but see 'Multiprocessing' below)</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li><i>Without the killer applications to use the processing power, the PC hardware market will suffer from slowing demand. Software already drives the PC hardware replacement and upgrade cycle, and this will be reinforced still further</i></li> <li><i>However, the increased power will allow applications that were previously only possible on larger Unix machines or mainframes to be done on the desktop. These type of applications are not mainstream though (e.g. geodesic data analysis and financial derivative modelling) so the effect will be minimal on business</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li><i>No significant effect</i></li> </ul>
<p>'Thin client' makes significant in-roads into the PC market due to total cost of ownership (TCO) considerations</p> <ul style="list-style-type: none"> <li><i>The PC and its software increases in complexity but so does the support costs, in spite of attempts by software manufacturers to make their products self-servicing</i></li> <li><i>In an effort to reduce cost, many companies will install simpler, cheaper PCs ('thin clients') with restricted capabilities to simplify support (or they will use older PCs with lesser capabilities). Applications will be run on central servers and the thin clients will be relatively simple terminals displaying the data. Only 'super-users' will have full function PCs with the fastest processors. e.g. financial analysts or scientists</i></li> <li><i>In other words, IT architectures will return to large, centrally run</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li><i>As thin client is implemented, assisted by good, fast telecoms links, support costs should be reduced significantly as they can be centralised in just one or two sites</i></li> <li><i>Because the servers become critical again for running end user applications, businesses may need to build more LAN infrastructure (and in places, WAN) to ensure that they are always accessible</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li><i>More WAN bandwidth will be required, with higher reliability</i></li> </ul>

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<p><i>and supported servers, with distributed, relatively dumb terminals, very similar to the architecture from the days of the mainframe</i></p>	
<p>Multiprocessing becomes widespread for financial analysis and other apps</p> <ul style="list-style-type: none"> <li>• <i>The increasing power of systems is opening the door to new applications that previously could only be done on extremely expensive super-computers, if at all. e.g. the financial analysis of derivatives</i></li> <li>• <i>Multiprocessor systems are now commonplace in high-end servers, offering concurrent processing of data and increased reliability (albeit at a higher cost than single processor systems)</i></li> <li>• <i>In addition, power unused on the desktop could be harnessed by creating a massive web of seemingly independent PC processors across floors and even buildings. This approach is already in use in a loosely connected way for the Search for ExtraTerrestrial Intelligence (SETI) initiative wherein 1.6m keen amateurs around the world have downloaded a 'SETI@Home' screensaver which processes incoming space data on SETI's behalf, analysing for extraterrestrial radio signatures, and mails back the results on reconnecting to the Internet. A corporation's PC population could then be utilised out of working hours to perform tasks previously done by much larger, expensive machines</i></li> <li>• <i>Essentially, the ubiquity of IP networking, enabled by the operating systems' clustering capabilities and applications, will allow a closer integration of the individual processors regardless of geographical proximity, greatly increasing cost-efficiency of the PC assets</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>How much effect multiprocessing will have will depend upon whether the appropriate application exists</i></li> <li>• <i>If it does, at the desktop, a multiprocessor 'web' will require good LAN connections. These are likely to be there already so the effect will be minimal, making this a very cost-effective way to use spare processor power</i></li> <li>• <i>At the server level, multiprocessing will allow the development of new products in the financial area at a cost-effective price. They will also increase availability, reliability and serviceability of existing applications as it will become possible to maintain systems without having to power them down (something which the mainframe world has been used to for some years)</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Assuming the appropriate application exists, the only effect is likely to be an increase in power consumption outside normal working hours (which probably will not be significant as many systems are left on overnight today) and a potential increase in telecoms bandwidth required (again, probably not significant)</i></li> <li>• <i>A small knock-on effect of the increased reliability may be a reduction in back-up systems required</i></li> </ul>

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<p>Closer integration of multiple access devices will occur</p> <ul style="list-style-type: none"> <li>• <i>Today, we have multiple access devices from desktop PCs to mobile phones. These will be integrated and allow users to access their information from wherever they are and whichever device they have, particularly with the advent of new user interfaces such as natural language processing</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>There will be a significant increase in complexity, as the systems become interlinked. However, common programming standards, such as XML, SOAP and UDDI, will remove some problems</i></li> <li>• <i>The linking together of multiple devices has the potential to significantly increase building wiring requirements (but see 'Wireless office' below)</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Integration will affect chiefly internal infrastructure requirements</i></li> </ul>
<p>Java 2, Enterprise Java Beans (EJB), etc. - do or die</p> <ul style="list-style-type: none"> <li>• <i>The Java Platform was developed by server hardware company, Sun Microsystems, as an open, system-independent execution environment (Java Virtual Machine or Java VM) and language (Java) in the mid-1990s. It was/is an attempt to break the dominance of Microsoft in the Intel-based PC and server arena, by allowing programmers to write programs in Java once and run them on any system that supports Java VM without a rewrite, even mobiles, PDAs, etc.</i></li> <li>• <i>However, whilst it is generally well supported by Internet browsers and many operating systems, it has not achieved the broad acceptance that Sun and other Microsoft competitors hoped for in the business applications development industry. Native Windows and Unix applications remain dominant (ignoring 'legacy' operating systems on which little significant development is taking place)</i></li> <li>• <i>Java 2 is version 2 of the Java Platform, adding many enhancements. EJB also reinforces the server-based change in</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Businesses will have to choose one or other of the camps in which to develop their applications. It is likely that Microsoft 'shops' today will remain in the Microsoft camp and Java will be largely ignored</i></li> <li>• <i>However, the mid- to high-end server industry is dominated by Sun and IBM, both of which are pushing Java strongly. As servers again become the heart of the system (see 'Thin client' above), they are in a strong position. Microsoft recognises this and is far from complacent, having recently released its 'Datacentre' edition of Windows 2000, designed to offer features that Unix and mainframe systems have offered for years. So, the jury remains out on who will dominate in the mid-term future</i></li> <li>• <i>In both camps, there will be a need for more skills which are already scarce</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>No significant effect</i></li> </ul>

Development	Effect on Businesses and the City Infrastructure
<p><i>architecture (outlined above in the 'Thin client' entry)</i></p> <ul style="list-style-type: none"> <li>• <i>However, Microsoft has conspicuously fallen out with Sun recently in public and the courts, and is promoting its own Windows-based vision of the future, '.NET' (see below). The stage is set for a tough battle ahead for the web-centric future, one which is still too close to call</i></li> </ul>	
<p>The 'next generation' Internet - Microsoft .NET &amp; other initiatives such as UDDI</p> <ul style="list-style-type: none"> <li>• <i>Microsoft recently announced the .NET initiative (pronounced 'dot net'). This lays out a broad framework for Windows into the future, designed to allow users to access information at any time from any device, regardless of where it is. However, it is little more than a marketing announcement at present and it will take some months before it is clear whether Microsoft can deliver on their vision over the coming years</i></li> <li>• <i>Other initiatives are taking only a slightly less ambitious path. The Universal Description, Discovery and Integration (UDDI) organisation is a consortium of hundreds of companies (including Microsoft) leading the definition of a standard that creates a platform-independent, open framework for describing services, discovering businesses and integrating business services using the Internet. As such, it is essentially an automated 'yellow pages' for business services which will allow applications to find and use applets on the Internet seamlessly</i></li> <li>• <i>The significance of these initiatives is they both attempt to make business on the Internet easier and more automatic, reducing integration expense and speeding transactions. There is a tacit acknowledgement that everything will revolve around the Internet in the future</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>The intention of both initiatives is to make the Internet central to the way people work. Inevitably, this means that telecoms will be vital to mesh together many devices and applications</i></li> <li>• <i>As the Internet becomes ever more vital, the need for high quality services will be essential</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>The demand for telecoms will be increased, with multiple suppliers, physical fibre routes and ducts essential to ensure high levels of reliability and throughput</i></li> </ul>

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<p>Extensible Mark-up Language (XML), based on a 1986 UN standard called <i>Standardised General Mark-up Language</i>, is widely adopted to allow interoperability at a business level, not just the systems level</p> <ul style="list-style-type: none"> <li>• XML adds significantly to EDI and potentially allows SMEs (small and medium enterprises) to cost-effectively use electronic trading to reduce costs and increase efficiency</li> <li>• XML is a flexible, wide-ranging, well supported, open standard that allows the definition of what information <u>is</u> as opposed to just how it looks (as per HTML). It is a 'meta-language'</li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Businesses will increasingly be required to code in XML in order to interoperate on the Internet with their partners and customers. Skills will be scarce at first, driving up costs. However, this will be beneficial in the long run as the need to support multiple standards decreases. The long-term total cost of ownership of systems will fall</i></li> <li>• <i>There will be no significant effects on infrastructure requirements</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>No significant effect</i></li> </ul>
<p>Wireless office - Bluetooth and IEEE 802.11</p> <ul style="list-style-type: none"> <li>• <i>Wiring offices, particularly older buildings not built with modern systems requirements in mind, can be very expensive. With mobility enhanced by laptop computers, organisational change and geographically scattered ('virtual') teams, wireless connectivity holds great promise by allowing free movement within buildings (and without), untethered to desks</i></li> <li>• <i>However, there are significant limitations, particularly relatively low network access speed - Bluetooth allows under 1Mbps in aggregate, IEEE 802.11 allows 2Mbps - which must be shared by multiple devices. (Contrast this to a wired LAN where each PC can have 10Mbps to itself and 100Mbps is becoming commonplace.) In addition, multiple radio base stations are required, wireless LANs use unregulated radio frequency bands (already used by microwaves and other commercial data systems in many countries), there are problems with the first 'standard' resulting in incompatible implementations of the</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>As outlined opposite, the impact on the office environment is likely to be low except in restricted areas where there will need to be some base stations installed with the appropriate wiring</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>No significant effect</i></li> </ul>

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<p><i>technology and emerging security concerns</i></p> <ul style="list-style-type: none"> <li>• <i>Consequently, wireless technologies are likely to be used only in niche applications. e.g. sales and marketing suites where there is a lot of office movement. Office connections are likely to remain wired until significantly faster connection speeds are possible. However, in time, a hybrid environment is likely to appear which supports multiple device types such as PDAs and mobiles, which only need low data speeds</i></li> <li>• <i>In the home, where the slower speeds are not likely to be a problem, Bluetooth is likely to be widely adopted as chip sets become cheap and appliances become enabled with them</i></li> </ul>	
<p>Infra-red / laser / microwave as point-to-point alternative to wireless</p> <ul style="list-style-type: none"> <li>• <i>Infrared (IR), laser and microwave potentially offer a greater bandwidth than the wireless technologies currently envisaged. However, these technologies require a clear line of sight between sender and receiver and they are therefore not suitable for most internal office environments</i></li> <li>• <i>In spite of this, the technologies offer a good point-to-point, cost-effective, high bandwidth solution between buildings in close proximity to each other (upto 4 km)</i></li> <li>• <i>They also offer the possibility of fast implementation, requiring little in the way of road digging and plant</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Microwave, laser and IR connections will allow businesses to implement broadband connectivity when required in relatively short timeframes and at a reasonable cost</i></li> <li>• <i>Companies that already have fibre into their building will be unlikely to use it (assuming significant capacity remains on the fibre link they have). However, they may utilise it for back-up purposes where insufficient diversity exists in their telecoms supplier(s) and the appropriately placed buildings exist</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>The connections require small antennas / receivers to be installed at high points on the appropriate buildings. This may lead to a proliferation of antennas that cause public complaints about 'eyesores'</i></li> <li>• <i>There may also be some health and safety issues with microwave communications. However, with careful siting of the antenna on the roofs, this is a very minor problem</i></li> </ul>

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<p>Web collaboration</p> <ul style="list-style-type: none"> <li>• <i>Disparate teams can communicate with each other cheaply over the Internet, both synchronously and asynchronously, to securely share data and discuss information, etc.</i></li> <li>• <i>Software to enable this exists today and will become increasingly cheap (and probably free with operating systems and more sophisticated document management software)</i></li> <li>• <i>From today's text-only collaboration, video and voice will be also be shared through high speed collaboration sessions across the Internet, removing the need for private videoconferencing links and expensive equipment</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>The ability to work collaboratively but remotely from each other will enable team travel costs to be cut, and potentially office space costs too, as teams are enabled to work at home, their client site or wherever they happen to be without having to travel to physically meet each other</i></li> <li>• <i>General availability of broadband telecoms (or 3G) and encryption technology will permit voice and video links over the Internet to overcome today's limitations of data-only synchronous collaboration</i></li> <li>• <i>In the office, it may be necessary to upgrade the LAN, at least to a switch-based architecture, to enable the video and voice support</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>Yet more Internet bandwidth will be required with high speed, guaranteed throughput to enable full exploitation of this technology</i></li> </ul>
<p>Quality of Service arrives on the Internet</p> <ul style="list-style-type: none"> <li>• <i>Today, it is difficult to provide good quality voice and video over the Internet due to unpredictable end-to-end transit delays inherent in an unmanaged network of the size of the Internet</i></li> <li>• <i>IP version 6, along with massive increases in underlying network infrastructure, will allow Quality of Service (QoS) parameters to be specified for time-sensitive traffic such as voice or video across the Internet. ISPs may also start to offer differentiated levels of services for premium customers and applications</i></li> <li>• <i>However, the 'local loop' will remain an issue for small and medium sized companies due to high cost and / or</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>A reliable Internet, end-to-end, along with encryption technology such as PKI (see 'Security' below) will allow businesses served by Internet broadband connections to move away from private networks in all but special circumstances (e.g. extreme security requirements), reducing considerably telecoms costs in both circuit and support areas</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>A significant rationalisation of lower speed, private network connections is likely in business districts, adding capacity back into the available pool, potentially reducing the need for more network cabling. However, the effect is likely to be minimal as</i></li> </ul>

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<p><i>unavailability, at least until ADSL is more widely available, particularly in non-business districts</i></p>	<p><i>the capacity is likely to be quickly taken up by the increased Internet usage and there is no obligation on suppliers to remove redundant infrastructure in the ground</i></p>
<p>Emergence of Storage Area Networks (SANs) for data repository</p> <ul style="list-style-type: none"> <li>• <i>SANs have already started to emerge wherein companies store their data on a separate network, accessible by many others and consolidated to arrays of devices, more easily managed in one place for reliability and scalability</i></li> <li>• <i>Their usage will very likely extend across internal networks, driving the need for greater bandwidth to support the access-anywhere model</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>By centralising all the data and support, significant support costs can be saved</i></li> <li>• <i>Additionally, economies of scale are possible for hardware costs and the ability to react rapidly to changes in business data storage requirements are greatly increased</i></li> <li>• <i>SANs will need to be added on dedicated and high-speed LAN segments (usually fibre-based) to ensure the connection to the SAN does not become a bottleneck itself. This may require a rewiring of parts of the building</i></li> <li>• <i>By centralising the data, regular backup and disaster recovery planning becomes vital to ensure continued business operation in the event of problems</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>No significant effect (although some companies may require dedicated fibre links to their remote DR sites)</i></li> </ul>
<p>Out-tasking - ASPs and outsourcing further up the value chain</p> <ul style="list-style-type: none"> <li>• <i>Outsourcing will move further up the value chain into areas previously considered core to companies' businesses. For example, third party specialist companies are offering Human Resources services online. e.g. <a href="http://www.cubiks.com">www.cubiks.com</a></i></li> <li>• <i>Equally, the cost and complexity of core software support, often previously kept in-house despite outsourcing contracts, has led to the emergence of third parties called Application Service Providers (ASPs) who provide access to the latest software,</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>The ability to outsource specialised functions, departments and applications will appeal to many businesses who are reluctant to invest large sums of money in specialist staff, applications and IT support that may be hard to retain. In this regard, it will save them time, effort and money</i></li> <li>• <i>The use of ASPs (and some of the specialised outsourcing services) requires that companies have reliable telecoms of at least adequate capacity to access the applications, especially if</i></li> </ul>

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<p><i>such as SAP and Oracle, without the difficulties in acquiring, configuring and running the systems. Users require good telecoms to access the centrally-hosted system but pay only for what they use on an on-going basis, reducing capital expenditure and increasing flexibility</i></p> <ul style="list-style-type: none"> <li>• <i>Today, doubts remain that companies' data can be kept secure and private from other companies, and whether the ASPs business models are sustainable. However, in time (and enabled and even driven by web initiatives like .NET and UDDI), it is certain that variants of the major applications will be delivered that eliminate the concerns</i></li> </ul>	<p><i>the applications are business-critical</i></p> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>More telecoms will be required with redundant routing, etc.</i></li> <li>• <i>If the ASP or service provider is sited in the City of London, there may be a requirement for significant power supply in places. However, given the nature of the services, it is not necessary for the service provider to carry the expense of City property so long as their chosen location is well served by multiple telecoms and power providers</i></li> </ul>
<p>Complexity increasing with different platforms, integration difficulties, multiple input methods (voice, keyboard, pen)</p> <ul style="list-style-type: none"> <li>• <i>Natural language interfaces will gradually become available which can open computing and the Internet to users who previously were unable or unwilling to take part</i></li> <li>• <i>However, an unwelcome side effect is that with multiple access devices and user skill levels, businesses will need to ensure that their information is suitable for the presentation device and the user interacting with their system. This may be complex and expensive although some of the initiatives underway claim to be able to reduce or remove this problem</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Along with the complexity of integrating multiple access devices into the working environment (outlined above), companies will need to understand the limitations of certain interfaces and skill groups to fully exploit the technology. There will be a need for specialist knowledge from usability consultants and training for users will be very important</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>No significant effects</i></li> </ul>
<p>Mobile data connectivity moves to the next phase as 2.5G / GPRS and 3G / UMTS arrive, and mobiles become the most popular Internet access device</p> <ul style="list-style-type: none"> <li>• <i>General Packet Radio System (GPRS) is already running in the UK in selected areas and Universal Mobile Telecoms System (UMTS) network services will be implemented within the next 3-</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Once the problems outlined opposite have been overcome, business will be able to use mobile data to truly leave the office and yet still have access to all the data that is required</i></li> <li>• <i>Costs will initially be high for users and mobile data is therefore likely to be confined to applications which support high profit</i></li> </ul>

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<p>7 years</p> <ul style="list-style-type: none"> <li>• Data speeds will increase from the current 9.6Kbps for GSM to 115.2Kbps for GPRS and upto 2Mbps for UMTS (although 384Kbps is the likely maximum for UMTS and only 144Kbps is guaranteed). This speed is likely to increase but as yet, there is no 4G being proposed so throughput will have to be enhanced by more mobile antenna and better application encoding techniques</li> <li>• Significant issues must be overcome, including the huge cost of 3G infrastructure installation, billing for new 'always-on' services and limited capabilities of the handsets. It is likely that UMTS will coexist with GPRS and GSM for many years to come, particularly in rural areas</li> </ul>	<p>margin activities, such as equity trading, personal wealth management and executive information services</p> <ul style="list-style-type: none"> <li>• Companies may be able to make some money or receive preferential rates from the network operators if they command good sites within the City for antenna positioning</li> <li>• The real challenge will be to the service providers who have yet to convince business that there are 'killer applications' that will demand the use of GPRS and UMTS at a cost that allows the operators to make a profit</li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• Mobile phone companies will have to invest billions of dollars in constructing UMTS networks. Whereas GPRS networks can simply replace and co-exist with GSM networks, this is not the case for UMTS. UMTS also requires many more antenna to support the data speeds being touted. The cost for the infrastructure is accordingly going to be very high and network operators may face challenges finding enough antenna sites and paying for them. It is also likely that operators will never roll out the UMTS network to areas of low population density</li> <li>• The City is likely to be the first major commercial area to be covered by the network operators due to its high density of wealthy consumers of mobile phone and information services. There will need to be many antennas which may cause health &amp; safety plus aesthetic concerns amongst the public</li> </ul>
<p>24-hour world and globalisation - trading constantly requiring full service back-up and skills</p> <ul style="list-style-type: none"> <li>• The trend towards a 24-hour working environment will continue, driven by increased expectations set by the Internet</li> <li>• Businesses will require 24-hour service support and</li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• 24-hour working requires 24-hour amenities for people. For example, catering facilities will need to be provided in-house, particularly if there is nothing available outside company premises late at night</li> </ul>

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<p><i>infrastructure as they need to operate outside their standard working hours</i></p>	<ul style="list-style-type: none"> <li>• <i>Shift working rates are generally more expensive than normal rates and so staff costs will go up</i></li> <li>• <i>If no suitable transport infrastructure exists, companies will also have to provide car parking or transport of some sort for travelling home</i></li> <li>• <i>Support contracts may need to be revised to provide for maintenance and repairs of essential equipment out of normal working hours. This will inevitably cost more</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>If many people in the City demand it, restaurants and retail outlets will want to trade 24 hours a day too (as some of the supermarkets do already today), causing potential problems with environmental health (noise, litter, congestion, etc.)</i></li> <li>• <i>Transport will also be required for late night travel</i></li> <li>• <i>Utility and service support suppliers (e.g. telecoms companies) will need to provide full 24-hour coverage</i></li> </ul>
<p>ADSL arrives in UK at last - but slowly</p> <ul style="list-style-type: none"> <li>• <i>Asynchronous Digital Subscriber Line will become more widespread, driven by competitive and regulatory pressures</i></li> <li>• <i>The increased bandwidth will allow a better user experience of the Internet and permit the development of richer websites with sound and video becoming commonplace</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Cheap access to broadband Internet may transform business today. Companies will be able to cost-effectively put themselves on the Internet</i></li> <li>• <i>However, some companies will not be within the required 4km distance from a suitably enabled exchange, denying them ADSL. This is unlikely to be a problem in the City although the regulator, OFTEL, may have to force the pace from BT as it attempts to halt the cannibalisation of its other profitable private network services</i></li> <li>• <i>Additionally, a threat to companies' internal systems may arise wherein they could become a target for hackers and other</i></li> </ul>

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	<p><i>subversive groups as they remain on-line when previously they weren't. They will need to ensure that they are secure and this will cost them money</i></p> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li><i>To provide ADSL lines requires the connected telephone exchange be upgraded by the telco and the lines tested for suitability (noise, power levels, etc.). There may be some disruption to the City streets if remedial work is required on some of the lines</i></li> </ul>
<p>Convergence of infrastructure follows convergence of media</p> <ul style="list-style-type: none"> <li><i>As voice, video and data formats converge through digitisation, so will the transport infrastructure, increasing simplicity and reducing costs</i></li> <li><i>Voice over IP (VoIP) is available today, albeit in its infancy. Desktop voice handsets are now available that use IP and the same LAN infrastructure as network computers</i></li> <li><i>Digital TV and radio will replace today's analogue services towards the end of the decade freeing up more of the radio frequency spectrum</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li><i>When the technology has been proven and quality of service issues have been overcome, companies will be able to carry all their traffic digitally on a single network connection and therefore rationalise their infrastructure to reduce maintenance costs</i></li> <li><i>It is also possible that with the advent of new multifunction devices such as PDAs with add-on mobile phones, the desktop will converge onto just one or two devices, simplifying the desktop still further and reducing costs for support, maintenance, etc.</i></li> <li><i>Digital radio and TV also offers some interesting possibilities to overcome bandwidth throughput issues in areas with poor or no GPRS / UMTS coverage. It could offer the down-link whilst GSM with WAP offers the up-link. Business services for mobile data may therefore be more available for widespread consumption</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li><i>No significant effect</i></li> </ul>

Development	Effect on Businesses and the City Infrastructure
<p>Artificial intelligence (AI) will start to be used</p> <ul style="list-style-type: none"> <li>Artificially intelligent systems have been forecast for many years but have rarely made it to the real world. However, with the increase in affordable computer power, 'expert systems' are beginning to appear in the marketplace which allow a degree of 'fuzziness' in decision-making, basically by using rules, probabilities and matching patterns</li> <li>Take-up of AI systems will accelerate as complexity increases in many markets, speed of reaction becomes vital and certainty is no longer available</li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>Factors such as multiple channels to market, sophisticated systems and complexity of business are capable of generating overwhelming amounts of data. This presents enormous opportunities with enormous problems - how does business sort the wheat from the chaff? AI provides a possible way to do it fast and effectively by capturing the intelligence of a human in a narrow area and applying it to the mass of data, highlighting the information of value and thus worthy of further attention</li> <li>The cost to business is likely to be minimal beyond the AI software and there is a potential saving in time and people if companies do extensive analysis of their data today. However, it is more likely that the software will allow them to do today's analysis more efficiently. i.e. humans will not be replaced. (This assumes, of course, that the software is capable of doing the job properly!)</li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>No significant effect</li> </ul>
<p>Visualisation systems</p> <ul style="list-style-type: none"> <li>Already in use in large multinationals like BP, visualisation systems will become cheaper and more common. Based on very high powered computers coupled with virtual reality and/or 3D headsets or projectors, data will be presented in many different ways to allow users to see things differently and to make decisions using a much broader range of scenarios than today. Examples of use today include construction and financial modelling of derivatives</li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>The systems are likely to remain expensive for some time as they are particularly powerful and complex. However, they may allow the creation of new and innovative products and services which would be impossible to model in 2D on today's systems</li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>No significant effect</li> </ul>
<p>Security fears of e-commerce</p>	<p>Businesses:</p>

Development	Effect on Businesses and the City Infrastructure
<ul style="list-style-type: none"> <li>• <i>As systems move increasing on-line and connected to the Internet through simple-to-use software, security will become the single most important consideration for many companies</i></li> <li>• <i>Systems security will consequently gain an extremely high profile, including explicit representation at the Board of Directors level</i></li> <li>• <i>Public Key Infrastructure (PKI) will be adopted broadly at both corporate and personal levels for access authentication and non-repudiation purposes</i></li> <li>• <i>A significant side-effect will be the need for much stronger systems management disciplines to reassure business management and partners/customers, perhaps underpinned by third party audits of processes (similar to the British Standards institute 'kitemark' and Tick-IT standards)</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Companies will have to invest significant sums of money and expertise in ensuring they are 'bullet-proof' to hackers and terrorists. Given the shortage of expertise in this area, computer security services will become premium-priced services</i></li> <li>• <i>In some extreme cases, the openness of the Internet may lead to systems being taken off the net completely to ensure total isolation from the outside world for vital data</i></li> <li>• <i>Third party companies already exist to issue PKI certificates that underwrite authenticity. e.g. Verisign. Others with strong associated brand images will enter the market to provide services for companies and individuals. e.g. the Post Office</i></li> <li>• <i>Equally importantly, IT departments will need to wrestle with PKI certificate management issues that could have profound consequences in the event of failure. For example, if PKI certificates are inadvertently issued to the wrong person, a company could find itself liable for any purchase, defamation or illegal acts made in their name. Strong systems management and processes will become vital to stop this and will add an overhead and cost to the administration of certificates</i></li> <li>• <i>Also important will be the availability of disaster recovery facilities and telecoms to link to primary systems in the event of failures brought about by hacking, etc.</i></li> </ul> <p>City Infrastructure:</p> <ul style="list-style-type: none"> <li>• <i>No significant effect although it is likely that some telecoms will be required to connect companies to their DR sites</i></li> </ul>
<p>IT skills shortage gets ever worse</p> <ul style="list-style-type: none"> <li>• <i>With ever-increasing reliance on IT systems, skills shortages will become worse, particularly in e-commerce security</i></li> </ul>	<p>Businesses:</p> <ul style="list-style-type: none"> <li>• <i>Training and retraining will become important to ensure that there are sufficient people to fill the roles being created in IT by</i></li> </ul>

Development	Effect on Businesses and the City Infrastructure
<ul style="list-style-type: none"> <li><i>Business will realise that IT can no longer be a 'young persons' industry only and will accept that older, retrained and less experienced employees can be useful too</i></li> </ul>	<p><i>business</i></p> <ul style="list-style-type: none"> <li><i>Some projects are very likely to be delayed due to a shortage of required skills. This will have a knock-on effect on the competitiveness of companies in certain fast-moving markets, unless they increase their salary bills or employ consultants</i></li> <li><i>Outsourcing and out-tasking are likely to increase in key areas to avoid constant skills shortages</i></li> </ul> <p><i>City Infrastructure:</i></p> <ul style="list-style-type: none"> <li><i>No significant effect</i></li> </ul>

## ***APPENDIX C: INTERVIEW QUESTIONNAIRES***

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### **C.1 USER QUESTIONNAIRE**

**Company:**

**Name:**

**Title:**

**Tel:**

**Date:**

### ***Questions***

1. Please can you outline your role & responsibilities today?
  
2. What is your company's primary service(s), who are your main customers, where are they located and how do you communicate with them?
  
3. What changes, in terms of ICT, have been particularly apparent and / or important to you and your business in the last 10 years? How has this affected your existing accommodation and / or impacted on your future operational / property requirements?
  
4. What challenges, if any, have you faced recently with ICT and its infrastructure in the City of London? e.g. power, security or telecoms. How did you overcome them? Is there anything the Corporation can do to help overcome these barriers?
  
5. What technological challenges do you anticipate in the near-, mid- and long-term future?

*Specific Infrastructure Questions*

6. Please put the following in the order of most to least important to your organisation at the current time:

Wireless Telecommunications  
Internet Data centre  
Network Solutions  
Other? (please specify)

7. Why have you selected this order?

8. Please put the following in the order of most to least important to your organisation in the next five years:

Wireless Telecommunications  
Internet Data centre  
Network Solutions  
Other? (please specify)

9. Why have you selected this order?

*The Corporation of London & The City*

10. In the past, to what extent has the Corporation of London supported technology developments within the City of London and your organisation in particular?

A – very supportive  
B – supportive  
C – quite supportive  
D – not very supportive  
E – not supportive at all  
F – don't know

11. If anything, what could they have done better? What could they do now?

12. How do you think the City of London compares to other major financial centres in terms of technological development?

A – excellent  
B – good  
C – average  
D – below average

E – poor  
F – don't know

13. Have you got any examples regarding the status of other financial centres technological development to compare and contrast with the City of London? e.g. New York, Frankfurt, Tokyo, Hong Kong.
  
14. Is there anything that the City of London could do better in the future, to facilitate technological development in the City of London, and for your organisation in particular?
  
15. What is the least attractive thing about being located in the City of London (aside from cost)?
  
16. Have you any other comments or suggestions? e.g. areas for improvement, analysis, etc., in the area of technology and / or infrastructure (if you had a 'magic wand'...).
  
17. If we need to, could we contact you again? Yes / No

## **C.2 SUPPLIER QUESTIONNAIRE**

**Company:**

**Name:**

**Title:**

**Tel:**

**Date:**

### *Questions*

1. Please can you outline your role & responsibilities today?

2. What is your company's primary service(s), who are your main customers, where are they located and how do you communicate with them?
  
3. What changes, in terms of ICT, have been particularly apparent and / or important to you and your business in the last 10 years? How have they changed your clients' requirements?
  
4. What challenges, if any, have you faced recently with ICT and its infrastructure in the City of London? How did you overcome them? Is there anything the Corporation can do to help overcome these barriers?
  
5. What technological challenges do you anticipate in the near-, mid- and long-term future? How will this change your requirements?

*Specific Infrastructure Questions*

6. Please put the following in the order of most to least important to your organisation at the current time:
  - Wireless Telecommunications
  - Internet Data centre
  - Network Solutions
  - Other? (please specify)
  
7. Why have you selected this order?
  
  
8. Please put the following in the order of most to least important to your organisation in the next five years:
  - Wireless Telecommunications
  - Internet Data centre
  - Network Solutions

Other? (please specify)

9. Why have you selected this order?

*The Corporation of London & The City*

10. In the past, to what extent has the Corporation of London supported technology developments within the City of London and your organisation in particular?

- A – very supportive
- B – supportive
- C – quite supportive
- D – not very supportive
- E – not supportive at all
- F – don't know

11. If anything, what could they have done better? What could they do now?

12. How do you think the City of London compares to other major financial centres in terms of technological development?

- A – excellent
- B – good
- C – average
- D – below average
- E – poor
- F – don't know

13. Have you got any examples regarding other financial centres stages of technological development? e.g. New York.

14. Is there anything that the City of London could do better in the future, to facilitate technological development in the City of London, and for your organisation in particular?

15. What is the least attractive thing about being located in the City of London (aside from cost)?

16. Have you any other comments or suggestions? e.g. areas for improvement, analysis, etc., in the area of technology and / or infrastructure (if you had a 'magic wand'...).

17. If we need to, could we contact you again? Yes / No

## ***APPENDIX D: SURVEY OF CITY RESIDENTS***

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As part of this study, over 30 interviews were held with many different users and suppliers in and around the City of London. The objective was to discover what their ICT challenges have been to date, what they may be in the future and what the Corporation can do to assist them. We are very grateful for the time and support offered by these companies, and for the Corporation's assistance in securing the interviews.

Companies were interviewed using structured questionnaires - one for users, one for suppliers. A copy of the questionnaires can be found in the appendices to this document.

### **D.1 SUMMARY OF KEY FINDINGS**

- Wire-based telecoms is by far the most important infrastructure element for City companies and is expected to remain important in years to come
- Wireless telecoms is not seen as important at present but will become so in years ahead when data speeds have improved
- Internet data centres are not a priority - many companies consider their data centres as far too important to outsource. Some companies use outsourced data centres for disaster recovery but these are inevitably sited outside the City area
- The Corporation's role in promoting technology in the City is overwhelmingly unknown amongst the respondents
- Power supply issues concern a third of respondents although many believe supply continuity is better than the past
- The City of London is rated well in terms of technology though a significant minority do not know how the City ranks against other locations
- Respondents understand the issues regarding congested ducting in the road but would like the Corporation to take an active lead in co-ordinating the road digging and a proactive lead in creating a structured, common ducting system for network infrastructure in the City
- Almost everyone cited transport as the number 1 problem in the City of London

### **D.2 SURVEY PARTICIPANTS**

The following end user companies were interviewed:

#### ***Financial (11)***

Cazenove	Credite Suisse First Boston
Deutsche Bank	Dresdner Kleinwort Wasserstein
Goldman Sachs	JP Morgan
Merrill Lynch	Rothschild
Societe Generale	SSSB
Royal Bank of Scotland	

#### ***Insurance (3)***

Benfield Greig	Marsh
Swiss Re	

#### ***Legal (1)***

Linklaters

**Exchanges (3)**

London Clearing House  
OM Exchange

London Stock Exchange

**Accountants (1)**

KPMG

**Information Providers (2)**

Lloyd's Register

Reuters

The following supplier organisations were interviewed:

**Telecoms (5)**

BT Network Planning  
Vodafone  
COLT

BT Sales  
WinStar

**Utilities (1)**

London Power Networks

**Property & Services (2)**

HighSpeed Office

Land Securities

**IT Suppliers (2)**

IT Direct

Dexterus

**Regulatory (1)**

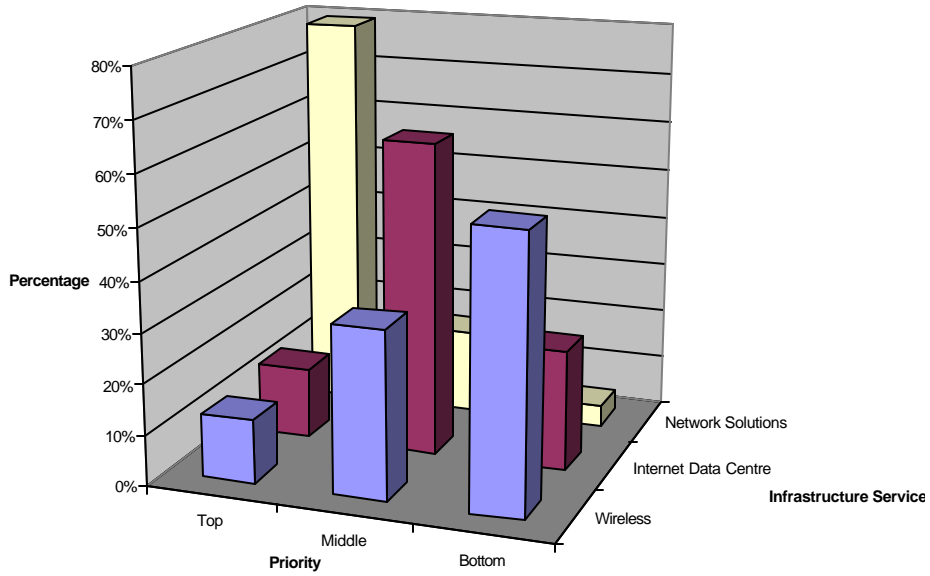
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**D.3 KEY FINDINGS****D.3.1 Technology Infrastructure Elements**

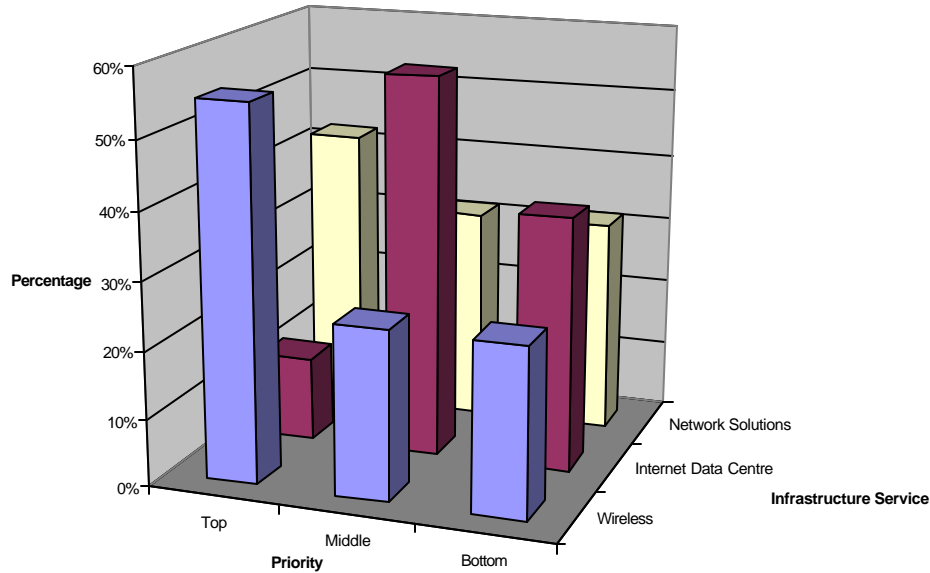
A number of questions asked interviewees to rank three infrastructure elements against each other in their importance to the interviewee's company today and in 5 years time. The infrastructure elements were nominated by the Corporation of London and were wireless communications, Internet data centres and wire-based network solutions.

The results are illustrated in the following two charts.

### Today's Priorities



### Priorities in 2006



It is clear that wire-based telecommunications are vital today for the vast majority of all respondents. Almost everyone described computer networking as one of the most apparent changes in ICT over the last 10 years, with a welcome proliferation of suppliers offering high speed network connections.

Access was cited as a problem for some companies, with an apparent reluctance from suppliers to bring fibre into buildings, particularly multi-tenanted buildings.

In 5 years time, wire-based telecommunications are still expected to rank highly. It is clear though that companies view wireless communications as increasingly important in the future.

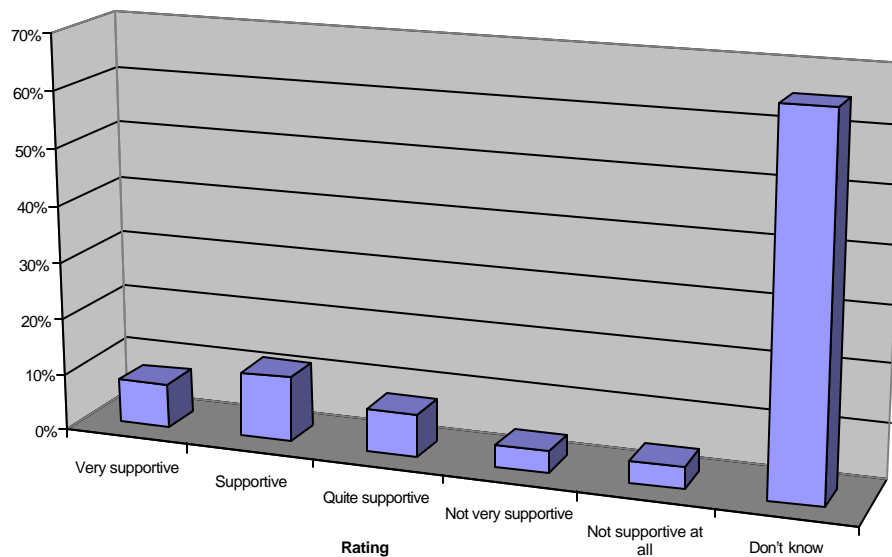
As can be seen above, interest in Internet data centres ranked consistently in the middle between wireless and network comms. However, it should be noted that this does not mean that companies were actively pursuing this option - simply that it was a more immediate task than the bottom ranked issue. For example, some respondents were very adamant that data centres were far too critical to their business to outsource to a third party, although many used the web hosters for corporate websites which required no back-end connections to internal systems.

A number of companies also cited business continuity planning as important to their business and some used third party data centres for this purpose. However, the nature of these disaster recovery and web hosting sites is such that geographical proximity to the City is not required, and, indeed, is discouraged for DR sites.

### D.3.2 Corporation Technology Support

A surprisingly high majority of 65% of respondents do not know what the Corporation does to support technology. This lack of awareness prevented some correspondents from answering some of the other questions too, implying there is a great need for some education in the City area. 70% of respondents wanted more communications on technology infrastructure issues from the Corporation.

**Awareness of Corporation Support for Technology**



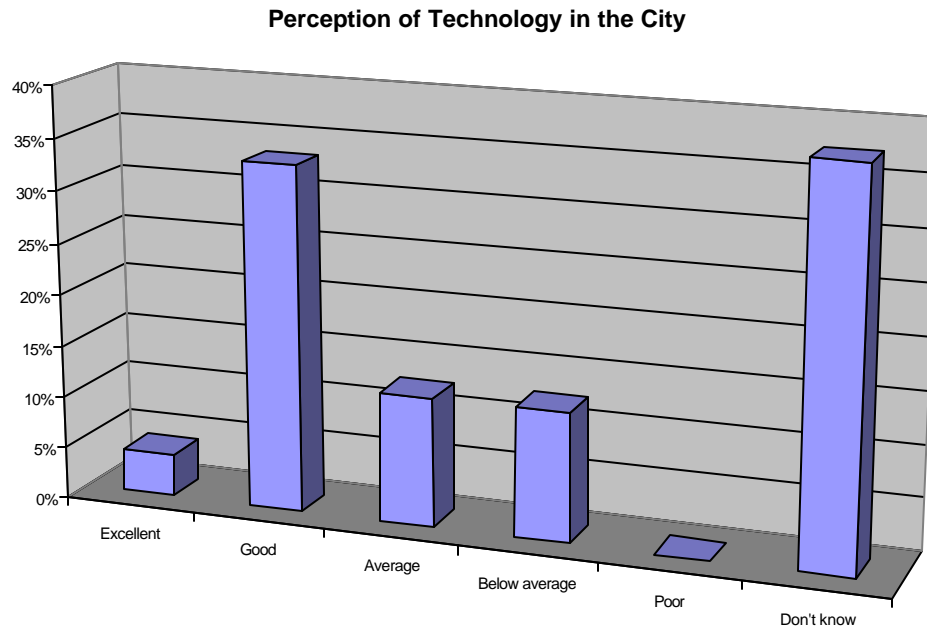
### D.3.3 Power Supply

Over 35% of respondents cited concerns about power supply in the City, ranging from getting sufficient power into new developments at the appropriate times, through to specific failures which have caused companies to purchase expensive back-up, power generating capabilities. One company asked that the power suppliers work closer with them so that developments can be co-ordinated better.

However, in 5 years time, just 8% of respondents expect to have power supply issues. Indeed, some companies said that power failures were not as common today as they used to be. The figures suggest that many companies have confidence that the power companies are getting or will get power provision under control.

### D.3.4 Perception of Technology in the City of London

The City of London's technology is rated well by those respondents who had an opinion. However, a majority do not know how London compares and this issue should be tackled by raising the awareness of the facilities and services available to users in the City to ensure that companies know they have a world-class infrastructure in many ways.



### D.3.5 Ducting in The City

Amongst the respondents, there was good awareness of the lack of ducting in the road and the knock-on problems this was causing. i.e. the difficulty getting cabling laid and the constant road digging.

There was also a desire for some co-ordination of the road-digging that accompanies its installation to avoid congestion and gridlock wherever possible. Most respondents were unaware that the Corporation is almost powerless to control the road digging.

A number of respondents would like to see the Corporation take a lead in providing a structured, common ducting and network infrastructure for the City. No-one was aware that the Corporation is proactively laying ducting at present in various roads, albeit in an unstructured manner.

### D.3.6 Transport

A huge 93% of respondents cited transport as one of their top problems with the City of London. Whilst some recognise that the City is very well served by road, rail and underground services, the old, deteriorating track and coaches, along with the road congestion and digging, is seen as a major problem and encumbrance on the quality of life in the City of London.

## **APPENDIX E: GLOSSARY**

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2G	Second Generation cellular networks, including GSM, CDMA, TDMA, etc. All of these technologies are digital and follow the first generation of analogue cellular networks. 2G supports up to 9.6Kbps data connections.
2.5G	Intermediate technology taking us from today's 2G mobile networks to tomorrow's 3G network. Based on GPRS technology and offering greatly improved mobile data speeds.
3G	Third Generation cellular networks, including UMTS, etc.
ADSL	Asynchronous Digital Subscriber Line, a technology for fast local loop connections using existing telephone wiring. Asynchronous refers to the fact that the down-link is a different speed than the up-link (which is usually faster and therefore ideally suited to surfing the Internet). Synchronous DSL is also available from some suppliers.
ASP	Application Service Provider, a service provider who remotely hosts applications across the Internet and offers them to companies on an as-used basis.
ATM	Asynchronous Transfer Mode, a broadband high-speed communications method used in trunk networks and LANs, particularly suited to network traffic of differing types. e.g. voice and data.
B2B	Business-to-business, an Internet industry term for companies that cater for inter-business Internet services.
B2C	Business-to-consumer, an Internet industry term for companies that cater for Internet services catering for the consumer.
Bluetooth	A very short-range digital radio standard designed for office and home wireless networking and for communication between mobile phones and other devices such as headsets, PDAs etc.
Dark fibre	Optic fibre which is not 'lit'. i.e. which has no laser signalling equipment at either end. This option is essentially for highly technical users only or companies offering telecoms services to others.
DR	Disaster Recovery, is usually the provision of another site or services wherein systems are duplicated for business continuity in the event of a disaster occurring at the main site.
DWDN	Dense Wavelength Division Multiplexing, a technique which allows multiple different wavelength lasers to use a single fibre link.
Gbps	Gigabit per second or (approximately) $10^9$ bits per second, a unit of speed for data transmission on telecoms circuits.
GPRS	General Packet Radio System, a packet switched upgrade of the GSM networks, offering higher throughput, up to likely rates of 56kbps.

GSM	Global System for Mobile Communications, a widespread, circuit switched cellular mobile communications standard, operating at either 900MHz or 1800MHz. The digital, second-generation mobile system dominant in the UK and Europe.
ICT	Information, communications and technology, an umbrella term linking Information Technology with communications.
IP	Internet Protocol, often used as shorthand for TCP/IP but technically a lower level network protocol.
ISP	Internet Service Provider, the supplier who links you to the Internet.
ITU	International Telecommunications Union, a global body responsible for generation of telecommunications regulations, recommendations and standards.
Kbps	Kilobits per second or (approximately) $10^3$ bits per second, a unit of speed for data transmission on telecoms circuits.
LAN	Local Area Network, a computer network confined to a building connecting PCs to servers, printers, etc.
Linux	An open source operating system, designed to run on a very wide variety of hardware and being touted as a rival for Microsoft's operating systems offerings.
LINX	London Internet Exchange, where all the UK's major Internet Service Providers' networks have a cross-connect.
Local loop	Common term for the telecom link between a building and the local telephone exchange.
MAN	Metropolitan Area Network, usually a very high speed, fibre optics based network used to connect buildings together.
Mbps	Megabits per second or (approximately) $10^6$ bits per second, a unit of speed at which data is carried on telecoms lines.
P2P	Peer-to-peer, an Internet term used to describe technologies and services that connect users directly to each other without the services of a central server. e.g. the Napster music-sharing service.
PDA	Personal Digital Assistant, a range of small, usually hand-held electronic devices providing personal and corporate data management. e.g. Palm Pilot and the Compaq i-Paq.
PKI	Public Key Infrastructure, a standard methodology for encryption and authentication on the Internet.
Pico Cell	A Pico Cell is technology that treats mobile phones as local in-building telephone extensions when they are in range of the cell. This can also enable free or cheap calls to be made to/from these mobile phones.

SAN	Storage Area Network, a high resiliency solution where data is centrally stored to optimise information availability and skills, and minimise recovery and down time.
SDH	Synchronous Digital Hierarchy, a very high speed optical fibre-based ring configuration which can 'self-heal' in the event of link breaks. Usually used in the construction of metropolitan area networks (MANs).
SME	Small to Medium Enterprise, a description of the market sector covering smaller companies.
SMS	Short Message Service, a text based feature of GSM offering messaging of up to 160 characters via a system control channel.
SONET	Synchronous Optical Network, a fibre optic-based network architecture predominantly used in the USA and similar to SDH.
TCP/IP	Transmission Control Protocol/Internet Protocol, the standard network protocol for the Internet and the majority of company LANs and WANs
UMTS	Universal Mobile Telecommunications System, a third generation cellular network enabling multimedia applications via a mobile terminal.
VoIP	Voice over IP, a technology still in its infancy where voice is encoded into IP packets and transported across a data network.
VPN	Virtual Private Network, is a technology where connectivity is made up of an encrypted data tunnel over a public network (typically the Internet). This tunnel can be used to connect other offices, home workers, mobile workers or clients in a secure manner back to office based systems.
WAN	Wide Area Network, originally defined as being outside of the context of building and campus computer networks, but which now with the addition of wireless technologies means just about anywhere.
WAP	Wireless Application Protocol, a set of communications protocols and associated micro-browser designed to access and display web applications on a WAP enabled device.
Web hoster	A company that offers a variety of services, the most basic of which is space, heat and power for a company's servers. Usually co-located by a very fast internet backbone link, companies put their web applications at a web hoster's site for speed of access, flexibility and security reasons.
XML	Extensible Mark-up Language, a meta-language designed to enable the use of SGML (Standardised Mark-up Language, a global information standard) on the World Wide Web.