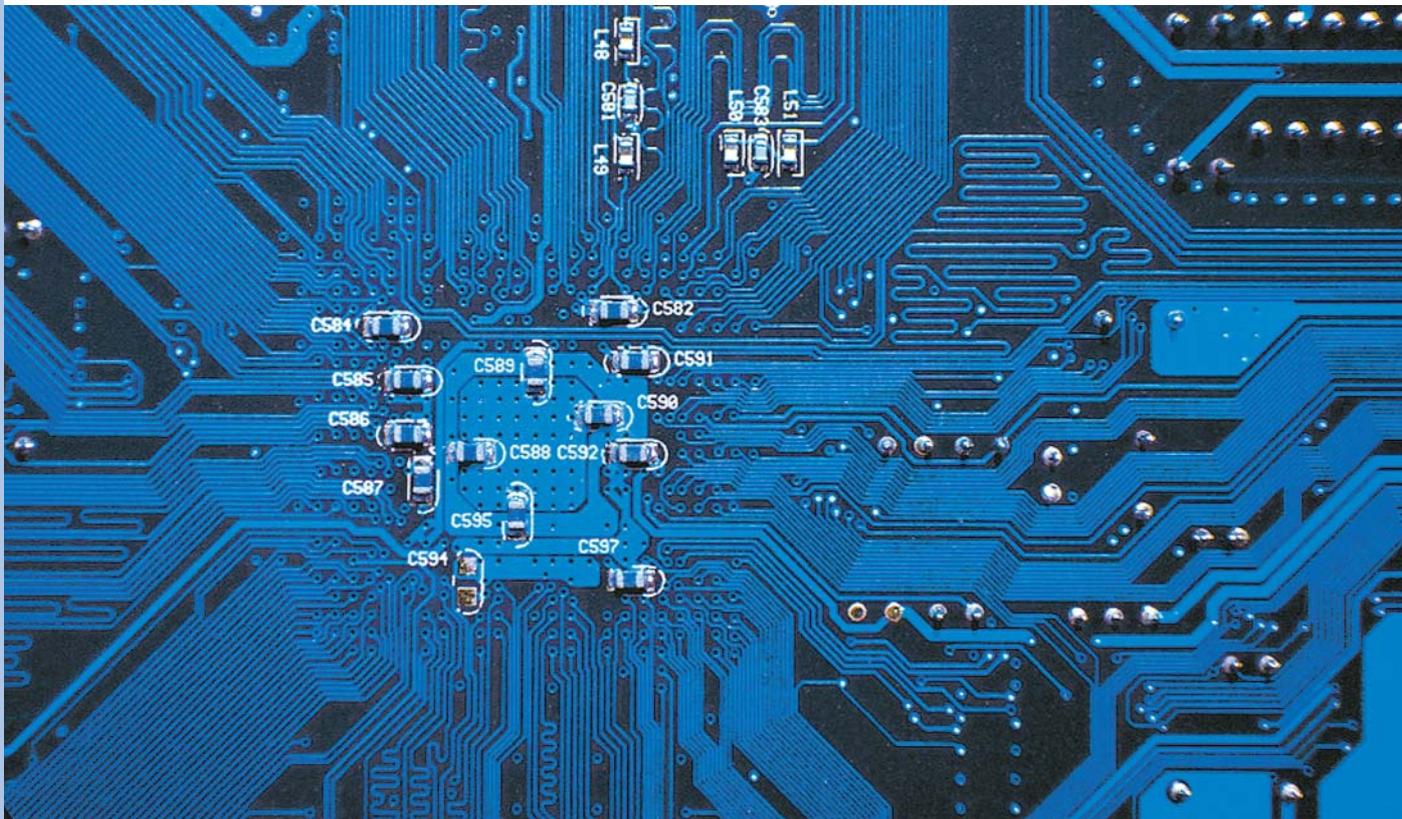




SAMI Consulting

An Assessment of the City's ICT Infrastructure



June 2009



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Foreword

Stuart Fraser

Chairman, Policy and Resources Committee

City of London

The focus of this report undertaken for us by SAMI Consulting is on the information and communication technology (ICT) infrastructure of the central financial area of London. The research is concerned with the relative efficiency of ICT support for market operations in London and their present and future role in ensuring we retain the excellent operational links to the rest of the world that give London its leading role as a global financial hub.

Efficient operation of financial centres is clearly a critical requirement; a wide range of factors contribute to this. The latest Global Financial Centres Index, for example, shows that London continues to be seen as having a breadth of 'cluster' benefits that overlay its English language, global commercial law administration and optimal time zone advantages. These cluster benefits include access to markets, skilled multinational talent and the regulatory environment. All of this concentration of activities in a global financial centre requires substantial and continuing investment in technical support systems and the highest quality of communication infrastructure by both private and public agencies to generate the efficient operation of market platforms and processes. ICT innovation is essential to retain London's position as the centre of global networks – allowing the cost savings from distributed back offices while retaining the concentrated face-to face engagement with clients and related service providers that are needed.

This study is based on interviews with 62 City stakeholders during November and December 2008 and associated analysis and provides an update on the research published as "The City of London ICT Infrastructure Review" commissioned in 2001. Since this time there have been many important changes in the ICT industry and this report provides insight into the attractiveness to business of the City of London and its fringes, in terms of existing ICT infrastructure and future challenges. It assesses how current and future ICT regulation is likely to affect the attractiveness of the City as a base for the financial services sector.

Overall the report supports a favourable view of the ICT provision in the Square Mile in that most respondents believed that the ICT infrastructure in the City was "as good as anywhere in the world", and above the necessary threshold to maintain the attractiveness of the City to the financial services sector in comparison with other global financial centres. The City was found to have sufficient depth of network connectivity and enough data centre providers to

offer network resilience and security to businesses in the City and to accommodate future demand.

We cannot be complacent though. Some respondents raised concerns over the availability of power supplies in relation to the building of new Data Centres. EDF is identified as the main player here and the City of London has already encouraged City stakeholders to contribute to EDF's Distribution Price Control Review 5 Stakeholder Consultation, which will determine the amount that EDF can invest in their network from the period 2010-2015. As the local authority for the Square Mile, we will continue to actively engage with EDF Energy and the regulator, the Office of the Gas and Electricity Markets (Ofgem), at a strategic level to ensure that sufficient investment is made to upgrade the City's electricity supply network.

The study observes that while larger organisations are in a position to benefit from ICT services offered by a multitude of network infrastructure providers, SMEs often use standard retail ICT services. An important finding is that SMEs could therefore benefit from the delivery of enhanced services and Service Level Agreements which would include ICT planning and installation of ICT Infrastructure to serviced offices.

Respondents commented that while the current regulatory framework for ICT infrastructure was seen as adequate, there was additional scope for the City of London to encourage Ofgem to take a clearer view on harmonisation of fixed line standards across Europe. It is important for example that spectrum allocation does not interfere with emergency networks, and standardisation of terms in Service Level Agreements.

In regulating the companies which run the electricity networks in the City, future ICT provision must be considered in the light of how it will serve the effective operation of the City as a global financial centre. It is important that we actively monitor and address the issues raised by users across the City. We face a period of enormous structural change in world economic power and global trading patterns. ICT provision must continue to serve and address the challenges of London's central place in the communication links to other financial centres.

Stuart Fraser

London

June 2009

Executive Summary

The City of London Corporation has commissioned this new study into existing ICT infrastructure and the future ICT requirements of businesses in the City and its immediate Fringes, eight years after the first such study¹. This report is complementary to the City's earlier report² on financial markets, which identified that "electronic trading has had an important impact on all the main markets covered"; and to the Review of the Competitiveness of London's Financial Markets commissioned by the Mayor of London³, the Wigley Report, and the Bischoff report on Britain's financial services competitiveness.

This report is primarily based on interviews and research undertaken during November and December 2008, a very volatile time for many organisations. The project team is therefore especially grateful to the 62 people who took the time to discuss City ICT infrastructure with us. The core question that we addressed was: **What should the City of London do to ensure continued effective ICT infrastructure support for Financial Services in the City and fringes?**

Both large organisations and SMEs concur that London's current ICT infrastructure is "as good as anywhere in the world". In addition to aspects of ICT infrastructure contributing to competitiveness through its role in quality of life, the competitive ICT infrastructure for the future of financial services will include five key aspects:

- **Network connectivity;**
- **Data centre capability;**
- **Electrical power supplies;**
- **Security and resilience; and**
- **Skills.**

Network connectivity is felt to be adequate for the next decade, even allowing for doubling of demand every year. Mobile technologies will start to deliver reliable broadband services, and be increasingly used for "the last mile". London is well served by worldwide network operators, and has numerous suppliers of high specification fibre connectivity.

In terms of **data centre capacity**, the demand for data centre space will continue to increase. The EC estimates that power demand from data centres will nearly double from 2007 to 2020. New technology will increase power requirements per square metre, which together with Green ICT policies, mean that many existing City data centres will require replacing.

This means that additional electrical **power** supplies will be needed. This is seen as a major problem for the City. A number of our respondents were planning

¹ "The City of London ICT (Information, Communications and Technology) Infrastructure Review" 2001

² "The Competitive Impact of London's Financial Market Structure", City of London, April 2007

³ Review on the Competitiveness of London's Financial Centre, January 2009.

data centres outside London, but this is not feasible for many core City trading applications.

The **security and resilience** of the City's ICT infrastructure is important for many companies. This includes guarding against the threat of electronic attack. Security concerns are leading many organisations to locate data centres physically separately, as well as employing firewalls. The need for a highly secure and resilient mobile network for use in an emergency is flagged.

The **skills** needed to support the ICT infrastructure are currently a strength of the City, but skills in the supply industry are expected to be subject to increased competition for engineers and other qualified professionals from other financial services centres, other industries, and the changing dynamics of the ICT industry.

SMEs in the City and fringes are very diverse, but one common theme was the multiple roles of staff. Guidance from the City of London Corporation on aspects of managing the ICT infrastructure could help.

The overarching **conclusions** are that:

- **The City is currently well supplied with ICT infrastructure services;**
- **Future financial services will be increasingly dependent on ICT; and**
- **Electrical power supplies are the least tractable part of the supply chain.**

The key **recommendations** from the study are that the Corporation should:

- **Co-ordinate a 10- year ICT Infrastructure Plan** covering the five aspects of ICT critical to financial services, namely, worldwide network connectivity, fibre "in the ground", mobile broadband, data centres, electrical power supplies, security and resilience, and skills, "within the M25". This would provide a vehicle for a structured dialogue with the Greater London Authority (GLA), London Boroughs, the electrical power supplier EDF Energy Networks and e-skills UK;
- **Spearhead a discussion with the government and regulators** on the perception that power availability and cost are a constraint on the competitiveness of the City;
- **Develop a package of supporting programmes for SMEs**, covering business and ICT planning, Service Level Agreements (SLA), data security and choosing serviced offices;
- **Consider sponsoring or commissioning a commercially available secure and resilient mobile network**, especially focused on availability during sustained emergencies;
- **Open discussions with Ofcom** on telecommunications supplier serviceability level agreements standards, wireless spectrum allocation, and the implications of converging network technologies;
- Within the context of a 10- year ICT Infrastructure Plan, **consider the future ICT skills needs of the financial services sector**, within the wider context of the changing shape of the financial services industry, to anticipate potential future developments.

Chapter 1: Introduction

Summary

This chapter considers the role of ICT (Information, Communications and Technology) Infrastructure in the context of the City, and explains the relevance of the study to the future competitiveness of the City. It identifies the main ICT infrastructure factors affecting competitiveness of financial services, lays out the structure to be used for later chapters, and briefly describes the methodology used.

Background

Since "The City of London ICT Infrastructure Review" was published in 2001, there have been many changes in the IT & Telecoms industry and in the global environment. The City of London Corporation (CoLC) has commissioned this new study into existing ICT infrastructure and the future ICT requirements of businesses in the Square Mile and the City fringes to inform its own actions and policies, and that of stakeholders and other interested parties.

The City and Financial Services

London as a global city has at least four main strengths: as a global financial services centre, as an attractive place to live for those with money at their disposal, as a centre of the media, arts and leisure industries, and as a global centre for education, with world famous universities and a host of supporting facilities.

The City of London's economy is centred on Financial Services. Financial services refer to services provided by the finance industry. The finance industry encompasses a broad range of organisations that deal with the management of money. This includes, for example, banks, credit card companies, insurance companies, consumer finance companies, stock brokerages, investment funds and some government sponsored enterprises. The focus for this report is the ICT infrastructure requirements of financial services organisations and the network of supporting businesses in law, staffing, and other business services.

An earlier report on "The Competitive Impact of London's Financial Market Structure" ⁴ published by the City of London in April 2007 emphasised the key role of the international equities, derivatives, foreign exchange and fixed income markets in the City, and the important impact of electronic trading on all of these. In this report we do not explicitly cover the systems to deliver these

⁴ "The Competitive Impact of London's Financial Market Structure", City of London, April 2007

services except in so far as they create demand for data centres and high specification connectivity.

In this report we distinguish between:

- The Square Mile – the physical City of London;
- The City – this term refers to financial services in the UK, encompassing London as well as other centres, however on this report we have used this primarily to refer to institutions in the Square Mile, Canary Wharf and Docklands; and
- The City of London Corporation – the organisation that provides local authority services to the Square Mile and promotes financial services globally. Its name is often abbreviated to the City of London, but in this report we have referred to it as CoLC, to avoid confusion.

The City fringes comprise the Boroughs of Hackney, Tower Hamlets, Camden, Southwark, Lambeth, Westminster and Islington. This report focuses on the ICT infrastructure as it supports the Square Mile and City fringes.

The role of ICT in Financial Services

The whole financial services industry, globally, assumes that a robust data and voice communications infrastructure will be available between industry members and also to connect to their customers: new products are designed increasingly on this basis. ICT has now become completely pervasive in all aspects of financial services, both in the business to consumer (B2C) market and in the business to business (B2B) market.

Electronic trading has been an important part of the City's development of the raft of new B2B systems for electronic trading which have come to the fore in recent years. These B2B systems require high specification connectivity, where the high specification refers to speed, quality and availability of services.

B2C services typically use "retail" connectivity – which may be broadband or legacy fixed line networks, or connection to mobiles. The quality of these connections is particularly important to SMEs, while being part of the picture for large organisations' links to their customers.

Financial services institutions can increasingly exploit ICT so as to establish operations and source facilities across the globe and operate either independent subsidiaries or integrated global businesses at will. So the provision of an effective ICT infrastructure across the Square Mile, Docklands and Canary Wharf is important in retaining London's position as a leading global financial services centre.

The core question that we addressed was: What should the CoLC do to ensure continued effective ICT infrastructure support for Financial Services in the Square Mile and City fringes?

Measuring ICT and competitiveness

There are a number of comparative indices of ICT capability, covering a wide range of countries utilising country wide data. The implications of the indices and rankings for the UK are discussed in Chapter 2. Overall, the UK lags the US in the ICT infrastructure-specific indices, which are focused on the retail infrastructure and not to City high-specification (financial services) systems, in which the City is believed to be competitive; this will be discussed in Chapter 3.

By studying the role of government in supporting the development of ICT infrastructure in lead cities in the countries heading these rankings – Singapore, Dubai, and the US, focusing on New York - we are able to provide some indicators of best practice and guidance for ways in which the CoLC could support the continued competitiveness of the City as a global financial centre. The three comparator cities all had an ICT Plan. These are focused on citizens' use of ICT to deliver services, but suggested to us that some of the concerns raised during the study would best be handled through a co-ordinated plan. We recommend that this should cover the factors that we have identified as contributing to the City's strength in financial services, namely:

- Network connectivity, fibre in the City, worldwide networks and mobile broadband;
- Data centre capacity and utilisation;
- Electrical power supplies;
- Security and resilience, covering both physical security and response to electronic threat; and
- Skills in the ICT supplier industry.

At a city rather than country level, there are two sets of indices comparing global financial centres: the Global Financial Centres Index (GFCI), published by the CoLC, and the Mastercard Worldwide Centres of Commerce (WCOC) index. Both consider a very wide range of factors and – tangentially – ICT infrastructure. Both rank London first and New York second, with Hong Kong and Singapore in the next group. These rankings suggest that the ICT infrastructure in the City and fringes is above a threshold level needed to maintain overall competitiveness.

We find additionally that the measures taken by the UK government and the CoLC represent best practice as identified by the Economist Intelligence Unit. We recommend that the CoLC further follow best practice and develop a 10-year plan for ICT in support of financial services in London.

The current ICT infrastructure in the City

So dependent are financial services on ICT that no city can any longer expect to host a Financial Services industry presence without a reliable, high performance ICT infrastructure. The ICT infrastructure in this context covers more than just the wires, for instance all five dimensions identified above.

In Chapter 3 we consider the current state of the City's ICT infrastructure, under these headings, for large organisations and for SMEs, as this relates to broadband and legacy networks, high specification (fibre)⁵ networks, mobiles and wireless networks, data centres, security and resilience, power supplies, and skills in the ICT supplier industry.

Major institutions have highlighted the importance of a marketplace with multiple suppliers to provide an environment which will control price and deliver innovation and service quality, for all aspects of ICT infrastructure.

The City has a large number of worldwide network operators, and there is more data centre space in London than in European competitor cities. Both of these reflect what seems to be a very competitive market, with multiple suppliers, and indeed find that competitive price and availability of ICT infrastructure is taken for granted by large and SME organisations. We recommend that the CoLC should monitor these as measures of competitiveness, within a 10- year ICT plan.

While large organisations can create an effective operational ICT infrastructure, in the case of smaller businesses, the need for affordable access to these services means that an effective regulatory regime to ensure a reasonable level of "universal access" to network services is very important, as discussed in Chapter 5.

The research shows that the City at present is well placed in all respects of ICT infrastructure provision. But ICT no longer presents a positive competitive advantage because it is becoming ubiquitous. A robust ICT infrastructure is no longer a motivator for financial services to set up shop, it is a hygiene factor⁶. However deficiencies in the ICT infrastructure and/or supply chain will undoubtedly have a negative effect.

We anticipate that competitive pressures on ICT suppliers will cause them to focus on quality of services. This will cover, over and above connectivity, the factors of:

- Ease of installation and delays in installation of new services;
- Speed of response between a terminal and a system, whether on specialist trading services or retail broadband; and
- A more standardised approach to the interpretation of service level agreements.

Availability of services will become a prime differentiator between financial centres. This covers for instance:

⁵ Optical fibre, used e.g. for high connectivity between data centres or where fast response is required. Modern-day optical fibers can carry information at around 14 Terabits per second over 160 kilometres of fiber

⁶ Frederick Herzberg "One More Time: How Do You Motivate Employees?" , Harvard Business Review Classics, (2008)

- Continuity of power supplies;
- Nature and serviceability of business continuity planning; and
- The impact on the availability of services of shared networks and common duct works etc.

The need to build resilience into supply, through peering and other forms of co-operation, leads to a recommendation that the CoLC should encourage Ofcom to take a clearer lead on serviceability standards.

Challenges in the medium term

In the medium term, there are challenges to the City from newer Global Financial Services Centres who are able to plan “from the fibre up”. The City also faces challenges from new electronic trading platforms, from electronic attack, power supplies for data centres, and in maintaining skills in the ICT supply industry.

These challenges are discussed in Chapter 4. We should emphasise that the three headings for networks used in Chapter 4 (broadband, high specification and mobiles) were widely expected to converge over the next decade, with suppliers using whatever connection technology was most effective.

While network connectivity is expected to meet the demand in the medium term, challenges in meeting data centre capacity needs are flagged. As the Wigley report identifies, the electronic trading applications at the heart of the City are increasing using algorithmic trading; this increases the volume of transactions, requiring more power and generating more heat. The report points out that much of the Square Mile data centre real estate is unsuitable for refurbishment to meet new Green ICT policy requirements for reducing carbon footprints, so that in addition to meeting extra demand there needs to be replacement of existing facilities. This is covered in more detail in Chapter 4.

Data centre power requirements across Europe are expected to nearly double between 2007 and 2020, according to the EC. The constraints on additional power in London were highlighted by the study. We recommend two ways to tackle this. First, the generic UK-wide problems of cost and availability of power need to be tackled by discussions with the regulator and government. Second, the production of the ICT plan identified would provide a vehicle for reaching a shared understanding between the responsible bodies and the major users of ICT infrastructure on the capabilities which could be delivered, with a scope of “within the M25”.

Over the next decade, the degree of electronic threat is expected to be significant. The CoLC’s business continuity exercises are well regarded, and two extra recommendations have been suggested during this study. One is that the threat of electronic attack be built into business continuity preparation. The

second is that the CoLC should consider the role of a highly secure mobile commercial network in security and resilience, especially in an extended emergency, within the context of a 10- year ICT Plan.

Chapter 4 also contains a section summarizing the similarities, differences and particular concerns of SMEs. This led us to the recommendation that the CoLC should develop a package of supporting programmes for SMEs, covering planning, Service Level Agreements, data security and choosing serviced offices

Regulation

The existing and future role of regulation was discussed with suppliers, government, regulators, and businesses. We also were able to take advantage of the specialist regulatory expertise of Netstrategics Ltd. These issues are covered in Chapter 5.

The EU has taken a strong role in regulation of financial services, which may affect the operations of a number of UK-based platforms and their associated infrastructure – with a two hour recovery rather than a 24 hour recovery being the required standard. Overall, recent events in the financial services markets are expected to result in increased regulatory and supervisory activity.

While the EU regulator has taken a free market approach to telecoms deregulation, there was scepticism among UK suppliers at the effectiveness of this on strong national incumbents in France and Germany.

The UK regulator, Ofcom, is due to publish in June 2009 a report by Lord Carter⁷ on “Digital Britain” which is widely expected to suggest that the spectrum currently set aside for digital television could be used for fourth generation mobile technology. The interim report is available now⁸. This would support wireless downloads at five times the speed of fixed line broadband.

One topic of concern to our respondents is the upcoming spectrum auctions, where it is felt there could be a possibility of compromising emergency services. We recommend that the CoLC should discuss these concerns with Ofcom. ICT suppliers were concerned that regulation might limit their capability to use a mixture of network technology (broadband, high specification fixed line or wireless mobile networks) to deliver connectivity. We recommend that the City should work with Ofcom to ensure regulation is not a barrier to competitiveness,

⁷ “Digital Britain”, <http://www.computerweekly.com/Articles/2009/01/26/234457/the-carter-review-digital-britain.htm>

⁸ Command Paper 7548, published jointly by BERR and DCMS.

Looking further ahead

Financial services will be subject to a number of forces over the next decade. The role of the regulator, competition from new directions, and the ongoing development of new ways of electronic trading, are leading to a complex picture of change, discussed in Chapter 6. The end points are not yet clear, but we recommend that the City should continue to commission research to clarify perspectives on the financial services sector's future.

In the ICT industry, there are also questions on the future shape of the industry, and its effect on the competitiveness of the City. The current credit crisis will have an effect on investment, as will the trend towards end-to-end connections, using a range of fixed line and wireless technologies. While it seems probable that technology will be available, its use requires skilled manpower. The study picked up a few warning signs of skills shortages, and we recommend that the City should facilitate research on the future ICT skills needs of the financial services sector and related business activities in the City.

Chapter 6 also includes a summary of our conclusions and recommendations.

Methodology

The approach chosen for this study combined primary research in the form of interviews, and secondary research in areas where there was an existing literature. SAMI's Natural Agenda framework was used for analysis to ensure that we could capture both the detail and the consensus from our interviews. Chapters 3 and 4 are primarily based on interviews, with supporting desk research. A framework for the interview questions was established via meetings with key advisors from academia, the Challenge Forum and the Financial Services Club.

Interviews

There was a common approach to the interviews:

- Interviews were conducted by phone (using where necessary our conferencing facility BT MeetMe) or in person, depending on availability of the interviewee;
- Interviews were held under the Chatham House Rule, so that quotations could be used but not attributed to an individual;
- Interviewees would be asked questions appropriate to their position and organisation, drawn from a standard set of questions (Appendix 2);
- Interviews were recorded under a set of standard headings, and stored on our project Basecamp™ web site. This facilitated the extraction of common themes and key points for the report.

The list of participating organisations is included as Appendix 1 and the set of questions used as Appendix 2. The questions could be broadly grouped under two headings:

- Are ICT services adequate for your needs (for example, response time, time to install, etc)?
- Are ICT services resilient against potential failures in power, interruptions of service through failure of common components, etc? How well tested are back up routes?

Interviewees

We divided the people / organisations to be interviewed into six main categories:

- Banks, brokers and insurance companies, financial services organisations;
- Service providers, of services focused around financial services;
- Infrastructure providers ("telcos");
- SMEs in the City and fringes;
- Local Government, including the City of London Corporation; and
- Regulators.

We then chose organisations to give a spread across the types of company, both new and established, and by sector of their industry.

Table 1: Interviewees by organisation type

Organisation Type	Number of interviewees
Banks, insurance and stockbrokers	13
Service providers e.g. trading platforms	10
Infrastructure providers e.g. telcos	13
SMEs in the City and fringes	12
Local Government	5
Regulators	2
Other experts	7

Secondary (desk) research

Chapters 2, 5 and 6 are primarily based on desk research of published sources.

There is no single source which compares the ICT Infrastructure in global financial centres. As a leading research publisher told us, this was the sort of research that was talked about but not done. We therefore began by considering the country-wide comparisons of ICT Infrastructure.

We also studied the published data on Singapore, Dubai, Hong Kong and New York, in relation to ICT infrastructure, and the two comparative indices which look at the overall competitiveness of cities.

Chapter 5, on regulation, contains an analysis of published sources plus a review of the attitude of the interviewees to regulation. Chapter 6 is based on published sources on the future of the financial services industry, and discussions with experts on the future of the ICT industry.

Chapter 2: ICT Infrastructure and Competitiveness

Summary

This Chapter uses comparators for the City to suggest initiatives that the CoLC could take to promote competitiveness. We start by comparing the country-wide indices relating to ICT infrastructure, to bring out best practice guidelines for government. This leads us to study Singapore, Dubai and New York in more detail. We then bring out the role of ICT infrastructure in a wider assessment of global financial centres. We conclude that the ICT infrastructure in London is currently above a critical threshold, but that the CoLC could focus on factors critical to financial services to ensure competitiveness over the next decade, in the context of a 10- year ICT Infrastructure Plan

Introduction

We started our research on ICT infrastructure and competitiveness by looking for comparator indices or measures which might throw a more detailed light on ICT elements as they relate to financial centres. However we found that, while there are comparisons of overall competitiveness at City level, comparison surveys of ICT are at the country level. Whilst some aspects of city ICT infrastructure are determined by government policies, others may vary radically from one part of the country to another. These country level indices did, however, provide some possible role models for the CoLC.

Country-wide ICT infrastructure indices

We reviewed three indices which contained factors relating to ICT infrastructure:

- The World Bank's Knowledge Economy ICT index⁹;
- The World Economic Forum's Networked Readiness Index ¹⁰; and
- The Economist Intelligence Unit's e-readiness scores¹¹.

World Bank's Knowledge Economy ICT Index

The World Bank publishes a Knowledge Economy Index, based on their Knowledge Access Methodology (KAM). The KAM consists of four Knowledge Economy (KE) pillars:

- Economic Incentive and Institutional Regime;
- Education;
- Innovation; and
- Information and Communications Technologies.

⁹ <http://info.worldbank.org/etools/kam2>

¹⁰ <http://www.insead.edu/v1/gitr/wef/main/analysis/showcountrydetails.cfm>

¹¹ http://a330.g.akamai.net/7/330/25828/20080331202303/graphics.eiu.com/upload/ibm_ereadines_s_2008.pdf

The ICT element is made up of:

- Internet users per head of population;
- Computers per head of population;
- Telephone lines per head of population.

The UK is ranked 11th on the KE index overall and 14th for ICT. The ICT statistics are relevant to B2C infrastructure and financial services, and to wider citizens' use of ICT.

The World Economic Forum's Networked Readiness Index

The World Economic Forum's (WEF) Global Information Technology report contains a Networked Readiness Index. The Networked Readiness Index Framework provides a model for computing the relative development and use of ICT in countries, and also allows for a better understanding of a nation's strengths and weaknesses with respect to ICT.

The WEF state that there are three important stakeholders to consider in the development and use of ICT, namely: individuals; businesses; and governments.

They describe a model of a general macroeconomic and regulatory environment for ICT in which the stakeholders play out their respective roles, where the degree of usage of ICT by the three stakeholders is linked to their degrees of readiness (or capability) to use and benefit from ICT. They therefore assess factors such as:

- Availability of latest technology;
- Accessibility of digital content;
- Secure internet servers / head of population;
- Laws relating to ICT;
- Government prioritisation of ICT; and
- The importance of ICT to government vision of the future.

A market economy such as the UK or the US might argue that a factor such as the government vision of the future is less relevant than a measure such as the number of secure servers/head of the population, for which, as seen in Table 2, the UK ranks 9th and the US ranks 2nd.

The Economist Intelligence Unit's e-readiness scores

The e-readiness ranking from the Economist Intelligence Unit (EIU) compares 70 countries, under six categories. The e-readiness ranking combines six scores, including connectivity, and government policy and vision.

The EIU have in their most recent analysis changed the factors that affect the connectivity scoring, removing narrowband telephone penetration and adding broadband and mobile phone penetration. They also use broadband affordability – the ratio of a subscription to median household income. In addition, they have added a new factor – electronic identity cards.

The list of factors measured is now:

- Broadband penetration and affordability;
- Mobile phone penetration;
- Internet penetration and security;
- PC penetration;
- WiFi hotspot penetration; and
- Electronic ID.

These factors are mostly consumer and citizen oriented, rather than focused directly on business services, although Internet security is clearly relevant to B2B as well as B2C financial services.

The UK ranks 5th on connectivity, behind the Netherlands, Hong Kong, Australia and the US. On government policy, the UK ranks 4th.

The EIU report suggests five components for ensuring digital best practice as follows, where the UK / City of London Corporation's approach is described in *italics*:

- Let the market build it: Policymakers should allow market forces to determine the course of the digital economy. Part of a government's mandate is to ensure fair access to the resources that network operators need (spectrum and rights of way, for example). *The UK measures up well to this guideline.*
- Step in when needed: *The CoLC has commissioned this report in order to assess areas where it might be fruitful to step in to support the provision of ICT infrastructure to maintain competitiveness.*
- Lead by example: *The CoLC leads on such areas as business continuity readiness exercises.*
- Don't do it all - Governments must: Champion digital development; Fund their own infrastructure; Regulate lightly; Encourage others to adopt. *The CoLC operates in an environment subject to EU, UK and local government regulations, and within this looks to encourage both large organisations and SMEs in the City.*
- Keep at it: *The CoLC has an ongoing programme of support and review regarding ICT provision in the City.*

The e-readiness index forms part of the Global Financial Centres Index (GFCI).¹²

¹²http://www.cityoflondon.gov.uk/Corporation/LG_NL_Services/Business/Business_support_and_advice/Economic_information_and_analysis/GFCI/

Table 2: Comparison of Country-wide ICT Infrastructure Rankings

Country	World Bank						WEF/Insead						EIU		
	KEI	ICT		NRI	IEI	ALT	ADC	SIS	L ICT	GICT	VIS		ER	Con	GV
Netherlands	4	5		7	16	14	11	12	15	32	46		6	2	3
UAE	43	42		29	56	16	40	35	33	7	4		35	36	32
Germany	10	15		16	14	8	13	16	4	31	63		14	9	19
Hong Kong	26	8		11	33	23	11	22	18	17	12		2	3	11
UK	11	14		12	11	11	14	9	11	21	42		8	8	8
US	8	13		4	2	6	8	2	12	18	28		1	7	8
France	20	25		21	18	15	19	28	19	43	31		22	22	21
China	77	78		57	86	78	52	101	56	74	29		56	54	51
Singapore	21	10		5	26	12	15	18	3	1	1		6	17	6
Australia	9	5		14	10	18	23	6	19	48	40		4	6	13
Japan	19	21		19	21	10	30	17	29	15	25		18	21	7

Key:

World Bank: KEI = Knowledge Economy Index,
 ICT = ICT component of this

WEF/Insead: NRI = Network Readiness Index;
 IEI = Infrastructure Environment Index;
 Sub-indices ALT = Availability of Latest Technology;
 ADC = Accessibility of Digital Content;
 SIS = Secure Internet Servers/head of population;
 LICT = Laws relating to ICT;
 GICT = Government prioritisation of ICT;
 VIS = Importance of ICT to government vision of the future

EIU: ER = E-readiness;
 Con = Connectivity;
 GV = Government Policy and Vision

The Role of Governments

Two countries which rank highly in the ICT indices which also have global financial centres are Singapore and the United Arab Emirates (Dubai). We explore below the role of government in these two countries, and also in New York, to suggest possible ways in which the CoLC could act to improve competitiveness.

Singapore

Singapore is a small island with its people as its only resource. ICT has been important to Singapore's growth, and a key component of its economic infrastructure. Singapore's ICT journey began with the introduction of the National Computerization Plan in 1981. As the government's confidence in ICT as an economic enabler has grown, the country has formulated and implemented six ICT master plans, each guided by a developmental theme relevant for the economy at the time. "An Intelligent Nation, a Global City, powered by ICT" is the vision of Singapore's latest ICT Master Plan, Intelligent Nation 2015 (or "iN2015").¹³

The Ministry of Communications and Information Technology is responsible for transportation, postal services and ICT policy. The Info-communications Development Authority is responsible for regulating and promoting postal and ICT services, and the iN2015 Plan, shown in Appendix 7.

The WEF/Insead report ¹⁴ comments:

"Singapore's focus on linking ICT to strategic objectives combined with strong leadership from the very top of government provides useful insights for other countries as they seek to leverage the potential of ICT for their own development and competitiveness."

The implication for the CoLC is the importance of an ICT plan linking ICT to strategic objectives.

United Arab Emirates

The UAE has launched a number of ICT initiatives including Dubai Media City (began in November 2000), Dubai Internet City, and Knowledge Village. A more recent addition to the Dubai hi-tech corridor has been Dubai Silicon Oasis, intended to be one of the world's leading high-technology parks for the semiconductor and micro-electronics industry. The centrepiece is the Dubai e-government initiative, begun in April 2000, and highly regarded by practitioners.

¹³ <http://www.ida.gov.sg/About%20Us/20070903145526.aspx>

¹⁴ Dutta, S. and Mia, Irene, "Executive Summary", The Global Information Technology Report, 2007-2008, World Economic Forum / Insead, 2008, p.xiv

The WEF/Insead report ¹⁵ comments:

"Dubai's e-government initiative is an integral component of Dubai Vision 2010, which aims to establish Dubai as a knowledge-based economy by leveraging tourism, IT, media, trade and services as pivotal industries in an effort to move away from dependence on oil-related products."

The EIU report ¹⁶ adds:

"Convenience as a whole is the watchword of Dubai as a global trade entreport; it is an easy, tax free and luxurious place for technology workers to live with their families; sports facilities, schools and shopping malls abound. These quality of life factors are a significant component of its success in attracting the world's largest technology firms."

ICT in Dubai is seen as part of e-Government and a quality of life ingredient as well as supporting financial services.

New York

New York City with a population of just over 8 million is similar in size to London (with a population of 7 million). New York City's Mayor has a budget of \$59 billion this year, and among the many departments and agencies within his scope is a Department of Information Technology and Telecommunications (DoITT) which works with ICT providers to provide a range of services to the citizens of New York City. It covers ICT for economic development and sustainability, public safety, social services, education, community services and city infrastructure for the agencies.

The focus of its current PlanIT is "Better Government through Customer Service", and its core vision is

"New York City transforms the way we interact with residents, businesses, visitors, and employees by leveraging technology to improve services and increase accessibility, transparency and accountability across all City agencies".

ICT in New York is seen as transformational for government in its relationship with the citizens and visitors. The New York City government is seeking to radically improve the quality of life for its citizens, and the experience for its visitors, through using ICT.

One initiative is the City-wide Mobile Wireless Network, established to provide a highly secure network for use by the City's agencies such as police, fire etc.

¹⁵ "Connecting the World to the Networked Economy", The Global Information Technology Report, 2007-2008, World Economic Forum / Insead, 2008, p. 17

¹⁶ "High technology and quality of life in Dubai", E-readiness rankings 2008, EIU, 2008, p. 17.

It is difficult to make direct comparisons between New York and London because the structures are so different, as discussed below.

London, the City government and ICT infrastructure

The Greater London Authority (GLA) is most nearly equivalent to the New York City administration, but has far fewer statutory powers, with many residing in the Boroughs.

As part of the City of London Corporation's role in supporting and promoting the City's financial services globally, it hosts and participates in a number of forums, such as the Lord Mayor's Financial Services Group¹⁷, and the City of London Security and Contingency Planning Group¹⁸.

Examples of Good Practice

Whilst the cities compared – Singapore, Dubai, New York and London, are very different, examples of good practice can be drawn out.

Singapore, the United Arab Emirates (Dubai) and to a lesser extent New York are driving ICT infrastructure through government plans. They are focusing on services to the public rather than to business. So there is a general lesson, that a good ICT infrastructure is seen as an important part of quality of life, and hence competitiveness. ICT needs to be seen as an enabler for not just financial services but also for the other sectors, such as media and leisure, and education, important to London.

None of the cities examined had publicly visible plans for ICT infrastructure specifically in relation to global financial services.

Given the planning and other hurdles to setting up new data centres in London, and the increasing importance of third party data centres for specialised trading services, the CoLC could benefit from the co-ordination and publication of an ICT plan for the City's infrastructure supporting financial services, covering networks, data centres, security and resilience, power supplies and skills of the ICT supply industry.

In terms of its financial services responsibilities, the CoLC takes a broader view across "the City", in London, for example, including the Square Mile, Docklands and Canary Wharf. This would set a precedent for an ICT Infrastructure Group to take a view across the three geographies. The group could take advantage of

¹⁷ This has representatives from the relevant Livery Companies including the IT Livery Company.

¹⁸ The City of London Security and Contingency Planning Group covers the Square Mile, Canary Wharf and Docklands.

the work of the Data Centre Forum¹⁹ and London Resilience²⁰, both concerned with aspects of ICT infrastructure.

We recommend that the CoLC should consider setting up a group to create a 10- year ICT infrastructure plan for the City. The constituents of the plan are outlined under "Lessons Learnt", and discussed further in Chapters 3 and 4.

City specific indices

Global Financial Centres Index

The City of London publication, "The Global Financial Centres Index 5", March 2009, ranked London as the world's leading financial centre. It had a sub-index for infrastructure which also ranked London in pole position; this included information on property and amenities as well as telecoms data. The telecoms data used came from the Economist Intelligence Unit's rankings.

The Global Financial Centres Index 5 (GFCI) used 57 indices to compare financial centres, grouped into five key areas of competitiveness:

- People, including a skilled and flexible workforce, and quality of life measures;
- Business environment, including regulation, tax rates, and the ease of doing business;
- Market access, including the levels of securitisation and volume and value of equities and bonds trading;
- Infrastructure, including the cost and availability of office space, transport, and e-readiness rankings; and
- General competitiveness, covering general economic factors.

Worldwide Centers of Commerce

The MasterCard Worldwide Centers of Commerce 2008 Study ranked London number one by a clear margin in its index aggregate ranking for the top 30 cities. A wide range of factors were used to assess competitiveness, using seven dimensions:

- Legal and political framework
- Economic stability
- Ease of doing business
- Financial flow
- Business center
- Knowledge creation and information flow
- Liveability

¹⁹ The Data Centre Forum has as its members Bank of America, Barclays Capital, Credit Suisse, DrKW, Goldman Sachs, JPMorgan Chase, Morgan Stanley, Royal Bank of Scotland, Societe Generale.

²⁰ <http://www.londonprepared.gov.uk/businesscontinuity/> gives details of the extensive membership of London Resilience

The most relevant dimension here, “Knowledge Creation and Information Flow”, comprised eight factors:

- Number of universities;
- Number of medical schools;
- Number of MBA programmes;
- Patent applications per million people;
- Search engine hits;
- Researchers per million people;
- Scientific and Technical Journal articles per million people; and
- Broadband access per thousand people.

London ranked first among the 75 centres considered on Knowledge Creation as well as overall.

London Chamber of Commerce Competitiveness study

This study was published in April 2008, and compared London with Dubai, Moscow, Shanghai and Mumbai. It suggested that in global business services, on current trends, London will maintain its lead in productivity over its nearest rival, Mumbai, through to 2030, but that the gap will narrow²¹.

Review of the Competitiveness of London’s Financial Centre²²

This review, chaired by Bob Wigley of Merrill Lynch and hence known as the Wigley report, was commissioned by the Mayor of London and published in December 2008. It warned of increasing competition from regional financial centres such as Singapore and Dubai, and specialist centres such as Bermuda for insurance and Switzerland for Hedge Funds. It emphasised the crucial and increasing role of ICT in financial services as trading becomes algorithmically (software) driven, which tends to increase transaction volumes. We discuss the detailed recommendations of the report for ICT infrastructure in Chapter 4 below.

What is the bottom line?

The ICT-specific rankings relate to country-wide factors relevant primarily to the retail infrastructure. The provision of a high quality consumer ICT infrastructure across London, and to a lesser extent the rest of the UK, is an increasing part of quality of life indicators, and hence a contributor to competitiveness.

Access to specialised financial services infrastructure is not reflected in these indices, and we will discuss measures more directly relevant to financial services in the next chapter.

²¹ <http://www.londonchamber.co.uk/>

²² <http://www.london.gov.uk/mayor/economy/london-winning.jsp>

City-specific indices comparing a wide range of factors, including ICT, place London in pole position. This suggests that the ICT infrastructure provision in the City is currently above a threshold level at which ICT becomes a discriminator.

In order to ensure continued effectiveness of the ICT infrastructure in support of financial services, given the importance of financial services to the City of London, the increasing importance of ICT in the delivery of financial services, and the issues we found in planning and the provision of power in setting up new data centres, we recommend that the City of London Corporation should set up a group to develop and monitor a 10- year plan for ICT infrastructure. The geographic scope should be at least the Square Mile, Canary Wharf and Docklands, as for the Security and Contingency Planning Group. This would provide a context for the long term investment decisions required in planning physical infrastructure and power provision, and the shorter timescale for setting up a data centre and its ICT connections. The geographic scope could with benefit be “within the M25” as will be discussed in Chapter 4.

Recommendation

The City of London Corporation should set up a group to develop a 10- year ICT Infrastructure Plan in support of financial services.

Chapter 3: The City's Current ICT Infrastructure

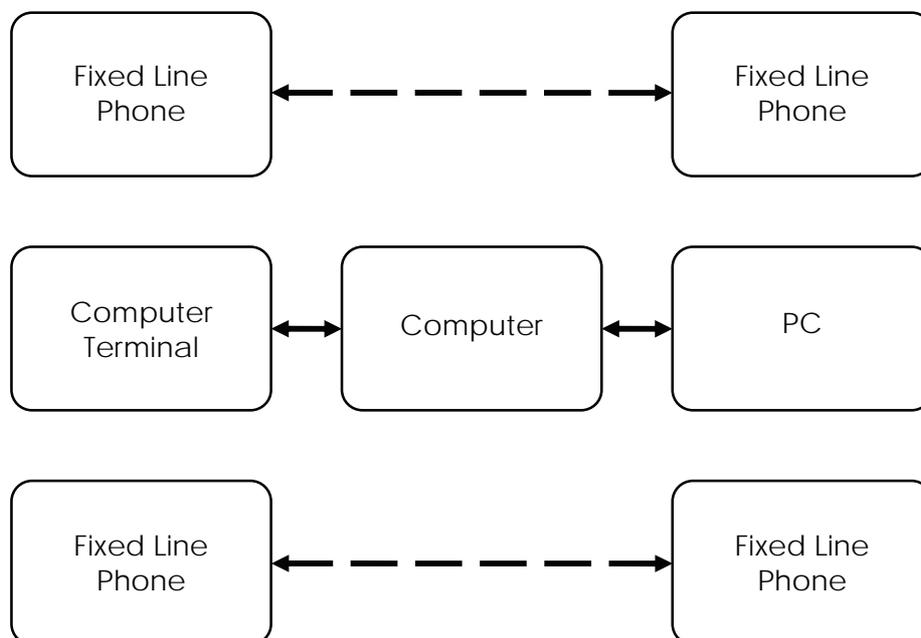
Summary

This chapter starts by reviewing recent changes in the ICT infrastructure technology, before providing a snapshot of the status of three possible measures of relevant ICT infrastructure for the City – connectivity through worldwide network operators, number of suppliers of “fibre in the ground”, and data centre capacity. Then, based on interviews, we identify strengths and weaknesses of the current infrastructure under the headings of broadband and legacy services, mobile and wireless services, high specification (fibre) networks, and data centres. Power supplies emerged as a concern and are addressed further in Chapter 4. We separately address resilience and security, and make the case for a secure mobile network, available commercially, for use in an emergency.

ICT Infrastructure and recent changes

Historically, ICT infrastructure could be divided into data networks for computers and terminals, networks for fixed line telephones, networks for wireless communications, and more recently, networks for mobile phones.

Figure 1 – Historic ICT Infrastructure

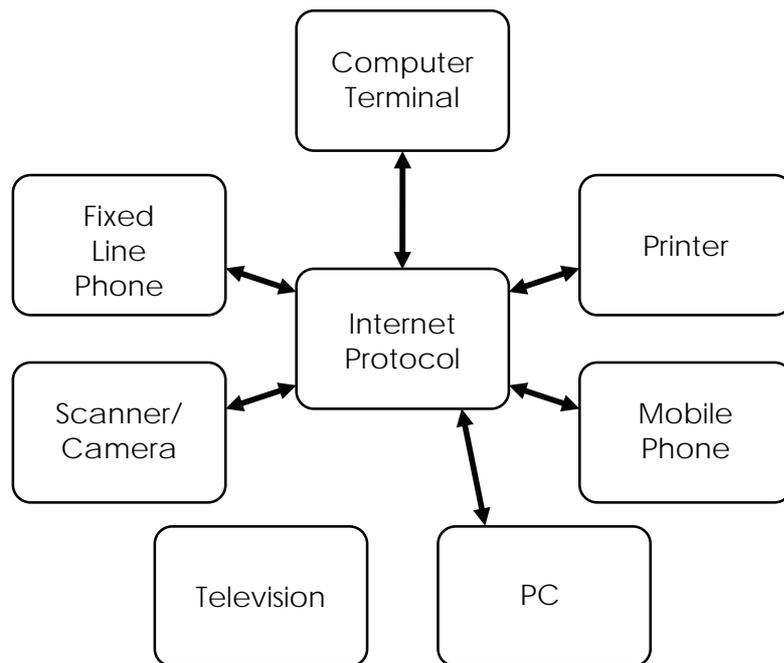


Technical trends

Over the last five years or so we have seen four significant changes in the ICT infrastructure:

- Convergence of network services including telephony on to the Internet Protocol (IP), which means that voice and data services share the same network. The design of Internet networks mean that many alternative routings are possible between two end points, see the glossary. This commonality has caused a number of organisations to rethink their resilience strategies.
- The shift of the major mobile operators from a focus which is primarily voice to one which is primarily on data (including SMS messaging); and the emergence of broadband data transmission as a wireless mobile service, leading to the blurring of the distinction between fixed line and wireless or mobile suppliers. Figure 2 illustrates the current position, in which Voice over Internet Protocol (VoIP) is widely used as is internet protocols for data networks, with TV still mostly separate at the time of writing.

Figure 2 – Current ICT Infrastructure



These trends are driven by the demands for cost reduction and questions of risk management. The cost of managing highly functional desktop/mobile equipment is growing all the time, while high profile cases of security breaches on the client side emphasise the benefits of holding data and programs in a high security data centre environment with encrypted access from known client devices.

It is likely that these innovations will lead in turn to the introduction of thin client desktops, where most of the application software is on the server, and to mobile devices. This will increase the demand for, and reliance on, high bandwidth network services while reducing the power demand at desktops.

Our discussions with both users and network providers lead us to conclude that this may prove challenging from a commercial point of view, but that the physical infrastructure in the City is likely to be able to cope. Duct capacity is available and the ability to move to Wave Division Multiplexing (which combines several streams of data within the same physical fibre optic cable) on new and some existing fibre optic cables (so as to move from single to multiple data "circuits" within each fibre-optic cable) provides a reasonable level of capacity "headroom".

The third new development in the last five years is the introduction of servers which can be densely packed in racks (commonly known as blade servers). This greatly increases the power demand per square metre in data centres.

The use of virtualisation decreases the demand for data centre space but further increases the power demand per square metre. Typically, the number of machines can be halved for a given work load by using virtualisation, and some case studies show 66% reduction.

A higher power requirement per square metre is connected to a higher heat production rate with consequent need for cooling and an increased carbon footprint. This accelerates the trend towards specialist data centres that are designed to minimise power use and heat export.

Case study – Reducing the need for data centre real estate

A leading insurance intermediary was finding that, as computer hardware became increasingly powerful, the typical utilisation of an application server computer was falling. While this was beneficial for the performance of the application systems on a server, it was inefficient and expensive for a single server. As the numbers of servers increased, it was increasingly wasteful and was poor value for money. The company chose virtualisation as an effective mechanism for server delivery and possibly desktop delivery.

Virtualisation technologies like VMware operate by adding a layer of abstraction. This allows a single machine to run not just multiple instances of an application but multiple instances of an operating system. There are a number of advantages to this approach:

- It is invisible to the operating system and applications;
- It allows multiple under-utilised machines to be consolidated onto a single machine;
- It is an effective method of isolating troublesome, badly behaved or sensitive systems;
- It enables the best use of machine room space, power and cooling capacity;
- The degree of consolidation is limited only by the power of VMware's ESX server;
- Server provisioning lead time is vastly reduced – down to hours as it is not necessary to install new hardware each time.

ICT Infrastructure for the City's Financial Services

As we discussed in Chapter 2, the ICT indexes comparing countries' infrastructure capability have three shortcomings for assessing the ICT infrastructure that contributes to the City's competitiveness. The first is that the measures are directly relevant for B2C financial services, but not the B2B services that are the core of London's expertise. The second is that country-wide indices will underestimate the capability of the City, as the Ofcom analysis reported on in Chapter 5 shows. The third is that, above a certain threshold, the differences do not impact on overall competitiveness as a global financial centre or world centre of commerce.

So, what metrics could we suggest to focus directly on the ICT infrastructure central to the City's expertise?

We have suggested five headings which will be of increasing importance to the City going forward. This list is based on our discussions with experts, and the interviews that we conducted. The aspects to be measured are:

- The ability of the City to trade. This means metrics of connectivity, both world-wide, and across the City between traders and trading systems;
- The capability of the City to host new applications – the amount of data centre space available;
- The ability to supply data centres with electrical power;
- The security and resilience of the ICT infrastructure, covering both the technology and the systems; and
- The skills of the ICT supply industry.

In the following discussion we introduce two possible additional factors to those the CoLC already record, and which address the first two aspects. We have not been able to provide more than qualitative thoughts on the third, fourth and fifth.

The City's ICT installed infrastructure

Worldwide Network Operators

The number of worldwide network operators providing telecoms services in the City is clearly relevant to the City's ability to connect globally, and to the creation of an effective market (see Chapter 5 for Ofcom's analysis).

Table 3: Worldwide Network Operators and Global Financial Centres served

OPERATOR	HOME	Lon	NY	Paris	F'furt	A'dm	Syd	Tok	HK	S'p	S'hai	D'b
BT	UK	x	x	x	x	x	(x)	(x)	x	x	x	(x)
Cable & Wireless	UK	x	x	x		x	x	x	x	x	x	
China Mobile	China								x		x	
China Telecom	China										x	
China Unicom	China								x		x	
COLT	UK	x		x	x	x						
Deutsche Telecom / T-Mobile	Germany	x	x	x	x			x	x	x	x	
Emirates Telco Corp / Etisalat	UAE											X
France Telecom / Orange	France	x	x	x			x	x	x	x		
Global Crossing	USA	x	x	x	x	x		x	x			
Hutchison Whampoa	HK	x					x		x			
KDDI	Japan	x	x	x	x	x	x	x	x	x	x	
Level 3	USA	x	x	x	x	x						
NTT Comm	Japan	x	x	x	x	x	x	x	x	x	x	(x)
PCCW Ltd.	HK	x	x					x	x	x	(x)	(x)
Royal KPN NV	N'lands					x						
Singtel	S'pore	x	x	x	x		x	x	x	x	x	X
Telstra	Aus	x	x				x	x	x	x	x	
Verizon communications	USA	x	x	x	x	x	x		x	x		
Vodafone	UK	x										
Key:												
Presence in City	x											
Representative in City	(x)											

Table 3 shows a substantial selection of the world's leading network operators from the countries of interest to this project, and the cities relevant to this project in which they have a presence. Appendix 6 describes the provenance of the data in more detail. This chart should be treated with caution, as the situation is changing fast as companies merge and expand their networks - it provides a

snapshot at the end of December 2008. It suggests that London is well served by worldwide network providers.

Several of these worldwide network operators also have fibre in the ground in the City, namely: BT, Cable and Wireless, COLT, Global Crossing, Level 3 and Verizon. The City has additionally a number of other suppliers with fibre networks "in the ground" in the City, including: Abovenet, Geo, Interroute, Neos Networks, Thus, and Virgin Media.

The CoLC should monitor the number of worldwide network operators servicing the City, in addition to their interest in fibre networks "in the ground".

Data Centres – definitions and usage

A facility used to house computer systems and associated components, such as telecommunications and storage systems. It generally includes redundant or backup power supplies, redundant data communications, environmental controls (e.g. air conditioning, fire suppression) and security devices to ensure continuity of service.

We found that "data centres" had very different roles.

The first, and still dominant use, was in-house data centres for the organisation's own use. The applications would include customer account processing for instance. The large financial services organisations had mostly rejected outsourcing their main data centres, primarily on the grounds of security.

Third party data centres are used for back up purposes, and to run specialist applications for subscribers. Data centres used for back up need high bandwidth connections to the primary data centre, and high security. Specialist applications run in data centres include internet services and trading systems for financial services.

Trading systems in particular need to have high bandwidth connections to the trader, to deal with volumes of trades, and the speed of response (latency). Since even fibre networks have finite transmission times, there is pressure to site data centres running trading applications as near as possible to the trader, or even to co-locate in the same building. This pressure becomes more marked as trading moves to software-driven, or algorithmic trading, which may need sub-millisecond implementation times to take advantage of a specific price range.

Data Centres

As discussed above, the drive for cost reduction is leading to virtualisation to reduce the number of servers and denser packing to reduce data centre space. This means that data centres are increasingly specialised installations, able to connect to high bandwidth networks and to deal with the power requirements and heat dissipation issues. These are driving the trend towards third party (specialist) data centres. Third party data centre space could be a measure of the provision of ICT services.

In Table 4 "Carrier neutral" Data Centres in London, i.e. data centres which accept connections from all telcos, are shown: the banks that appear have space in West London, remote from office space in the City or Canary Wharf.

Table 4: Data Centres in London

Organisation	Location of Data Centre	"Third Party"
City Lifeline	City	yes
Deutsche Bank	West London	no
Easynet	City	Yes: Internet service
Equinix	City, West London (2)	yes
Global Switch	Docklands (2)	yes
Interxion	City	yes
Telecity	Docklands (7)	yes
Telehouse	City, Docklands	yes
telstra	Docklands	yes
UBS	West London	no
Cable and Wireless	West London	no
Interoute	Docklands	yes
Level 3	City	Yes: Internet service
Morgan Stanley	West London	no
IBM	City	yes

Source: From the Technology Practice Group at CB Richard Ellis, with permission

It also appears important for the CoLC to be able to track the major data centres, both in-house and third party, for planning and business continuity reasons, in the same way that the telecoms infrastructure is tracked. Additionally, our search to establish data centre capability identified that many of the data centres in the City and City fringes were part of international groups, so regular contact with these organisations would aid in understanding competitiveness in relation to ICT infrastructure.

So, for instance, Telehouse ²³ has data centres in Los Angeles, New York and Hong Kong as well as London, and Interxion²⁴ has 40,000 sq metres across 24 data centres and 11 countries in Europe.

The same CB Richard Ellis report used in Table 4 provided for Q3 2008 a European overview of the stock of data centre space in the main European cities. It shows that London had more data centre space than the other centres, with significant availability, as shown in Table 5.

Table 5: European data centre space as at Q3 2008

City	Stock(Square metres)	Vacancy %	Vacancy (amount)
Amsterdam	63,540	24%	15,250
Frankfurt	177,020	25%	44,255
London	260,610	27%	70,365
Madrid	36,360	41%	14,910
Paris	83,460	27%	22,534

Source: From the Technology Practice Group at CB Richard Ellis, with permission

What can be learnt from these comparisons?

First, London has by far the greatest stock of data centre space. This comes in many categories, of which the two main are shell (or shell and core) and carrier neutral hotel.

The demand for carrier neutral hotel (CNH) data centre space - data centre space where the operator allows any carrier (telco) to connect into the facility and to connect to third parties within the facility - is growing. The amount of CNH data centre space is a measure of the City's activities and the extent to which the City's companies use outsourced services, whether internet, disaster recovery, or specialist trading services.

Shell data centre space is space available for in-house operations, a shed. A typical new corporate data centre might need 10,000 to 30,000 square metres of data centre space, so that the total data centre space in London is only equivalent to 10 new large data centres.

A possible metric for the CoLC to monitor would be the total amount of data centre space, or if the information were available, the amount of CNH space,

²³ www.telehouse.net

²⁴ www.interxion.com

compared with other global financial centres. Table 5 shows that London is better placed than other European cities, on this metric.

Additionally, data centres act as sounding boards for the business environment. Level 3, for example, claims to be “one of the few London data centres with 100% power up time”²⁵, reflecting the power supply concerns in London. Equinix²⁶, a US company with data centres across the US, Europe and Asia-Pacific, states:

“Our award-winning “green” approach touches all aspects of our day-to-day business activities. From energy conservation practices in our centers to recycling and eco-friendly purchasing policies, we take pride in promoting initiatives that protect the environment while improving energy efficiency for our customers.”

We recommend that the CoLC should maintain contact with data centres, to complement their detailed knowledge of fibre “in the ground”.

In the next sections we report on the results from our interviews.

Broadband and legacy services

Large organisations

Large organisations use standard retail broadband services, delivered over the legacy local copper telephone wires (ADSL), for a range of applications such as backup, ATM networks and home working, but mostly use fibre optic cable delivery of very high speed services as their main technology.

Large organisations mostly use multiple vendors for resilience, but one large organisation commented that even if the contracted service was with an independent supplier, such as Easynet (a global managed network, hosting, and telepresence company owned by BSkyB), the link to premises at either end was with BT. Another pointed out that COLT and BT shared a number of physical ducts and connection points, which for some organisations meant that they were unsuitable as back up to each other.

Reasons for choosing a supplier vary but often large organisations choose the supplier which is able to deliver in the time available, or because it is the dominant supplier for a specific purpose (e.g. link to Bermuda, managed home broadband).

In spite of some individual concerns, there is overall satisfaction with fixed wire voice and data services. Reflecting London’s competitive position, representative quotes from the interviewees included:

²⁵ www.level3.com

²⁶ www.equinix.com

"We buy services around the globe and by comparison the UK is good and London is very good."

"London is particularly good in its ICT provision. The Far East is also very good, and COLT is not bad in Europe. Paris is good. Luxembourg is bad."

"I think [New York and London] are pretty much on a par, although they both have a different way of going about things, they face the same issues. Now, if you wanted me to compare London to Dubai or Moscow, there's a very marked difference in favour of London..."

However another respondent compared BT's performance in the UK with their performance in international markets:

"BT are worse in the UK than anywhere else, both initially and providing an on-going service."

A weakness is identified in configuration management during disaster test scenarios, when it proves difficult to re-start networks after catastrophic failure.

Supplier performance in relation to new products and initial service delivery was widely flagged as inadequate, highlighted in the discussion under 'Skills' later in this chapter.

Large organisations mostly have a clear perception of the number of suppliers and the range of tariffs available and levels of service and see themselves as "strong buyers" who can negotiate value for money. It would appear that the market, with informed buyers, is effective in providing value for money for a service that is increasingly regarded as a commodity, since the costs of using ICT infrastructure were not flagged as a concern overall.

Large organisations tend to have Service Level Agreements (SLAs), and to enforce them strongly. Some respondents commented on the need for a standardised set of terms to describe levels of service in SLAs, to enable realistic comparisons between suppliers. Suppliers think that standardisation of service level terminology – perhaps co-ordinated by Ofcom – would enable more effective co-operation and peer-to-peer distribution²⁷ arrangements. It was recognised, however, that penalties set in SLAs cannot reflect the real cost of an outage to the business.

The chapter on Regulation notes the opportunity for suppliers and Ofcom to co-ordinate the standardisation of terms and descriptions in SLAs and for the CoLC to publish standards.

²⁷ The process of directly transferring information, services or products between users or devices that operate on the same hierarchical level

SMEs

Most small organisations use standard retail broadband services, delivered over the legacy local copper telephone wires (ADSL).

Some small organisations use leased lines but there were comments from SMEs interviewed as part of this study that leased lines are too expensive or not permitted by the landlord. One SME company in serviced offices was forced to use only the standard specification ICT provided and was not permitted to install fixed lines of its own. Other companies intimated that serviced offices do limit scope. This could be because the landlord has an exclusive arrangement with a particular service provider, or that the premises are physically unsuitable for the installation of fibre networks or base stations for mobile networks.

Given the need for SMEs to use serviced offices, we recommend that the CoLC promote building and refurbishment standards to facilitate the addition of fibre networks and base stations for wireless networks.

SMEs had fewer problems with installation than large companies, perhaps because they bought standardised services.

Prices and Tariffs

SMEs find the tariffs of retail services broadly acceptable. It would appear that the market is effective in providing value for money for a service that is increasingly regarded as a commodity. Only a few SMEs consider ICT infrastructure costs as significant in their operations.

Only 10% of organisations contacted do not use SLAs at all, and they were all SMEs. Other SMEs said that they used SLAs when their clients imposed SLAs on them, to get back to back agreement on service levels. SLAs will become increasingly important as organisations become even more dependent on ICT networks, with home and dispersed working, and virtual offices.

High specification networks

As discussed earlier in this chapter, the technology trends and drives towards cost savings are increasing the demand for high specification networks. Security and resilience needs place further demands on high specification networks.

Large organisations

Specialist ICT platforms are essential for the core City activities of electronic trading, settlement and clearing across the equities, derivatives, foreign exchange and fixed income markets, which depend on very high speed connectivity and latency. The need for network latency at the millisecond level was raised by our interviewees as a requirement for trading desks. Some organisations placed equipment at the London Stock Exchange (LSE) or other trading systems' premises to ensure high speed responses to trading requests by

traders or software. Low latency pods in the London Stock Exchange environment were seen as an important differentiator for the City, as was co-location with other trading systems. Some data centres specifically promote their ability to co-locate traders with trading systems.

It is clear that all the major telco service providers, both fixed wire and mobile, were well aware of these needs and are working hard to ensure that necessary capacity is available. One major operator summarised the high speed network situation as follows:

"It is clear there is a continued and insatiable demand for higher speed services based on packet technologies such as Ethernet and IP as traditional services decline. We see an increasing demand for high speed services from 100Mbit/s to above 1Gbit/s on both the local metropolitan and pan-European basis. In addition, there is a clear need for services with lower end-to-end latency and higher resilience. We can already address most of these requirements with our fibre network connecting more than 16,000 buildings across Europe. Recently, we deployed a Multi-Service Platform²⁸ based on Ethernet over MPLS that reduces latency, improves resilience and adds a level of flexibility that allows greater control of services and faster delivery. We can do this because of the quality of our infrastructure."

The same operator also confirmed the trends observed in data centre demand:

"We are also seeing a significant increase in demand from customers both for data centre facilities and associated managed services to help manage all or parts of their IT infrastructure. Latency, geographical diversity, together with lack of staffing and capital, are the key trends we are seeing."

While there is recognition that demands for higher speeds will increase, the view is that network connectivity can be provided, albeit at higher cost.

Large organisations recognise that industrial strength connectivity offering security and resilience can be provided, at a price.

SMEs

There were comments from SMEs using basic broadband services that they saw a need for higher speeds for data transfer in the future. This is for backup, and to run applications on servers without using "expensive City office space". Some SMEs have problems in serviced offices where it is not possible to install new fibre due to space limitations within the building. However there is a consensus across

²⁸ The multi-service platform allows the telco to deliver voice and data services from the same network infrastructure, software based, which allows fast service delivery as supply is enable by parameter settings. It is also cost effective as it obviates the need for specialised networks for voice, data and other services.

large City-based and City fringe stakeholders that high specification telecoms connectivity is readily available.

Mobile and wireless services

In this section we distinguish between mobile phones (mostly 3G technology) and wireless. Wireless is of two categories, WiFi and WiMax.

WiFi and WiMax

WiFi is a short range wireless technology using unlicensed spectrum which allows for over the air connection between a client (laptop, Blackberry, etc) and a base station or between two WiFi clients. Also known as wireless LAN (local area network), with a range of up to 100 metres. This is Supported by Blackberry and iPHONE hand-held devices.

Companies providing WiFi services in the City include:

- The Cloud, delivering over a million Internet connections per month;
- BT Openzone, with links to mobile operators Orange, Swisscom, etc

WiMax is a wireless MAN (metropolitan area network) using licensed spectrum to provide access to an ISP (Internet Service Provider's) network, with a range of kilometres. It can be used for instance to connect WiFi hotspots to the Internet, and as a wireless alternative to cable and DSL for "last mile" broadband access.

Our respondents felt that in London, mobile phone usage is usurping the role once seen for WiMax, and that mobile broadband will continue this trend.

Large organisations

The picture in terms of use of wireless and mobiles is mixed. Whilst there is very wide use of Blackberries and 3G for email on the move, there is little apparent enthusiasm for wireless connections. Some use wireless networks for visitors or for in-house back up. Several organisations with high security consciousness said "We don't touch wireless". Others have restrictions on what can and can not be used on laptops.

Connectivity in some geographies is more difficult than others, for example:

"The two worse-case scenarios are the Middle East and Russia. They're both very expensive and poor quality."

Only two companies interviewed use multiple suppliers of mobile or wireless services to increase resilience, reflecting the lack of enthusiasm for wireless, and its inherent lack of reliability. Some use wireless for "last mile provision" in addition to mobile services.

Overall, wireless networks are not seen by large organisations as currently of mission critical quality.

SMEs

SMEs also make wide use of Blackberries and 3G mobiles for email on the move, as a necessity. There are concerns over security as well as resilience, for example, one SME stated that

“Encryption is expensive on wireless, but we use it outside our own network.”

On the other hand, some SMEs routinely use wireless within their offices for convenience and simplicity of installation. However one SME commented that in the Square Mile in-house wireless has very poor reception with high interference. This is due to the high density of users in some areas.

We discuss this further in the next chapter, since the expectation is that mobile, wireless and fixed line technologies and services will converge over the next decade.

Data Centres

Large organisations

Large organisations such as the big investment and retail banks tended to believe that their requirements for power, security and resilience, and availability would stretch most external data centres. Specialist financial services suppliers, such as those supplying trading, clearing or settlement, use state of the art ICT platforms and in-house data centres to match. These facilities are often in data centres owned and managed by the organisation. Large organisations mainly use third party premises to host disaster recovery and web sites.

Large organisations often disperse their data centres to different locations. The need for resilience and risk management means that there is a need for separation between main/standby data centres. Data centre specialists suggested that an ideal set up in this context was a triangle with sides up to 30 miles. One large organisation uses a data centre in Paris as back up to mitigate against terrorist threats. Large organisations tended to use the word “paranoid”.

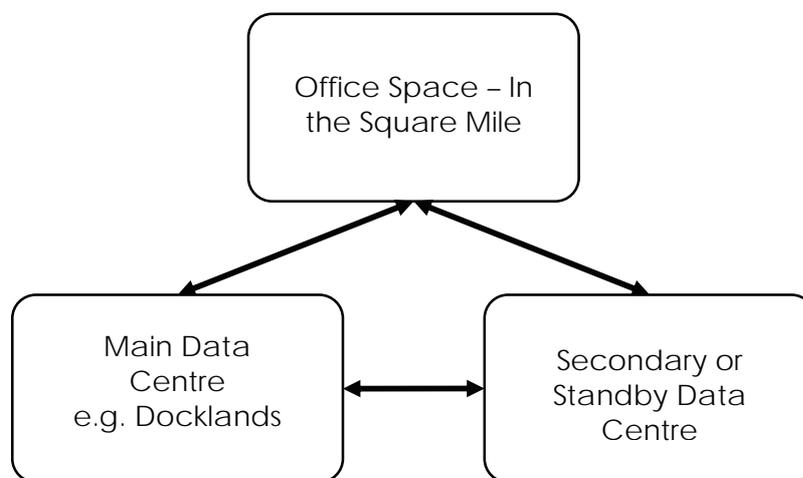
There is increasing support, particularly within larger organisations, for a three site infrastructure as a vehicle for risk management. The three sites are typically offices, main data centre and standby data centre. In respect of data centres there is a balance to be struck between the demands of resilience and reliability and the need for low latency. There is a continuing desire to maintain offices within the City with a reasonable degree of access to data centres. There is a

growing consensus as to the optimum balance between these conflicting demands, which is considered to be a triangular model with each side up to 30 miles long.

The implementation of such an approach is critically dependent on the ready availability of very high bandwidth data links and power.

One could therefore see the possibility of such a scheme as shown in Figure 3 below:

Figure 3: Data Centre Triangulation



Demand for space for data centres has recently levelled, due to the reduction in financial services activity. There is known spare capacity in Docklands, as mentioned earlier, and new capacity is being added to meet the demands of the Olympics, among others.

Data centre space is not flagged by our respondents as currently a problem, but in the next chapter we discuss the problems of adding new data centre capacity, in the context of the impact of advanced technology in reduction of space and power requirements for a given processing load, versus the expected increases in demand for more ICT transactions.

SMEs

Some small organisations used hosting in third party premises to reduce cost – remarking “City space is expensive” (i.e. the Square Mile). Others used third party hosting as part of a risk strategy, so that one SME reported that

“Our physical security is based on using external [server] farms [in a data centre], well secured (except for aircraft strikes in the US). We use back up systems [widely and our in house network is physically well secured. But reliable power supplies through the Grid are a problem in London, which is why we go outside the square mile for servers and storage”.

Another SME identified that, with external hosting for backups, instant access is a concern, and high specification networks to and into the building are needed.

Power Supplies

Large organisation

Power was mentioned by many respondents.

There were a few instances where respondents had specific comments on power cuts, but the problems were intermittent, as in

“Every year there is an area that blacks out. We have an emergency generator and have often been a blaze of light in a pool of dark.”

Most organisations feel they have adequate Uninterruptible Power Supply (UPS) capacity through batteries for an orderly close down of operations.

With regard to accessing sufficient power, although the majority of respondents are satisfied with the adequacy of power supplies, there are some organisations with specific current and future concerns. It appears to be a greater problem than it might be in other circumstances in that they feel that they have less control as they are in the hands of a single provider, EDF Energy Networks. Some large organisations are planning to move data centres out of London to reduce this reliance.

A couple of organisations have fears about the demands for power from the 2012 Olympics, although EDF Energy Networks states that plans are in place to meet the demands of the Olympics in addition to those of the City, and that the plans in National Grid for power transmission are also in place.

SMEs

Several smaller organisations have plans in place to use other offices in the UK or overseas to continue business in the event of longer power cuts, linking via the internet.

Power supply in serviced offices was a concern to one SME:

“Power is not satisfactory in our building. There is a UPS attached to the office which routinely gives problems. Building owners say it is the grid which is the problem, but the UPS does not satisfactorily compensate”.

Few SME organisations appear to have backup generators. This is apparently mostly due to the cost or availability of space. One smaller organisation has plans in place to use other offices in the UK or overseas to continue business in the event of longer power cuts, linking via the internet.

Power supplies and associated planning and regulatory hurdles for new generating capacity are discussed further in the next chapter, together with EDF Energy Network’s response.

Security and Resilience

Sources of threat

The City is a noted global centre and the financial services in the Square Mile, in Docklands and Canary Wharf, and in other parts of the country are an important part of our critical national infrastructure²⁹, as discussed in the brief issued by the Parliamentary IT Committee (Pitcom).

The UK Centre for the Protection of National Infrastructure ³⁰ states:

“The UK faces a range of covert threats to its security. There is a serious and sustained threat from international terrorism to the UK and UK interests overseas. The current threat level in the UK is assessed as ‘Severe’ which means an attack is highly likely. The most significant terrorist threat comes from Al Qaida and associated networks.

The threat from espionage (or spying) against the UK did not end with the collapse of Soviet communism in the early 1990s. Several countries are actively seeking British information and material to advance their own military, technological, political and economic programmes.”

²⁹ <http://www.pitcom.org.uk/briefings/PitComms1-CNI.pdf> defines the Critical National Infrastructure as essential services over 10 sectors including finance.

³⁰ www.cpni.gov.uk

The City, with reference to the Square Mile, Canary Wharf and Docklands, is not homogeneous in terms of risk, as one of our respondents pointed out:

“The City core [the Square Mile] is the best served of the three in terms of risk management and Canary Wharf the worst because of its exposure and limited transport and power routes. Docklands is seen as a standby site for the City and Canary Wharf. There are many contingency centres there but few main offices.”

Another respondent pointed out that the Docklands contained data centres handling a lot of network traffic, with consequent major disruption if this went down.

During the study, it was pointed out that there is co-ordinated business continuity planning across the three areas in the City, but that there was not a similar co-ordination for ICT infrastructure. Given the increasing importance of ICT in financial services, we recommend (see Chapter 2) that a joint body should be set up to look at the ICT infrastructure of the “City”, on the lines of the City of London Security and Contingency Planning Group, to develop a 10- year ICT Plan.

If there is a failure of the electricity transmission network, as opposed to the distribution network, there could be a ‘Black Start’ position where there is a shut down across the United Kingdom. Such shutdowns of transmission networks have occurred in both Europe (57 million users) and the USA (50 million users) but not in the UK.

The likelihood of such an event in the UK is low but it would be particularly difficult to manage as we are a ‘power island’, (the continental interconnector cannot be used to help restart the network). There are a number of designated ‘black start’ power stations that will be used in such circumstances to resume supplies that will be gradually be built up through a number of power islands. Once these are established they will need to be synchronised and linked. Following this, power can progressively be established across the network, maintaining a balance between supply and demand.

The City is an area of high demand with no generation, so it will not receive any power until late in the reconnection process. It should therefore be noted that a failure of the electricity transmission network could result in power loss in the City for over 12 hours and demand management for a further few days.

Those organisations with back up generation should be able to continue some operations. However, it should be noted that after about 3 hours the consequences could include the following:

- Public telecommunication congestion/failure
- City traffic gridlocked;
- All rail and underground travel stopped;

- City workers facing uncertainty about the journey home;
- Food outlets becoming unavailable;
- Retail trade and EPOS services suspended; and
- Major workload for emergency services.

The case study below illustrates the four dimensions of business continuity – computer systems, people, networks (telephone and computational) and physical sites.

It is often the case that an unexpected factor is found during these exercises. In one exercise, a well-designed cascade system had been put in place so that nominated staff had a list of people to call after an emergency. The people that had been called then had to call an emergency number and leave a voice mail. A “real” test of the process found that a zealous employee had reduced the amount of storage rented for voice mail, on the grounds that 50 messages was plenty – the 5,000 staff were able to call in but only the first 50 were able to leave a message.

Case study – Disaster simulation to keep prepared

Turquoise offers an innovative trading platform for Europe. Its members include the largest banks and brokers active in European trading, as well as specialist trading firms and institutions with local, regional and sectoral focus. The Turquoise Multilateral Trading Facility (MTF) has secured market-making relationships with key stakeholders that, together with its wide membership, differentiated functionality and competitive pricing, ensure a critical mass of natural liquidity.

The technology and connectivity which underpins the thousands of orders per second the MTF processes must be both robust and resilient. For this reason, according to Chief Technology Officer Alex Krovina, every quarter Turquoise tests its ability to continue trading in the event of a major disruption to the trading systems or telecommunications infrastructure. “One of the major requirements for us is that we require redundancy and disaster recovery facilities” he notes. “So if a failure occurs, it is automatically monitored and corrected. If it cannot be corrected, we relocate to our alternative site and activate our Business Continuity Plan.”

Recently, for example, a “disaster event” was simulated during a trading day to make sure that Turquoise could continue trading if a site was lost. The event was unannounced and simulated a major failure. Members of each team were relocated to the Disaster Recovery site during the event. The company was able to continue to operate from this new site without any interruption or impact on members; they saw business as usual.

Large organisations

In analyzing the risks associated with various technologies, it is clear that a wise user will assume that networks are insecure and take steps, outside the network, to secure their assets both physical and logical. All the larger financial institutions and their suppliers appear to do this.

Large organisations take responsibility for their own physical and logical security, both in their data centres and across networks and third party data centres. One has introduced a complete failover solution at the data centre to ensure resilience. Large organisations tend to take a two prong approach. First they insist on secure protected network routes with no crossover so that disaster recovery (DR) is not impacted if the main route fails. Additionally they encrypt any client data. Dual supply of fixed line is frequent, but not of mobile phones or wireless connections, which are not thought of as mission critical.

Comments from large organisations illustrated this caution:

"We assume all networks are insecure and don't enter into contractual arrangements about this. We undertake all our own security."

"We never store data on third party premises"

SMEs

Most SMEs assume low levels of security on networks they use and take precautions accordingly, such as encryption. Their precautions in some cases matched those used by the larger financial services organisations. Some, however, considered their infrastructure suppliers as secure, and a few others are not deeply concerned about security outside avoidance of viruses etc.

It could be that this is a topic on which guidance for SMEs would be helpful.

Implications for ICT infrastructure

Although this study is primarily concerned with the ICT Infrastructure, it is worth noting that the human factor, often the most senior staff, is a major source of risk. For this reason, ongoing programmes to test the capability of the ICT infrastructure to recover are essential, as described in the previous case study.

There are significant interdependencies between utility services and some of those greatly increase potential vulnerabilities in major disaster scenarios.

Examples considered included:

- The use of mobile phone technology as the method of communication amongst electricity grid workers in major failure scenarios when there are many such scenarios that would cause mobile communications to fail simultaneously. EDF Energy Networks has a variety of methods to maintain communication with maintenance staff during major and/or extended fault scenarios. This includes mobile and fixed satellite telephones. In

addition they have ready access to mobile generation equipment that can be deployed to restore power to specific sites such as local exchanges for the fixed wire telephone system (FTN) and mobile base stations, as part of a co-ordinated response with other utilities.

- Lack of clarity in priority of telecoms service restoration, particularly amongst competing providers who use the same set of contractors for maintenance.
- Flooding in London could affect power provision as well as the availability of back up ICT services, with the ICT infrastructure unable to kick start the power supplies or vice versa.

One respondent pointed out that, post 9/11, the US emergency services were supported by a national system which was widely available. New York City is utilising this for their agencies in New York. In the UK, in contrast, if the mobile network goes down:

"We have only one SIM card on the Government system. As demonstrated on 7 July, this does not provide resilient coms and in practice is of limited benefit. It also has to be switched by the operator for selected parts of their network. We have walkie-talkies, and other back-up devices, but there should be more provided by the authorities."

Another respondent said:

"Communication is seen as a major factor in security planning and disaster response, because of the large number of organisations with involvement. There is work going on here but there's no doubt that it needs more attention. In particular the limited standby power on the Airwave system looks to be a major (unnecessary) risk, but I think we may wish to recommend a review of emergency communication facilities in the event of a protracted disaster involving power outage."

The CoLC's business continuity programme receives high praise but there are some comments that it needs to take a wider scope, for example:

"The City [of London] staff believe they are better set up than New York, though New York is working very hard on these security issues. Such liaison as there is seems to rely on the dialogue the City [of London] has with the senior security staff at the major banks, which operate under national regulatory control in New York as well as in the City of London. I found no evidence of any liaison directly between the two City authorities."

Highly secure mobile networks for use in an emergency need to be independent of the grid for electricity, and be able to communicate not just between "blue light" services.

The UK government initiatives to support Vodafone to maintain the paging network and the development of the HITS (High Integrity Telecommunications Systems) programme may have implications for the City. The purpose of HITS is to

keep the government emergency committee COBRA and associated feeds operating even if the main telecommunications nets go down; a similar approach could be appropriate in the City.

It is felt that a market in resilience services is far more likely to be an effective solution to filling some of these gaps than regulation. However that implies an educated customer community that understands the technical specifications and is in a position to place sensible demands on the service providers. We recommend that the CoLC consider sponsoring or commissioning a commercially available secure mobile network, especially focused on availability during sustained emergencies.

We found that most City stakeholders are well aware of security and resilience concerns, and continuously assess threats and responses. CoLC contingency planning and readiness exercises are well regarded and could be extended to cover master classes and seminars.

Skills in the ICT supply industry

A number of our respondents in large organisations have had bad experiences with installation of new products and services, for instance:

"There are often problems during installation. After that, things tend to be OK. This applies to all suppliers."

Widespread problems are found around the programming of installation and suppliers not meeting deadlines, with a few suggestions that commissioning was not well implemented. The infrastructure suppliers contend that any operations involving permits for excavations in roads or needing planning permission are bound to be subject to delays. However respondents feel that the skills of the suppliers' engineers also contribute to delays.

On the other hand we heard:

"The instruction book was rubbish but we managed to speak to somebody who solved the problems in minutes".

Regarding staffing for data centres, one respondent compared London and New York favourably with Dubai. One SME commented that finding staff is far easier in London than in Caracas or Switzerland, and another on the advantages of an open city like London for recruiting staff.

SWOT Analysis: Summary of Results

Table 6 below serves as a summary of the main points, under the headings of Strengths, Weaknesses, (both internal factors) and Opportunities and Threats from external forces. It is divided into two tables, one for large organisations and one for SMEs,

Table 6: SWOT Analysis for the City's ICT Infrastructure: large organisations
<p>Strengths</p> <ul style="list-style-type: none"> • Large organisations operating in the City are mostly global operators with the staff and the knowledge to use ICT effectively. • The telecoms market appears to be working to deliver ICT connectivity infrastructure. • Large organisations recognise that industrial strength connectivity offering security and resilience can be provided at a price. • Price of ICT infrastructure seen to be competitive. • Positive comparisons of ICT infrastructure with other global financial centres. • Multiple worldwide network operators service the City. • Spare capacity for data centres at Docklands. • Well regarded approach by CoLC to business continuity.
<p>Weaknesses</p> <ul style="list-style-type: none"> • Large organisations noted a lack of quality staff in the suppliers, particularly noticed when installing new services. • Power availability concerns are leading decisions to locate data centres outside the City.
<p>Opportunities</p> <ul style="list-style-type: none"> • Provision of high security and resilience mobile services accessible to both City organisations and the emergency services, for use in a sustained emergency.
<p>Threats</p> <ul style="list-style-type: none"> • Viability of some ICT suppliers in current climate.

Table 7: SWOT Analysis for the City's ICT Infrastructure: SMEs
<p>Strengths</p> <ul style="list-style-type: none"> • SMEs are overall content with the "retail" ICT infrastructure. • Price of ICT infrastructure thought to be competitive. • Staff easier to find than in competitor cities. • Spare capacity for data centres at Docklands.
<p>Weaknesses</p> <ul style="list-style-type: none"> • Some providers of serviced offices do not provide the capability (space) for easy installation of WiFi base stations and fibre networks. • Power availability concerns as well as the price of space are leading decisions to locate data centres outside the City.
<p>Opportunities</p> <ul style="list-style-type: none"> • CoLC Building Regulations could promote the need for space and access provisions to install base stations and fibre networks. • Provision of commercial high security and resilience mobile service for use in a sustained emergency.
<p>Threats</p> <ul style="list-style-type: none"> • We found limited strategic planning for ICT infrastructure or awareness of suppliers' plans in user organisations. • Viability of some ICT suppliers in current climate.

Recommendations

Within an overall 10- year ICT Infrastructure Plan, the City of London Corporation should:

- Monitor the number of worldwide network operators servicing the City;
- Maintain contact with data centres, to complement their detailed knowledge of the networks, and maintain a view of the data centre space and its utilisation;
- Consider sponsoring or commissioning a commercially available secure and resilient mobile network, especially focused on availability during sustained emergencies.

The CoLC's readiness exercises are well regarded and should continue. They could perhaps be backed up by seminars and Master Classes.

Chapter 4: The Medium Term Outlook for the City's ICT Infrastructure

Summary

This chapter starts by reviewing the role of planning on the organisations surveyed. We discuss the medium term plans for the ICT infrastructure under the headings of broadband and legacy services, mobile and wireless services, high speed (e.g. trading) services (often global), and data centres for large organisations and for SMEs. We discuss mobile and home working and the relationship to Green policies. We discuss the implications of the Wigley report on ICT infrastructure, and suggest that Green policies are already having, and will have in the future, a major impact on data centre design and location. We also suggest some specific topics for guidance that the CoLC could provide for SMEs.

Planning in the organisations surveyed

Large organisations

There is a significantly different approach to planning ICT infrastructure between the large organisations and SMEs interviewed.

Large organisations typically have a technology roadmap of up to 5 years in duration, and a strategic plan which ranges in scope from 12-18 months, to "long term". They mostly take cost-effectiveness as a given, with typical targets to reduce unit costs year on year. Attitudes to innovation depend on the competitive position of the organisation, but there has generally been an increased focus on cost effectiveness vs. innovation over the last two years. Suppliers and consultants are used extensively by many large organisations for technology innovation, risk management and capacity planning. Of the larger organisations, the only one that did not work with its suppliers feels that it can do a better job itself.

Prices for ICT infrastructure are generally expected by large organisations to continue to fall for commodity services. However, although the unit costs were decreasing, the need for more capacity is always increasing so total costs are probably likely to increase as well.

Large organisations typically have a strategy incorporating a technology road map up to five years ahead.

SMEs

About a third of the SMEs interviewed have 3- or 5-year plans. Some of the SMEs which are actively documenting plans are prompted by the need for new

funding or new premises. At least two have just discarded their plans as a result of the impact of the credit crunch on their clients. The plans of SMEs are marginally more weighted towards competitiveness and innovation, or to meeting their clients' needs, than on cost reduction.

In most cases the SMEs feel that they are too small to work with their ICT suppliers. Some, however, have worked with suppliers, after hitting capacity problems, while others drive innovation in-house using standard technology. Where undertaken by SMEs, in-house development appeared to be very specialised to the SME, and part of their business package. For more commonplace applications they use standard products available externally.

This suggests that SMEs could benefit from guidance on planning, combined with access to suppliers in forums designed to give a forward view.

Broadband and legacy services

There are widespread plans to move to Internet Protocol (IP) networks, for both large and small organisations, with comments such as

"This conference call is taking place over IP."

There are concerns about reliance on IP, including putting "all ones eggs in one basket" with the possibility of voice and data services going down together, and regarding the quality of connection, but the general expectation of those concerned is that things would improve rapidly and that higher reliability can be built in where necessary. Overall the opportunities, including cost saving, outweighed the disadvantages, such as short term disruption, for almost all respondents.

Next generation broadband, with speeds up to 24 Mbit/s, is expected from BT with rollout up to 2010, the timing depending on the exchange.

The benefits of a common network are thought to exceed the dangers, which could be mitigated by attention to back up and routing.

High specification networks

Large organisations

In Chapter 3 we discussed the trends driving the increasing requirement for high specification networks. With the large number of worldwide network operators providing services in the City, the City is felt to be in a good position to cope with volatility of ICT suppliers through mergers and acquisitions.

Trading Systems

Trading systems will require significantly increased capacity for high speed connections, particularly if the processing is done at a remove from the trading desk.

SMEs

Several SMEs expect to increase their use of fibre for connection to backup systems and for running applications in remote data centres.

Suppliers

The suppliers we interviewed are confident of meeting demand over the next decade.

Mobile phones and wireless services

Mobile phones and wireless services are expected to converge with fixed line services over the next decade and a mix of technologies will be used by any given supplier. The use of these mobile and wireless services can be discussed under two headings:

- Staff outside the office, whether at home, or on a customer site, for example;
- Connections inside the office, where WiFi is used to connect over short distances as an alternative to fixed line cabling (as discussed in Chapter 3).

Large organisations

Large organisations see increasing levels of mobile working, mostly for international and out of office working, rather than home working. Some already embrace it as

"Home working is a big part of what we do".

Objections to home working focused on security and the productivity of people when working at home. Organisations were moving at different speeds to overcome these objections, for example:

"Culturally we are not ready for home working but we think this will become common in 3 to 5 years."

There is evidence that large organisations would very much like to use the flexibility of home working to reduce the costs of office space, although only a few have achieved this yet. The effort and cost of commuting is also a reason for allowing home working. Use of international mobiles services are flagged as likely to increase, as key financial services staff are based outside the UK. Green policies appear to be only a secondary reason for promoting home working.

SMEs

Smaller organisations tend to use mobile working for the convenience of staff, both for home working and the needs of staff "on the road". A few organisations note the advantages of mobile connectivity for staff who operated out of the office, for instance engaged in maintenance or personal services. SMEs also use home working to reduce the costs of office space. The effort and cost of commuting is also a reason for allowing home working, and connectivity to the office network is becoming less of a hurdle.

Wireless is used much less than mobile phones. The call success rate and call maintenance levels of wireless technologies are currently deemed inadequate, as one respondent put it:

"Well below what would be needed for a mission critical service."

Meanwhile the placing of base station sites for in-house wireless networks needs "creativity", using railways, and property companies and data centre operators among others in order to provide service in the City.

Most organisations anticipate a convergence of fixed line and wireless networks, with a focus on reliability and price rather than transmission mechanism.

Other organisations emphasise the risks of a single network mechanism:

"We are worried about single points of failure. Our IP network handles data networking and we use traditional telephone technology for voice. We don't want something on the network that takes out PCs as well as the telephones. Things will become cheaper as a result of convergence but there is a need to isolate data from voice."

This highlights the importance of arrangements for peering and co-operation to provide alternative routings for IP networks.

Flexible and home working: the Green impact

Flexible working has been promoted as a way of reducing office space needs, and as a contribution to the Green agenda.

As one respondent said on flexible working:

"We have implemented 'flex-desking' (8 desks for every 10 people) and this works. We have reduced the amount of real estate we need by one third."

The case for reducing carbon emissions is less clear. In the BT case study, with many staff commuting by public transport and an energy efficient building, the net effect of home working was to increase CO₂ emissions.

Case Study – BT’s experience of home working

This case study is extracted from “BT Carbon Impact Assessment Service”.³¹

BT’s challenge was to reduce CO₂ emissions from Stadium House, a mixed use BT building containing call centres, data centres, telephone exchanges and staff leisure areas. The emissions were categorized as:

- Contributed by workers and their mobile equipment and transport;
- Externally procured services;
- Building infrastructure including the fixed ICT infrastructure.

The majority of the emissions were from the building’s use of electricity. This divided into:

- BT 21st Century Metro Node 3%
- Data Centres 24%
- Air conditioning/cooling 21%
- Network infrastructure 52%

The surprise came, however, when BT analysed the emissions contributed by workers, their mobile equipment and transport - about 10% of the size of the building emissions. The feasibility study showed that 20% of the staff could work from home. But the Sustainability Manager pointed out that in the circumstances of Stadium House, home working could increase CO₂ emissions overall, for two reasons:

- 90% of the staff travelled by public transport to work;
- The electricity used at Stadium House has been produced with about 30% of the emissions of standard grid electricity. This means that, particularly in winter when home working implies extra domestic heating, the net effect of working at home may be increased CO₂ emissions.

³¹ Carbon Impact Assessment, private communication

Data Centres

In Chapter 3 we discussed the different uses of data centres for electronic trading, back up, back office processing, internet hubs and line of business applications, and the implications for ICT infrastructure.

The Wigley report – see box – has focused on data centres for electronic trading, where the need for fast response times (low latency) require that data centres be sited near to the desks of the traders.

The Wigley Report

The Wigley Report, discussed in Chapter 2, has raised two areas of concern about the infrastructure needed to support the financial services activity of London, as part of its wider competitiveness brief.

The report raises the question of the increased communications capacity needed to support electronic and algorithmic trading, and suggest that there are parts of the City where telecoms capacity will soon be inadequate for this. Whilst the suppliers that we interviewed were confident that demand could be met, the large multiples of traffic volume from electronic trading will test the limits before other applications.

The report also proposes a campus of new data centres to run electronic trading applications which are sensitive to response time. This would tackle three problems:

- Telcos could focus their efforts on providing high specification connectivity to this campus;
- The data centres could be built to conform to “green” standards, for instance re-using the heat created by the large numbers of computers, in a way not practicable in much of the existing City real estate; and
- It would focus the power requirements and allow them to be planned for – a data centre can use as much electricity as a small town.

The report suggests that such a campus would give London-based firms cost and scale advantages over other financial centres.

Whilst this is certainly true, and would be a benefit, a number of our respondents were cautious about any approach which did not include plans for resilience. They were concerned that there should be physical separation between the main and backup facilities, even if this meant losing some latency advantage when in backup mode.

The report concludes that there will be additional demand for data centres able to handle trading systems and provide co-location, as well as to cope with the higher power supply and cooling requirements of new technology.

We go on to consider the demand for data centre space from large organisations and from SMEs.

Large organisations

Our respondents tell us that data growth has been “enormous” over the last decade, but they expect it to level off during the next period, for back office processing and line of business applications.

Peer group applications such as social networking have been raised as a potential creator of demand for data centre and network capacity. Wiki technology and Sharepoint software are in widespread use, as are a number of social tools such as Facebook and LinkedIn. Large organisations have however more security concerns over external usage than capacity concerns over the internal use of these tools. Other large organisations are concerned with access rules and use of employees’ time. But the trend is here to stay, and the question is whether this radically changes the usage of processing, storage and networks within an organisation, in the same way that email radically increased usage a decade ago. The majority opinion is that internal social networking can be managed within current configurations, for instance:

“We run social messaging internally and a professional site for our 30,000 users. The company stores information all over the place. Storage issues make no meaningful dent on what we do.”

Large organisations plan to increase the in-house capability for line of business applications rather than use third party data centres to run their applications. So the CoLC might be concerned at statements such as:

“As things stand it is easier to build data centres in Frankfurt or Northern England than in London from a planning and power perspective.”

SMEs

The level of service that is expected from data centres will continue to increase. As one SME running a service in a data centre observed:

“We are service providers on third party servers. Customers are demanding more and better software applications. Business continuity and disaster recovery are now mandatory, as are improving service levels.”

Most SMEs expected to continue to use data centres for line of business applications and for back up, due to the high cost of space in offices.

We expect that overall the demand for specialist data centre space from financial services organisations will increase year on year over the next decade.

Power supply

Planning is difficult in an environment of changing technology and large power requirements for data centres. A large data centre can consume the same power as a town, but can be put together much faster than a town. The regulatory regime is based on detailed planning of predicted demand over 5-years, and does not allow for anticipating demand as is needed for the discontinuous changes needed when a major data centre, which can be built inside a year, switches on.

However, there is an external source which can be used to suggest potential new demand from data centres. The European Commission estimates that the power required by data centres across Europe will almost double from 2007 to 2020, to 104TWh³². If the City only keeps pace with this rate of increase, it will involve nearly doubling the power requirements in the City. In 2002-3, ³³data centre “hotels” were estimated by EDF Energy Networks to add 150GWh to electricity demand in London, 12% of the overall growth. Total electrical power demand in 2002-3 London was about 35 TWh, and growing at about 1 TWh per year.

The case study in this section illustrates the hurdle for one organisation, which would like to add data centre capacity in the Docklands. In its view, the situation in the UK is that it costs £10M more to set up a data centre in the UK compared with elsewhere in the world. This cost difference arises from power supply issues.

When we asked about power supplies to data centres we found that there are a number of concerns about the ability of EDF Energy Networks to provision new data centres:

“In London EDF Energy Networks has proved problematic and rarely meets the 90 day commitment for a concrete offer of power delivery and are not easy to work with because they find it difficult to deploy the appropriate levels of planning skill.”

“Currently data centres will seek to position in [EDF Energy Network’s] competitor’s territory where the planning is more effective.”

Additionally the power requirements for the next generation ICT technology (blade servers and virtualisation) are higher per square metre of data centre

³² Computer Weekly, 1 February 2009, “Data centre energy under scrutiny”

³³ The Mayor’s Energy Strategy, on www.londongov.uk/mayor/strategies/

space than previous generations, as discussed in Chapter 3. This has ramifications for the design of data centres and their ability to dissipate heat. As one respondent pointed out:

“The energy concentration within buildings has changed significantly in recent years. Those data centres built in the late 1990s are largely full and have a supply design criterion of about 500 to 700 watts per sq metre. Those more recent data centres built since the turn of the century are designed to 1.0 to 1.5 kwatts per square metre.”

The electricity supplier for London, EDF Energy Networks, points out that:

“We are constrained in investment terms to avoid speculative investment and essentially we have to respond to best forecast at service levels laid down by our license conditions. We can invest in asset replacement and “Green” or quality of service goals if OFGEM approve the output measures which have to demonstrate benefit realisation.”

We suggest that there are two problems.

One is that the UK regulatory regime results in costly power, in the perception of several large organisations. In the view of many of our respondents, power availability and reliability in the City is already a competitive disadvantage. We recommend that the CoLC spearhead a discussion with the government and regulators on this.

In order to ensure that all parties are able to plan, we suggest that the 10- year ICT plan introduced in Chapter 2 should cover the issue of power supplies and Green ICT regulations, in addition to the network infrastructure and data centres discussed in Chapter 3. This would need to cover all the areas inside the M25 and hence would need to be coordinated with other boroughs. A 10- year plan would give EDF Energy Networks and the regulator a more certain framework for their discussions than a data centre by data centre approach.

We recommend that a 10- year ICT Infrastructure Plan be developed with EDF Energy Networks and the GLA, which takes into account power supplies and Green ICT regulation in the context of data centres.

The Role of Green ICT in data centre policy

Green ICT is defined as the process necessary to reduce the footprint of CO₂ from the operation of ICT equipment. A flurry of early activities centred around the recycling and disposal of equipment, and this is now enshrined in European directives. Few organisations had issues with the EU's WEEE directive on the recycling of hardware, larger companies simply sending it back to the manufacturer.

Attention is now moving to the regulations that will affect the policy for data centre location over the next decade. Of particular relevance to the City is the approach taken by the GLA to planning applications for data centres, in one case requiring a renewable energy criterion which was not felt to be feasible. The following case study is of a company that was able to make use of renewables, but outside the M25.

Case study - Lack of energy supply threatens City expansion

One of the world's leading information providers has a major global data centre (DC) in the Docklands. The Docklands DC is a vital element of the organisation's global network, pumping information and data around the globe in real time. As financial markets become more sophisticated and interconnected, the business needs to be well-placed to respond by ensuring that its networks are capable of performing at the high speeds and capacity levels that financial information clients increasingly demand.

The company would like to expand and develop its Docklands DC site, but its ability to do so is inhibited by uncertainty over whether adequate energy supply exists to permit the development. EDF Energy Networks, the only available supplier of power for the site, has asked the company to contribute to the start-up costs for an additional power plant in the area, which, at several million pounds, is a significant sum.

Energy policy could damage overall UK prospects

However, the problem is not just confined to the Docklands area. It is estimated that the cost of establishing a data centre in the UK is around £10m higher than in equivalent countries, including the U.S. This largely stems from difficulties in developing new power supplies.

As the company understands the situation, the underlying issue relates to the regulatory requirements that power companies face in the UK. Power companies in the UK have a disincentive to embark on major new projects, such as building power stations, because they must ensure that their customers will not face price rises in the event that such projects are not profitable.

The need to protect consumers is fully understood by the organisation. However, it believes that there is a balance to be struck between consumer protection and the ability of firms to respond to demand signals from the market. An excessively risk-averse strategy ultimately threatens to leave the UK without adequate power supply for major new commercial projects in the future.

Moreover, the current situation means that the business may need to consider moving its data operations to countries where access to essential power requirements is not in question. Over 1,000 people are employed in the UK by the company to maintain its data networks alone.

Large organisations

Among survey respondents, there is almost universal awareness of the Green ICT agenda and the likelihood of increased environmental regulation in future. Some support this on principle:

"I'm responsible for large amount of power consumption and I think about the green issues surrounding this all the time. If I can do anything to reduce consumption, I will."

For the majority, environmental regulation is more part of the business environment which has to be complied with, although Green ICT had helped open eyes to more efficient ways of working, and gaining competitive advantage through improved image. Banks provided an interesting example:

"It is difficult for an investment bank to invest in green products if it is not practicing these principles itself."

"Sustainability is important: we want to reduce energy and water consumption as well as waste production and carbon dioxide emissions. For example, the waste from one data centre is being used to heat a nearby council swimming pool. Planning permission was granted on the back of this."

But regulation has a potentially negative impact, as one respondent explained:

"Town planning is an issue because planners have difficulty with land use classification for data centres. Moreover in a test case 18 months ago for an application at Stockley Park, the GLA called in the application and applied a renewable energy criterion. If this sets a precedent it is not good news, because the way it was done did not take account of engineering practicality or cost effectiveness. No-one objects to energy efficiency, quite the contrary, but the demands from planners need to be sensible from an engineering point of view."

We also learned that, in Australia, regulation on the carbon footprints of office buildings has forced more IT equipment out to data farms.

Regulation to reduce carbon footprints within the GLA³⁴ area may force data centres outside the M25.

This reinforces our recommendation that the CoLC should work with the GLA and EDF Energy Networks to establish a 10- year plan for ICT infrastructure including network connectivity, data centres, the effects of Green ICT and new forms of electronic trading.

³⁴ www.london.gov.uk/gla/tenders/docs/environmental_policy.pdf

Case study - Moving to greener pastures

Chi-X Europe is the operator of the largest pan-European equity multilateral trading facility. It was set up following the European Union's Markets in Financial Instruments Directive (MiFID), which came into force in 2007, to establish a trading platform in competition with traditional exchanges such as the London Stock Exchange – which is faster, cheaper and has a higher capacity.

When the company started live trading in European equities in March 2007, it operated through a data centre in the Square Mile supplied by its (then) parent company, Instinet, which, in its own right, has more than 35 years history pioneering electronic trading technology. However, it quickly outgrew the office space capacity available and so had to consider options for expansion.

The company decided to locate to a new primary data centre at Slough Estates, west of London, where the energy is supplied by the largest biomass combined heat and power plant in the country. In the opinion of Chi-X's programme manager for the data centre relocation, this move would bring the benefits of much-needed capacity and would also begin to make a big dent in carbon emissions:

"For the last few years I have been looking to do what I can to lower data centre carbon footprint."

A reluctant choice

Despite the improved energy profile the new facility will bring, the decision to move out of the Square Mile was not taken lightly. As the programme manager explains, one of the key issues for an operation like Chi-X is that, because trading takes place in microseconds, the distance between the button the trader presses and the data centre is of crucial importance:

"The closer I can get to the button the better,"; "When you get down to microseconds, even at the speed of light, distance does start to become a consideration."

But the big problem, he says, is the lack of power capacity in the Square Mile and Docklands. Although he would have located the data centre in the City "in a heartbeat", he was well aware that power companies would be unable to offer any realistic solutions:

"From my perspective the problem of power capacity is probably one of the biggest constraints on economic activity and growth in the City."

On the whole, Green ICT is taken on board when it is sound business practice or regulated:

"I do not see concerns or impacts of Green ICT; I see it as a more efficient way of working and making resources work more efficiently. If we do not implement the Green ICT Agenda then there are ... risks"

"We find the lowest cost route to meet environmental regulation. There is no commercial advantage in being green in the City."

SMEs

SMEs are very much less systematic in their approach to Green ICT than the larger companies, and it often seems to be a matter of personal choice. Although a significant number of SMEs do take the issue seriously, others see little advantage in being green.

One SME is quoted as saying

"Green ICT? What's that?"

Another very small company with a tiny carbon footprint finds questions from government clients on its policies and use of Green ICT to be unhelpful.

Security and Resilience

The Pitcom brief mentioned earlier highlights the danger of physical attack on choke points in data communications networks, such as the London Internet Exchange.

Electronic attack divides into two forms, hackers and cyber crime. As the Pitcom brief discusses, the evidence for hacking activity from Eastern Europe, Russia and China on an international scale is not in the public domain, but is of increasing concern for the security services. Cyber crime is more financially driven, with systematic attempts by organised criminals to deceive, using "phishing" through targeted emails looking to gain information enabling the transfer of funds, or "denial of service" attacks used to blackmail organisations that rely on internet connectivity. Jonathan Evans, Director-General of MI5, sent a letter to 300 chief executives and security chiefs in banks and accounting and legal firms telling them that they were under attack from "Chinese state organisations"³⁵, an allegation that the Chinese Embassy denied.

A summary of the MI5 warning, posted on the website of the Centre for the Protection of the National Infrastructure, says:

³⁵ see Appendix 3

“The contents of the letter highlight the following: the Director-General’s concerns about the possible damage to UK business resulting from electronic attack sponsored by Chinese state organisations, and the fact that the attacks are designed to defeat best-practice IT security systems.”

It is understood that Rolls-Royce, the engineering company, has several layers of firewalls, with the most confidential information, thought to contain engine designs and repair codes, at the centre.

In relation to co-ordinating response in face of a physical or electronic attack, the key element is secure mobile networks with guaranteed sources of power. The major issue faced by the City is electronic attack. While this is harder to assess and prepare for than physical threats, it must be an increasing concern in the next decade.

SMEs: similarities and differences to large organisations.

First, the SMEs that we interviewed were more diverse than the large organisations - banks, insurance companies and stockbrokers - were. Some SMEs were parts of global organisations while being small as a unit, others were focused on the City. It is therefore difficult to generalise. But perhaps the major difference is that in large organisations there was often a range of people to talk to – and in several, the need to involve several people to answer our questions because of the variety of interested parties. In SMEs there was generally only one person to talk to and they were often stretched in several directions.

This leads us to a comment on the nature of helpful support for SMEs – it needs to be available when the responsible SME staff member has time to absorb it.

While large organisations are all using fibre networks, as were the suppliers, some SMEs are only using retail broadband. These mostly expected to start using fibre for access to data centres or for back up, in the near future, while using retail broadband or mobiles for access from home and remotely to the office.

There are, however, five areas in which we recommend that support specifically for SMEs could be provided, on topics where on the whole, large organisations were self sufficient.

Planning

We found, as discussed earlier, that SMEs do not typically plan ahead for ICT infrastructure. The CoLC could provide guidelines on business planning, and also host a series of seminars, focused on SMEs, staffed by suppliers on the future directions of ICT infrastructure.

Access to high specification (fibre) ICT Infrastructure

SMEs have a requirement for high specification infrastructure to give good response time for outsourced systems. The maps of fibre networks held by the CoLC cannot be disclosed, but the City Property Advisory Team can assist SME's here.

Choosing serviced offices

In addition to providing guidelines for new and refurbished offices which support the installation of fibre networks and base stations for wireless networks, as discussed in Chapter 3, the CoLC could provide guidelines for SMEs on "questions to ask" when choosing serviced offices.

SLAs and standardisation

While standardisation of terminology among suppliers in SLAs is discussed in Chapter 3 as relevant to all user organisations, it was thought that the provision of a "model" SLA as guidance would be of benefit particularly to SMEs.

Data security

SMEs tend not have specialist staff concerned with data security. Some guidance on standards "fit for purpose" in an age of electronic hackers and outsourced data centres could be helpful.

Recommendations

The City of London Corporation should:

- Spearhead a discussion with the government and regulators on the perception that power availability and cost are a constraint on the competitiveness of the City;
- Work with the GLA and EDF Energy Networks, through an ICT Infrastructure Group, to establish a 10- year plan for network connectivity, data centres, security and resilience, power supplies and skills of the ICT supply industry, and taking into account Green requirements; and
- Develop a package of supporting programmes for SMEs, covering business and ICT planning, Service Level Agreements, data security and choosing serviced offices.

Chapter 5: Regulation

Summary

This chapter has been written with input from Netstrategics Limited, a boutique consultancy specialising in telecoms regulatory issues. We start by considering the changing aspects of financial and business regulation before looking at telecoms regulation. European and Ofcom regulation is thought to be currently broadly helpful to the City. The scope of regulation will broaden from fixed line, mobile and wireless to channels historically used for entertainment, and broadcast technologies. The regulators need to reflect the convergence of mobiles, wireless and fixed line networks within a single operator. It is also felt that the regulators should ensure that upcoming spectrum auctions do not compromise the competitiveness of the City, and that, in this changing world, the regulators could take a lead in standardising terminology for serviceability, to enhance the effectiveness of peering in increasing network resilience.

Financial and Business Regulation

The Financial Services Authority (FSA) has stated clearly that they take no view on ICT infrastructure as such. They aim for principles based regulation and on facilitating good practice.

"We expect the regulated to comply. How they comply through ICT or without ICT is for them to determine".

One area of specific concern is the European Central Bank's (ECB) requirement for the critical financial services infrastructure: that business must be recoverable inside two hours (Europe) compared with four hours in the US or by the next working day (Financial Services Authority in the UK). The City's organisations are likely to be under pressure to meet European standards for recovery inside two hours, as trading systems in particular become more integrated across Europe. This has clear implications for suppliers of ICT infrastructure and trading systems.

The Regulation of Investigatory Powers Order (2002) which allows the Bank of England to require information on electronic transactions is not thought to be a practical concern in terms of confidentiality; organisations realise that anything sent by email should be regarded as liable to scrutiny.

The future of FS regulation

Our respondents and the Financial Services Club³⁶ believe that the industry will find itself subject to a level of regulatory and supervisory scrutiny as never seen before.

With government interests globally watching market activities, and particularly investment market activities, the US Securities and Exchange Commission (SEC) and the FSA along with the European Commission and the G20 group of major economic powers will aim to have measures in place to ensure that the contributing factors leading to the current economic crisis do not occur again.

This will lead to a Global Supervisory Framework (GSF), developed by the G20 over 2009 and enforced from 2010 onwards. This Framework will focus upon bank leverage and lending, along with the use of derivatives and the inherent flaws in the risk models that support such instruments. There will also be a major overhaul of credit rating agencies and how these operate.

Implications of Financial Regulation for ICT Infrastructure

From an ICT infrastructure view, this means that the interconnectivity of the banking systems between London and the rest of the world will be subject to a much higher degree of regulatory and supervisory intervention.

Already there is talk of creating an Equitas for the banking industry as was created for the insurance industry³⁷. Alongside these global changes are regional implementations of new trading and clearing policies as dictated by the European Commission, as well as new competitive and innovative trading instruments launched as a result of the MIFID and other competitive forces.

Overall, this means that the City ICT infrastructure has a number of challenges for the medium-term, in particular:

- Linking to new global and regional Central Counterparty and risk management systems;
- Creating plug and play, low cost connectivity across all exchanges and clearing systems; and
- Creating consolidated pricing and risk management systems.

The competitiveness of the City will be evaluated in terms of its ability to provide these links to other Global Financial Centres, and hence the importance to the City of the number of Worldwide Network Operators operating in London. As we showed in Chapter 3, London is well placed on this measure.

³⁶ The Financial Services Club is a forum for London based FS organisations to share best practice and anticipate change.

³⁷ Equitas, based in London, was established in September 1996 to reinsure and run-off the 1992 and prior years' non-life liabilities of Names, or Underwriters, at Lloyd's of London.

International, EU and UK telecoms regulation

The fundamental Telecoms regulation in the EU is the so-called "Regulatory Framework" Directive, the latest version of which was agreed in 2002. The key principles of the Framework are:

- Independent "National Regulatory Authorities" (Ofcom in the UK);
- A set of 18 defined "markets"³⁸ – wholesale and retail, fixed and mobile; this is to be reduced to 7 – mainly wholesale – markets;
- The concept of "Significant Market Power" (SMP) – dominance of any one of these markets by one (or possibly more) operator, usually the incumbent, which could be exploited to damage competition or consumer interests;
- A formal process of market reviews to determine SMP; open, quantitative and subject to consultation;
- A set of potential "remedies" to protect consumers, and encourage competition (usually in the form of price controls, and the requirement to provide certain services);
- Consumer protection issues - e.g. on mis-selling and on changing suppliers.

The European Commissioner for Information Society and Media, Viviane Reding, has addressed issues regarding mobile termination rates, mobile roaming, and Voice over IP, in the last two years. An attempt by the Commission to take more powers at a pan-European level (creating a pan-European regulator, and a veto over NRA decisions) was opposed by the European Parliament and EU States, and has now been watered down. It seems likely that this will make it more difficult for the Commissioner to force other EU countries to open their markets to competition to the same degree that the UK has done.

In the UK, the Office of Communications Act 2002 created the Office of Communications (Ofcom) from a number of previous regulators with responsibilities across television, radio, telecommunications and wireless communications services. Ofcom is thus ideally placed to address issues of "convergence", where broadcasting and telecommunications services begin to merge (for example, through pay TV, IPTV), and spectrum issues (including the so-called "Digital Dividend" – spectrum currently used by analogue TV broadcasting which will be freed up when digital terrestrial broadcasting supersedes it).

The Framework was incorporated into UK law in the 2003 Communications Act. Under the Act, Ofcom has Statutory Duties:

- To further the interests of citizens in relation to communications matters; and
- To further the interests of consumers in relevant markets, where appropriate by promoting competition"³⁹

³⁸ http://ec.europa.eu/information_society/doc/factsheets/tr9-listofmarkets.pdf

It has been suggested (for example, by the Communications Management Association) that this focus on “citizens” and “consumers” means that Ofcom does not have an explicit remit to support business. Ofcom states that a remit to support business is implied.

Ofcom takes the view that competition between operators offers the best prospect of providing customers with a wide range of services at the best prices. So, amongst Ofcom’s “Regulatory Principles” are “a bias against intervention” and the use of the “least intrusive regulatory mechanisms” – that is, acting only when the market will not operate effectively. This leads to an emphasis on regulating the wholesale market, while tending to de-regulate the retail market.

The Act removes the need for a company to apply for an individual licence to operate telecommunications services (“Electronic Communications Services”, ECS)⁴⁰. Companies can apply for powers under the ECS Code to dig up the streets and access people’s property in order to build and maintain electronic communications networks and services. In all, some 150 organisations now have powers under the ECS code.

In December 2003, Ofcom undertook its “Strategic Review of Telecommunications”, which focused on the control exercised by BT over the “local loop” - the connections into homes and offices. Eventually BT agreed to a legally binding set of “Undertakings” around the principle of “equivalence” – in essence that it would deal with competitors on exactly the same basis and in the same way as it dealt with itself – and set up a “functionally separate” division, Openreach, to put these into effect.

Elsewhere in the EU, implementation of the Regulatory Framework has been inconsistent. The European Competitive Telecoms Association⁴¹ produces an annual “Regulatory Scorecard” which reviews the effectiveness of regulation and the link between effective regulation and investment. The 2007 Scorecard concludes that, across 18 EU countries, investment in telecoms has suffered where regulation has failed to tackle dominant companies (for example, Poland, the Czech Republic), whilst countries that have opened their markets to competition (led by the UK and the Netherlands) have “stormed ahead”. This reinforces the views expressed by our interviewees that other countries have not opened their markets as the UK has done. This also concurs with the analysis of Worldwide Network Operators in Chapter 3, suggesting that an open market is attractive to suppliers,

The UK’s implementation of EU Regulatory Framework gives the City an advantage over other European centres.

³⁹ <http://www.ofcom.org.uk/about/sdrp/>

⁴⁰ There remains a licence regime relating to Radiocommunications Services, so services such as mobile telephony that require radio spectrum may depend on having a licence for that spectrum.

⁴¹ <http://www.ectaportal.com/en/basic651.html>

Broadband and legacy services

Voice services have been open to competition for many years in the UK, and the City of London was the area where intense competition first became a reality, with City of London Telecoms (COLT) and others entering the market after the ending of the BT/Mercury Duopoly in 1992. International services in particular have been highly competitive, with resellers taking a large share of the market.

Ofcom has encouraged the introduction of VoIP, imposing the minimum of conditions on the operators, although some issues (e.g. emergency calls) have yet to be resolved. The numbering schemes associated with VoIP also offer the prospect for companies to appear to be operating in a different location.

Broadband services offered by most of BT's competitors are either resold versions of BT's wholesale products or provided via Local Loop Unbundling (LLU), where the operator connects the customer's line, or just the broadband part of it, to their network instead of to BT's. Exceptions to this include Virgin Media, a cable TV company, and a number of small operators offering services using WiMax and similar radio-based technologies. All of the exchanges in the City and the City Fringe region have been unbundled, by up to as many as 6 different LLU operators⁴². *Exchange areas with more than 4 LLU operators are designated by Ofcom as being "competitive" and have no regulatory price controls.*

Areas with LLU tend to coincide with cable TV coverage and, other than a handful of rural WiMax schemes; broadband technology tends to be used to provide business services in London and other large cities.

Currently, Ofcom is consulting on "Super-fast Broadband" (or Next Generation Access).⁴³ The Government has also commissioned two reports – the Caio report on the "Next Phase of Broadband Access" was published in September 2008⁴⁴ and Lord Carter's report into Digital Britain is due to be published in June 2009⁴⁵. Among the issues addressed in these reviews are the role of central government funding (generally seen to be as a last resort), "passive" vs. "active" solutions (for example, duct sharing vs. wholesale products) and the prospects for local community initiatives.

Business Connectivity and High Specification Networks

Businesses in the financial services sector depend increasingly on computer networks, using the internet as a means of interacting with customers, suppliers and partners. This public technological face is backed up by private, high specification, facilities such as data centres and networks whose performance,

⁴² <http://www.samknows.com/broadband/mapping/mapping.php>

⁴³ www.ofcom.org.uk/consult/condocs/nga_future_broadband/

⁴⁴ www.berr.gov.uk/files/file47788.pdf

⁴⁵ <http://www.computerweekly.com/Articles/2009/01/26/234457/the-carter-review-digital-britain.htm>

security, reliability and cost are increasingly critical factors. As discussed in Chapter 3, these circuits are typically optical fibre running through underground ducts. It is easy to increase capacity on existing routes, but often expensive to add new routes.

One consequence of this is that, with a limited degree of effective competition in place, the regulatory authorities have found it necessary to apply a range of so-called “remedies” to drive prices down, force suppliers to publish quality of service and cost information and to prevent anti-competitive behaviour.

Ofcom, the UK communications regulator, has chosen in its 2008 Business Connectivity Market Review (BCMR)⁴⁶ to subdivide the market for business connectivity services – essentially private circuits – according to the data capacity, type of interface and area of the country.

In general, they found the degree of competition to be variable over those dimensions. For example, they found that BT has Significant Market Power (SMP, that is, dominance) in the market for lower-speed digital circuits across most of the country, but not for the highest speed circuits (622Mbps with a “traditional”⁴⁷ interface and 1Gbps with an Ethernet interface). A conclusion was that there is a unique area of Britain where no supplier has SMP in the supply of digital private circuits in any of the categories of speed or technology. This area is termed the CELA and covers the Central London congestion charge area, plus the Docklands (see Figure 4).

Ofcom’s in-depth analysis has provided strong evidence that competition is strong enough to drive down costs and prices in the City and City fringe areas, whilst ensuring that service levels and capability continue to advance and investment is maintained.

Mobile and wireless services

The main topics regulated by Ofcom and relevant to the City, in relation to mobiles and wireless, are spectrum, termination rates (including international roaming) and mobile number portability. These are explored in more detail below.

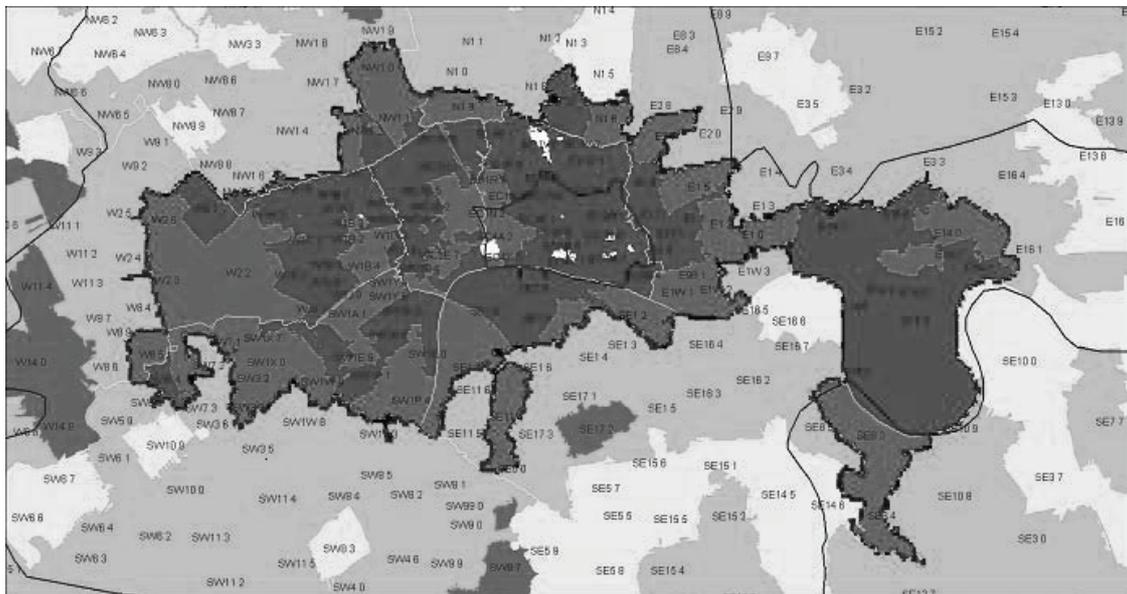
Spectrum

A mobile provider reaches the customer’s device by using radio frequencies (that is, spectrum). Spectrum is limited, and providers operating at similar frequencies may find their services interfere with each other.

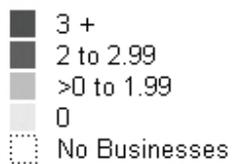
⁴⁶ www.ofcom.org.uk/consult/condocs/bcmr_tisbo

⁴⁷ By “traditional”, Ofcom mean that it uses one of the technical standards commonly used in telecommunications networks, rather than those, such as Ethernet, which have become popular in the Internet.

Figure 4: CELA area



Network Reach - 250m Build Distance
No of Operators within large businesses



Ofcom therefore licenses the use of much of the radio spectrum. Its strategy is to release as much as possible to the market, while remaining as “technology neutral” as possible - that is not deciding in detail in advance what technologies should be used for a particular radio frequency⁴⁸. The main benefits of a licensed spectrum are that interference issues are likely to have been resolved in advance, that standards are often more advanced, settled and international, and that vendors have made more of a commitment to develop devices and network equipment.

Ofcom’s standard way of releasing a parcel of spectrum is to auction it. Upcoming auctions are attracting a great deal of interest, as owning spectrum is seen as crucial in being able to provide mobile services that compete both with existing mobile services and with fixed telecoms services.

⁴⁸ <http://www.ofcom.org.uk/radiocomms/spectrumawards/>

Two blocks stand out as likely to see the fiercest bidding:

- 2500-2690MHz spectrum, often referred to as “WiMax”; and
- 470-854MHz, the “digital dividend” that will be released when analogue TV signals are switched off completely in 2012.

Though Ofcom’s plan is to auction spectrum as soon as possible, T-Mobile and O2 have challenged the 2500-2690MHz auction timetable, on the grounds that existing mobile issues have not yet been resolved and that these have a material impact on the value of the new spectrum, thereby making a proper bid impossible at present. Both cases are currently being decided by the Competition Appeals Tribunal (CAT).

In addition to licensed spectrum, many services are also being provided over freely available “unlicensed” spectrum. These services can range from communications between taxicabs and their controllers, to theatre microphones, Bluetooth headsets, restaurant credit card devices, or existing “WiFi” wireless broadband (e.g. public hotspots for internet access provided by The Cloud or BT’s Openzone and home wireless networks). Ofcom has no plans to convert these unlicensed frequencies to a licensed regime.

Overall the largest impact of spectrum policy and auctions on businesses in the City and Fringe is the extent to which this allows a wider, more innovative and cheaper set of wireless broadband services to be provided, both as direct competitors to fixed broadband networks and as resilient backups.

Termination rates and international roaming

The price of calls from mobile phones has never been regulated directly in the UK. Since 1999, the price of incoming calls to mobile phones (“termination rates”) has been the subject of direct regulation, mostly in the form of an RPI-X control (that is, mobile operators have to bring the daily average termination rate down by a minimum of X% below RPI each year of the control period). This is the price that the mobile operator charges the originating network.

The current control will continue until March 2011, by which time termination rates should be no more than 5.1 pence per minute. The retail price paid by a customer to call a mobile number is higher than the termination rate – and it is unregulated.

This form of regime is likely to continue after 2011, with further pressure to reduce voice termination rates from a number of EU Directives and from statements by Commissioner Viviane Reding⁴⁹.

In 2007, the EU directly intervened in the mobile market by legislation to set a ceiling on the retail and wholesale prices for EU customers making and receiving

⁴⁹<http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/708&type=HTML&aged=0&language=EN&guiLanguage=en>

calls while roaming to other EU countries. By August 2009 the ceiling for making a call will reduce to 43 eurocents per minute, for receiving 19 eurocents.

The EU has now extended that legislation to cover text message charges and data roaming (which includes internet browsing and email)⁵¹. From July 2009, it will cost no more than 11 eurocents to send a text within the EU while roaming, and the wholesale charge for data roaming will be 1 euro per megabyte. Voice charges will come down further from 2009 for at least three years. These measures will be coupled with greater transparency and communication to customers about charges as they cross EU borders.

Implications for the UK and the City of London

The UK has been at the forefront of European countries in introducing liberalising reforms that have driven prices down and quality up and encouraged huge investment in services and infrastructure. In recent years, as the EU Framework has come into operation and harmonisation gathered pace, there have been signs of other countries catching up and, for example in the case of high-speed consumer broadband, sometimes running ahead of the UK. In the case of the City of London, key services are now largely de-regulated and so a relative advantage over other centres may be difficult to maintain as the others catch up.

On the other hand, the benefits to businesses from having the Framework consistently applied across Europe are likely to be felt in lower costs and greater ease of installing and maintaining international networks. This may make it easier for firms in the City to gain leverage from their other relative advantages, such as the concentration of know-how, to compete more effectively in other centres.

Harmonisation of fixed wire regulations is an advantage to the City with its greater dependence on international connections than is the case for regional centres.

Regulators can have a major influence by the way in which they allocate the substantial blocks of re-cycled radio spectrum they have at their disposal. Ofcom is broadly for the "leave it to market forces" approach, and as described here, is pressing ahead with a programme of spectrum auctions that may pre-empt a more co-ordinated approach emanating from the EU.

In general this is likely to favour the interests of City firms, who will in the main consume the more profitable business data services, whereas a more interventionist approach might see greater use of resources for applications that

⁵⁰ European Parliament legislative resolution of 23 May 2007 ([COM\(2006\)0382](#) – C6-0244/2006 – 2006/0133(COD))

⁵¹ http://ec.europa.eu/information_society/activities/roaming/index_en.htm

support other public policy objectives such as universal service or public service broadcasting.

Nevertheless, the danger in a less regulated approach is that the uses to which the winners may put their parcels of spectrum may conflict in ways that are unforeseen to them and that might be avoided by greater coordination.

Wireless connectivity (including mobiles) is set to be the key technological and competitive battleground for the communications industry over the coming decade.

Views of ICT infrastructure regulation

Looking at the market from a UK and European product delivery perspective one of our service provider respondents pointed out:

“At a general level, greater harmonisation should ensure that all incumbent operators are regulated effectively so that there is a level playing field for all competing operators. More specifically, harmonisation of the regulations governing access to incumbents’ wholesale products and services is required in order to ensure that there is effective competition in the provision of communications services to businesses across the EU. Due to their historic position, incumbents are normally the only operators which are capable of providing communications links universally across any EU country, therefore any competitor seeking to provide competitive services to business users with multiple geographic sites will need to rely to some extent upon the wholesale products and services of the incumbent. With effective and harmonised regulation, business users will benefit from the competition offered by a choice of different communications operators, providing improved quality of service, lower prices and greater innovation. Overall, the economic competitiveness of the EU and of its Member States will also be strengthened as a result of such effective pan-European competition.”

Whilst welcoming the policy of harmonisation, several respondents are concerned that the EU and Ofcom have not succeeded in creating a level playing field with “consistency of products and tariffs”. This refers mainly to unbundling of fixed lines in Europe, and termination rates and international roaming of mobiles.

Among some other respondents, harmonisation of telecoms regulations inside the EU is seen as less of a concern than the costs of calls globally – with calls to Australia (when routed via the US) cheaper than to France.

There is some criticism of the approach taken to management of the wireless spectrum, while others feel that the market forces approach is appropriate. Our

respondents point out that if national jurisdictions allocate different parts of the spectrum to different services, this could cause interference affecting the capability of emergency services.

There was also plea for Ofcom to take a role in setting serviceability standards:

“Guidance on serviceability standards would be a significant help in the buying/selling activity. Quality measures are a lottery and the playing field is definitely not level, with some suppliers and customers very naive and others quite well versed.”

“Uniform standards for serviceability make co-operation and peering more effective as well as helping customers understand clearly what the SLA they are buying into provides.”

The important role of peering and co-operation in improving resilience has been discussed in Chapter 3.

At a more local level, some operators specifically raised the issue of implementation of the Traffic Management Act 2004 (UK legislation introduced in April 2008) by TfL. This results in every job (even the smallest and shortest) requiring drawings, maps, site meetings, mail shots and the like prior to works commencing. Delays can arise as a consequence, as it requires that most jobs fall into the three months planning lead time category. This was felt to be disproportionate for much telecoms-related work.

There is also some irritation that the congestion charge and parking fines did not recognise the importance of access to premises to facilitate service delivery and maintenance, although contractors displaying an HAUC board should be given a vehicle dispensation from CoLC’s Highways Department and therefore not be fined.

SWOT relating to regulation

In Table 8 we summarise the strengths, weaknesses, opportunities and threats in the UK’s regulatory regime, within the EU overall regime.

Recommendations

The City of London Corporation should:

- Encourage Ofcom to take a clearer lead on serviceability standards;
- Ensure that their representations to the European ICT regulators via Ofcom are based on a forward view of market needs;
- Consider commissioning a technical review of prospective radio spectrum allocation plans on the part of both Ofcom and the EU;

- Co-ordinate a discussion of the implementation of the Traffic Management Act between TfL and major ICT suppliers.

Table 8: SWOT of EU and UK telecommunications regulation

<p>Strengths</p> <ul style="list-style-type: none"> • Pro-competitive: presumption that competition should be introduced wherever possible and that competition is better than regulation. • Objective: strict criteria, based on sound economic principles, for when regulatory remedies should be applied. • Consistent framework: same overall rules apply throughout the EU, but with allowance for local conditions. • UK at the leading edge: the UK has led and shaped the process of liberalisation in European telecoms. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Inconsistency of application: foot-dragging and special interests have slowed progress in some countries and prices (e.g. intra-European calling, mobile roaming charges) have sometimes been slow to fall. • Speed of response: regulators have typically been too slow to respond to specific anti-competitive actions to prevent harm being done – for this reason blunter <i>ex ante</i> (preventative) measures are preferred. • Limited success at introducing competition into the local loop.
<p>Opportunities</p> <ul style="list-style-type: none"> • Wireless and mobile technologies offering increasing competition with fixed for broadband and data services, as well as for voice services. • The “Digital Dividend” – large blocks of prime radio spectrum made available by the ending of less-efficient older services. 	<p>Threats</p> <ul style="list-style-type: none"> • Increasing resort to litigation to try to overturn regulatory decisions – may make regulators cautious in future about offending powerful interests. • Extra-territorial issues – threats such as spam, abuses of data privacy, nuisance calls and denial of service attacks are increasingly international and originate outside the EU.

Chapter 6: The Longer Term View and Conclusions

Summary

This chapter looks at some of the longer term factors affecting the ICT infrastructure in the City and City fringes. Changes in financial services globally, in the ICT industry and the nature of telecoms supply need to be factored into the plans of City and City fringe stakeholders. The uncertainties surrounding the financial services industry are major, and there are also significant uncertainties over the future capabilities of the UK ICT industry. It will be particularly important to consider the future skills requirements of the ICT infrastructure industry in supporting financial services across the City. Finally we present a summary of the report's conclusions and recommendations.

The Financial Services Industry in the medium to long term

The credit and banking crises of 2008/9 raise questions about the shape of the financial services and ICT supply industries in 10- years' time.

Some of the issues shaping the financial services industry have been discussed in Chapter 5 on regulation. The increasing power of European bodies to set operational and reporting standards could have an implementation cost and effect similar to that of Sarbanes Oxley, or could provide a springboard for a major expansion in the City's financial services community.

A set of scenarios from the World Economic Forum, produced before the current crisis in financial services, compare possible models for the future of the industry.⁵² The determinants of the industry were thought to be technology and regulation, with the likely scenario thought to be "Global Ivy League". In this scenario, global regulation results in less innovation, causing a concentration into a few major global institutions. Regulation acts as a barrier to entry to financial markets due to its complexity and cost.

What is clear is that, as the centre of gravity of the world shifts away from Europe and North America, there could be fewer US and European based global firms operating in London, and more from Dubai, Mumbai, Shanghai, Hong Kong and Singapore. A question for the health of the City is its ability to provide a competitive location for the European arms of these new participants.

⁵² A summary of the scenarios can be found o <http://www.weforum.org/financialarchitecture>

The implications for the City's ICT infrastructure

There will continue to be a requirement for high speed quality international networks and for connections across the City for electronic trading. Security and resilience concerns may cause a "mirror" policy for data centres, for instance in West London and Docklands. What will not change is the speed of light or the desire to reduce the distance of connections to give low latency; hence there will be continued focus on data centres near to the City traders.

The future of the ICT industry

The Royal Academy of Engineering (RAEng) has recently commissioned a report on the future of the ICT industry. As it says in the brief for the report⁵³

"The ICT industry is under incredible transformational pressure around the world. This pressure results from changes occurring on many fronts, including globalisation, commoditisation, market driven short-termism, increasing systems complexity, and open innovation. These pressures have particular significance for ICT in the UK because of the relative lack of substantial indigenous centres of ICT industry leadership. With rare exceptions, most of the ICT industry leadership in the UK is held in local subsidiaries of multinational companies based in the US (for example, Microsoft, IBM, HP, Sun, and Oracle)".

The future of the digital communications industry future is more open to question. The communications industry is faced with seismic changes in technology, regulation and markets over the next decade. It is far from clear how it will emerge beyond the current business cycle, but investment payback cycles in this industry can be measured in decades and some big bets are being placed by operators and their suppliers now.

Appendix 8 describes four very different scenarios for the digital communications industry, post the Carter report and the explosion of available spectrum. They explore the investment made and the resulting fragmentation or consolidation of the supply industry.

One scenario suggests that there will be plenty of fibre for high quality networks, but at higher prices, another that there will be confusion during the re-alignment of suppliers, away from a connection mode basis of supply (for example mobiles, fixed line) and towards end-to-end connectivity. A third suggests that national fixed line operators (outside the City) retain SMP. A fourth sees no frills suppliers of commodity services at lower prices.

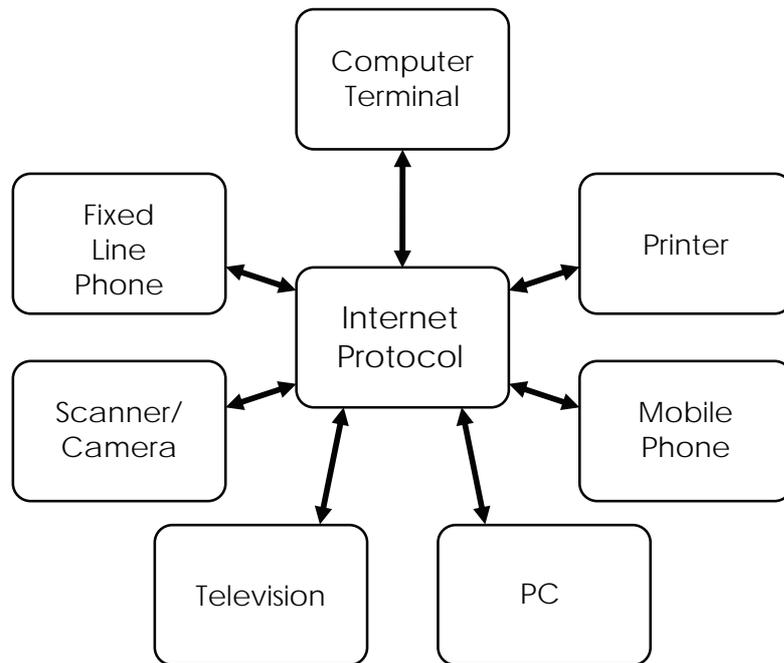
⁵³ The implications of the changing nature of Information and Communications Technology on UK competitiveness <http://www.raeng.org.uk/policy/ict/ict.htm>

What effect could this have on the City and City fringes?

As with all scenarios, none of these will accurately predict the entire future: but it is reasonable to suppose that high specification networks will become more expensive, that commodity services will decline in price, and that there will be market confusion during the re-alignment of suppliers.

Figure 5 illustrates this view of the future ICT infrastructure.

Figure 5: Future ICT Infrastructure



Implications for Skills

In Chapter 3 we discussed the perception that ICT suppliers' staff struggled during installation of new services. We were not able to establish whether this was a training issue within a few suppliers, or a more general reflection of a shortage of skilled ICT staff. After installation, services generally require little human intervention.

While in Chapter 3 we reported that some respondents found that the City is an easier place to recruit than other financial centres, the rise of other economies and their financial centre flagged in Chapter 2, and the crucial role of the ICT infrastructure going forward, means that the future ability of the City to recruit ICT

staff cannot be taken for granted. In addition, as the RAEng study brief suggests, without a career path in the UK for skilled ICT staff to set the framework for their operations, it could be difficult to attract the necessary calibre of staff to support the ICT infrastructure. We suggest that this is an important rather than urgent issue for investigation, for example in terms of identifying the skills profiles and numbers of ICT infrastructure people needed to support the financial services industry in the City in the future.

The Skills Sector Council for ICT skills in the UK, e-skills, could be a useful partner to the CoLC in investigating the likely scenarios for the digital communications industry and the implications for ICT industry skills to support the financial services in the City. The study could be part of an ongoing 10- year ICT Infrastructure Plan.

Conclusions and recommendations

The key question for this report was:

What should the CoLC do to ensure continued effective infrastructure support for financial services in the City and City fringes?

To address this question, we first compared ICT-related country-wide indices and rankings (Chapter 2). These rankings suggested that London's ICT infrastructure is above a threshold needed to maintain competitiveness, since, for example, London is ranked number one in comparisons such as the Global Financial Centres Index and MasterCard's Worldwide Centers of Commerce Index.

The conclusion drawn, after discussion with our respondents, is that ICT infrastructure in the City is "a given" and that the City is comparable to New York in ease of use, price and capability of ICT infrastructure (Chapter 3). Additionally, most large City organisations have global stature and the knowledge and staff to make best use of the ICT infrastructure.

Our interviews and desk research have highlighted that we need to consider five aspects of the ICT infrastructure in relationship to the City's future competitiveness, over and above the factors measured by existing competitiveness ICT comparisons. These are:

- Worldwide and high specification (fibre) network connectivity and mobile broadband;
- Data centre capacity and utilisation;
- Electrical power supplies;
- Security and resilience, covering both physical security and response to electronic attack;
- Skills in the ICT industry.

The City currently sponsors the "City of London Security and Contingency Planning Group, with responsibility across the Square Mile, Docklands and Canary Wharf. We recommend that a group similar to this be set up to plan and monitor the five aspects of ICT infrastructure as above, in so far as they affect the City's competitiveness, in the form of a 10- year Plan (Chapter 2). The reasons for this recommendation are articulated in the following sections.

Network connectivity

We find evidence, from the number of worldwide network operators, and suppliers of fibre "in the ground", that the City is a competitive market for ICT infrastructure, (Chapter 3), re-enforcing the Ofcom findings for mobile suppliers (Chapter 5).

We anticipate that in the future there will be increased international connectivity and increased demand for high specification networks, driven by technology

trends and the need for security and resilience. Availability of connections is not expected to be an issue over the medium term but the expansion of electronic trading would test the infrastructure capability first.

We recommend that the CoLC should monitor the number of worldwide network operators in London compared with other cities, and mobile broadband deployment in the City, as well as the number of suppliers of fibre “in the ground” within the context of a 10- year Plan, (Chapter 3).

Harmonisation of fixed line standards across Europe was not regarded as successful by several of our respondents, and three areas for concern over new regulation were expressed. First, networks will increasingly use “whatever” technology, and regulation should not impede this trend. Secondly, spectrum allocation across Europe should not be allowed to interfere with emergency networks. Third, standardisation of terminology in service level agreements would support effective back up arrangements. We recommend that representations should be made on all three items to Ofcom (Chapter 5).

Data Centres

A number of factors are driving a trend towards specialist data centre space. The need for high speed connections, continuous power supplies, Green legislation and business continuity is matched with high costs of office space to drive the need for data centres with specialist provision and cheap locations.

We recommend that the CoLC should track the total and available data centre space available to the City (for example, within a 30- mile radius) for three reasons. First, data centre space is a measure of competitiveness. Second, data centre operators are internationally focused and can give early warning of factors threatening competitiveness. Third, this would ensure their inclusion in business continuity exercises. This would be an additional element of the 10- year Plan (Chapter 4).

The demand for data centre space – both in-house and for shared services – is expected to continue to grow over the next decade. Data centres for financial services are ideally sited within 30 miles of the City, for a number of reasons. Further, data centres are easier to build and supply with telecoms and computer and other equipment, than to service with power. A data centre uses as much power as a small town. The planning cycle for power is longer than the build time for a data centre, which causes friction with the regulatory system.

Power supply for data centres is the major issue highlighted by this study.

Power

Power supplies for data centres and to a lesser extent for office space are highlighted by our respondents as a current and future problem. There appear to be two different areas of concern.

It is the view of many of our respondents that electrical power supply costs and perceived lack of ability to meet future demand are constraining the competitiveness of the City's financial services. Both government and regulators should stay abreast of this situation. It is recognised that this is a UK problem rather than specific to the City (Chapter 4).

Secondly, within the GLA area there are pressures on planning from environmental (Green ICT) concerns which make it very difficult to site a new data centre in the area. Additionally, power supplies in the M25 are constrained, with some large organisations choosing to site data centres in the North of England, Paris or Frankfurt, rather than London.

A 10- year Plan co-ordinated by the CoLC would enable the electrical power supply company, EDF Energy Networks, to make a better-founded case for new investment to the regulator. We recommend that the CoLC should use a 10-year plan to inform this discussion, (Chapter4).

Security and Resilience

The City is rated highly on approaches to business continuity by our interviewees, (Chapter 3) but we do not find evidence of measures to counter electronic threat (Chapter 4).

We recommend that the CoLC's readiness exercises should continue. They could perhaps be backed up by seminars and Master Classes, and additionally consider a focus on electronic threat.

We have also considered the role of standards for service level agreements in increasing peering and hence resilience.

The New York IT Plan has highlighted the importance of a highly secure, resilient, mobile network for use by the emergency services. In the UK, the Airwave system supports the emergency services with mobile communications. It has been tested, for instance on 7/7.

There were some concerns expressed by our respondents that the Airwave system for "blue light" services could be inadequate in case of severe emergency. A commercial mobile system with high security and resilience, available also to the emergency services would, it is thought, be an important asset to London's security and resilience. We recommend that, as part of a 10-year Plan, the CoLC examine the case for commissioning or supporting such a system (Chapter 3).

Skills in the ICT Supply industry

We identify some early signs of skill shortages in the ICT supply industry, though other respondents compare London favourably to other financial centres. The assumption which has been valid for the last 20 years, that London can attract staff internationally, needs to be re-examined for the next 20 years, as the ICT industry and the global economy change dramatically. We recommend that

the CoLC should review the skills profiles and numbers required, and continue to track these as part of a 10- year plan (Chapter 6).

SMEs

We surveyed SMEs in the City and City fringes. Some of these were the UK arms of international companies, and so have international sources and comparators. These SMEs find the City an easier place to do business than a number of competitor locations, and use approaches pioneered in offices elsewhere (for example, the US or Far East) to tackle matters such as security and resilience.

While the SMEs surveyed are found to often not have ICT plans, or SLAs, they are very attuned to their customers' demands. They use third party data centres for applications processing and back up, which require high specification networks, Some serviced offices make it difficult to install high specification (fibre) networks.

We recommend that the CoLC develop a package of supporting programmes for SMEs, covering business and ICT planning, Service Level Agreements, data security and choosing serviced offices (Chapter 4).

Finally, as discussed, it is important to bear in mind the wider context of the changing nature of the financial services industry in the UK and globally and to explore and anticipate future demands.

Appendix 1: List of Interviewees

Job title	Organisation	Business
IT Manager	Acrobot Company Ltd	Software and design engineering
Business Development Manager	Art of Computing	IT support
CTO	Arthur J Gallagher	Insurance
CIO	Arthur J Gallagher	Insurance
Director	Balatro Ltd	FS IT Consultant
Director of Communications Networks	BERR	Government
Director	Bizextra	Enterprise Agency
Regional Manager	BT	Infrastructure
Senior Marketing Manager, FS	BT Global Services	Infrastructure
Public Policy Manager,	BT Openreach	Infrastructure
Senior Director	CB Richard Ellis	Property Advisors
Director	Challenge Forum	Think Tank
ICT Director (new)	Charles Stanley	Stockbrokers
ICT Director (outgoing)	Charles Stanley	Stockbrokers
Infrastructure Project Manager	Chi-X Europe	Services
Business Continuity Management	Citigroup	Banking
Business Continuity Management	Citigroup	Banking
IS Infrastructure Manager	City of London Corporation	Local Government
IS Director	City of London Corporation	Local Government
Anon	City of London Police	Local Government
Development manager	Codefarm	Credit Derivatives Technology
Paper submission	COLT	Infrastructure
MD Europe	Decision Strategies International	Consultants
Chief Technical Officer	Denver Technology	ICT
Principal, CS Technology	Deutsche Bank	Banking
Planning Manager, South	EDF Energy Networks	Infrastructure
Chairman	Financial Services Club	Club of FS organisations
Policy Advisor	FSA	Regulator
Director	Hinton and Co	Work relationship advisors
Group IT Director	Hiscox	Insurance

Head of IT Operations	HSBC	Banking
Premier End User Support Manager	HSBC	Banking
Finance Director	Immune Targeting Systems Ltd	Biotech
Director, e-commerce	IoD	e-commerce
Head of ICT	LB Greenwich	Local Govt
Manager ICT service Dept	LB Tower Hamlets	Local Govt
IT Production Director	LCH Clearnet	Infrastructure
Director, EU Infrastructure Projects	Level 3	IP Transit
Executive/life coach	M D Training Group	Training
Group IT Director	Marks and Clerk	Patent Attorneys
Global Head IT Risk	Morgan Stanley	Investment
MD, Technology	Morgan Stanley	Investment
Director	Netstrategics Ltd	Telecomms consultants
IT Systems Manager	Norman Disney and Young	Consultant engineers
Director Technical Strategy Virgin Media	NTL (Virgin Media)	Infrastructure
Partner	OCP	Change Consultants
Policy Advisor	Ofcom	Regulator
IT Telecom Mgr UK	Regus	Serviced Offices
Director	SAMI Consulting	Consultants
Executive	SAMI Consulting	Consultants
IT Manager	Simon and Schuster	Publishers
Director	Simulations/ Hall Associates	Training /Software
Director	Steelhenge	Business Continuity
Director	Strategic Intelligence Consulting Services	Telecomms Consultants
Marketing Manager	Sungard	Infrastructure
MIS Systems & Application Management & Support Specialist,	SWIFT	Secure Financial Messaging Services
Head of Content, Technology & Operations	ThomsonReuters	Information services
IT Dept	Ttsp	Architecture
Chief Technology Officer	Turquoise	Equities Trading Platform
Director of Strategy	Vocalink	Infrastructure
Head of Core Engineering	Vodafone	Infrastructure
Managing Director	Wilshire Analytics	Fund Management Analytics

Appendix 2: Questions Asked

Current Position

Telecoms Infrastructure

- 1.01 What broadband fixed wire services do you use e.g. Leased line DSL, Local Ethernet Service, dedicated fibre? If using Leased line old style services what upgrade challenges do you face?
- 1.02 Do you source broadband services from more than one supplier and is this for resilience or other reasons?
- 1.03 What wireless services do you use and do you see any need for Wi-Max as well as 3G?
- 1.04 Do you source wireless services from more than one supplier and is this for resilience or other reasons?
- 1.05 Do you believe that the fixed wire voice and data services you buy provide a good, acceptable or poor level of reliability?
- 1.06 Do your suppliers meet your expectations of timeliness and quality of initial and ongoing service delivery?
- 1.07 Do you have formal service level agreements with your suppliers and do you track and enforce them?
- 1.08 Do you believe that you have access to a tariff regime that provides value for money in a variety of contexts and applications?
- 1.09 What assumptions do you make about the physical and logical security of the network services you use? Are suppliers willing to enter into contractual commitments on this?

Servers and Storage

- 2.01 Do you host application and other servers and/or storage in third party premises?
- 2.02 If so is the motivation cost or risk driven and do you have specific SLA and risk management arrangements?
- 2.03 If risk management is a factor what concerns do you have about physical and logical security of servers and applications (referring both to your own and hosted premises)?
- 2.04 Do you have concerns over availability of adequate power or other capacity concerns (referring both to your own and hosted premises)?

Medium to Long Term

Note that the questions are intended to assess the medium term intentions of both users and suppliers of services. It should be possible to determine from this work whether there are any significant mismatches in expectations.

User questions

- 3.01 Do you have a medium to long term strategic plan for ICT infrastructure?
- 3.02 To what extent is this driven a) by the need to maintain cost effectiveness in the infrastructure and b) by innovation and competition in business practices?

- 3.03 If it's documented would you be willing to share it under the "Chatham House" rule?
- 3.04 Do you work with suppliers on technology innovation, risk management and capacity planning, if not why not?
- 3.05 How does mobile working figure in your planning horizon?
- 3.06 Do you find any difficulties with reliability and/or security of international connectivity for mobile workers?
- 3.07 Do you expect to see increased flexible or home working and is this part of a "Green IT " Agenda or is it driven by your organisation's accommodation strategy?
- 3.08 Do you see benefits in convergence of all services onto IP network infrastructure and does this figure in your plans?
- 3.09 Do you see any significant reliability or resilience risks from the move to all telecoms services being delivered over IP and/or
- 3.10 Do you see any significant reliability or resilience risks from the increasing reliance on radio mobile technologies?
- 3.11 Do you see roles for social networking tools and other web 2.0 tools such as Wiki in your business and what do think the capacity impact would be on servers, storage and network and what threats to security would give cause for concern?
- 3.12 Are the unit costs of infrastructure services increasing or falling? To what extent are price changes influencing your own planning?
- 3.13 What are the biggest barriers to exploiting speed of available infrastructure?

Provider questions: Network Operators

- 4.01 What are your plans for new services e.g. Wi-max in the medium term?
- 4.02 What demands for new facilities and capacity are your customers imposing?
- 4.03 Is IP convergence a significant feature of your planning and if not why not?
- 4.04 For operators who are resellers: How does this affect your relationship with network service providers?
- 4.05 Do you see a shift in the balance between fixed and wireless provision in the future?
- 4.06 Have you had any significant difficulties meeting customer demand?
- 4.07 Was any of this difficulty specifically related to physical limitations and if not do foresee that physical limitations might become an issue in the near future?
- 4.08 What steps have you taken to ensure service delivery is resilient and have you tested your assumptions and plans in this area?
- 4.09 Does the City facilitate provision of services as well as it could, if not why not?

Server Hosting Providers

- 5.01 What demands for new facilities and capacity are your customers imposing?
- 5.02 Is IP convergence a significant feature of your planning and if not why not?
- 5.03 What steps have you taken to ensure the resilience of your service delivery infrastructure and did the planning involve disaster and threat scenario assessment?

5.04 Have you had any significant difficulties meeting customer demand and if so was there a specific constraint such as third party service provision, planning delay or lead times?

5.05 Does the City Corporation facilitate provision of services as well as it could, if not why not?

5.06 How do you see the impact of the "Green IT" Agenda?

Regulation

Environmental regulation and Green IT

6.01 How do you see the impact of environmental regulation on the management of power needs and the lifecycle management of equipment and related assets [WEEE directive and green power tariffs]?

Financial and Business Regulation

7.01 Are you content that you have adequate infrastructure for the business regulatory environment e.g. Sarbanes-Oxley, Basel II etc. What further impact of such regulation are you planning for?

7.02 Do you see any UK or London specific regulations that give cause for concern in implementation workload terms?

Network Services Regulation

8.01 Do you have concerns over the over The Regulation of Investigatory Powers (Interception of Communications: Code of Practice) Order 2002 and does it feature in your arrangements with customers/suppliers?

8.02 Do you have concerns about the inconsistency of telecoms regulation across Europe and elsewhere and does this affect your business directly?

8.03 What benefits (or drawbacks) could you anticipate from harmonisation of telecoms regulation in the EU?

8.04 Do you anticipate problems as a consequence of government policy on the licensing and exploitation of radio spectrum?

8.05 Do you believe that the regulators including OFCOM have a role to play in ensuring the robustness of network service availability? If not, how do you believe this should be ensured?

Generic London Issues

9.01 Have you been affected by any specific impact of regulation (positive or negative) within the City of London?

Case Studies

10.01 Do you have the material for a short case study?

Appendix 3: Data Sources

Countries: Background

"Knowledge Access Methodology (KAM) Indices", World Bank, 2008
<http://info.worldbank.org/etools/kam2>

"Global Information Technology Report, 2007-8",
World Economic Forum / Insead, 2008
www.insead.edu/v1/gitr/wef/main/home.cfm

"E-readiness rankings 2008", Economist Intelligence Unit, June 2008
http://a330.g.akamai.net/7/330/25828/20080331202303/graphics.eiu.com/upload/ibm_ereadiness_2008.pdf

"Telecommunications Market Report, 2007," Keynote, 2007

"The UK Communications Market 2008", Ofcom, 14th August, 2008
www.ofcom.org.uk/research/cm/cmr08

This is the fifth report in the series, and focuses on trends and developments in the UK's communications market, with the aim of providing a context for decision-making by Ofcom, as well as by commercial and public service organisations. Key points in this year's report include an examination of convergence based on content, distribution and consumption. The first next-generation broadband networks are beginning to emerge, offering a step-change in the speeds available as the UK moves towards a super-fast broadband network. In the first half of 2008, mobile broadband began to take off, representing a potential alternative to fixed-line broadband as users plugged in USB dongles to their laptops to access the internet via high-speed mobile networks.

Websites

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Cities: Background

"Corporation of London ICT Infrastructure Review", City of London, July, 2001

"The Competitive Impact of London's Financial Market Infrastructure", City of London, April, 2007

"London: Winning in a Changing World - Review of the Competitiveness of London's Financial Centre", (The Wigley Report), January, 2009
<http://www.london.gov.uk/mayor/economy/london-winning.jsp>

"The Competitiveness of London –future challenges from emerging cities", London Chamber of Commerce, April, 2008
<http://www.londonchamber.co.uk/>

"Global Financial Centres Index (GFCI) 3 – Review", in City Research Focus, City of London, No. 2, April, 2008, pp. 1-2.

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"Global Financial Centres Index 4", City of London, September, 2008

"Global Financial Centres Index 5", City of London, March 2009-05-27
http://www.cityoflondon.gov.uk/Corporation/LGNL_Services/Business/Business_support_and_advice/Economic_information_and_analysis/GFCI/

"MasterCard Worldwide Centers of Commerce Report", 2008
www.mastercard.com/us/company/en/insights/pdfs/2008/MCWW_WCoC-Report_2008.pdf

"Defying augury: can the stock exchange and the City see off the competition?" The Economist, 6th September, 2008, pp. 36-7

The City in the Global Economy

Sassen, Saskia, "Global Practice in Local Scenarios", Lecture at RIBA, 15th May, 2008 (Audio available on internet).
(<http://www.buildingfutures.org.uk/projects/building-futures/futures-fair-08/futures-dialogues-global-practice-in-local-scenarios>)

Sassen, Saskia, "Specialised cities make a difference in today's global age", Engineering News Record, 30th July, 2008
(<http://enr.construction.com/opinions/viewPoint/archives/080730.asp>)

Sassen, Saskia, "Territory, Authority, Rights: From Medieval to Global Assemblages", Princeton University Press, 2006

Sassen, Saskia, "Cities in a World Economy", Sage, 2006

De Graaf, Reinier, "Futures in Focus: People and Planning", (Abstract), Futures Fair, RIBA, May 2008.

Koolhaas, Rem, "Mutations", 2002

London Fringe

"Government in London - Greater London Authority", The Municipal Yearbook, 2007

"The London Plan: Spatial Development Strategy for Greater London. Consolidated with Alterations since 2004", Greater London Authority, February, 2008, pp. 115-6

"Corporate ICT Strategy 2007-12", London Borough of Camden, November, 2007

"Information and Communications Technology Strategy 2006-2011", Tower Hamlets Borough Council, July, 2006

Data Centres and Power Supplies

"The Mayor's Energy Strategy" on www.londongov.uk/mayor/strategies/

Websites

www.telehouse.net

www.interxion.com

www.level3.com

www.equinix.com

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OECD Communications Outlook 2007, OECD, 2007

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"The International Communications Market, 2008", Ofcom, November, 2008

www.ofcom.org.uk/research/cm/icmr08

This is the third report in the series taking into account data up to the end of 2007. Key points in this report include the acknowledgement that putting the UK market into an international context is becoming increasingly important, as communications service provision globalises and as technological innovation breaks down traditional national market boundaries. Mobile broadband availability using HSDPA technology now exceeded 70% in many European countries, and was highest in the UK at 87%. The highest growth in telecoms service revenues was in the UK and Canada, up by 5%, driven mainly by increased use and broadband take-up. Japan was far ahead of the rest of the

countries considered in the report in offering next-generation access broadband networks, with fibre to the building available to 85% of the population by the end of 2007. By contrast, the UK was lagging behind even other countries of Europe with less than 1%.

Richards, Ed, (Chief Executive, Ofcom), "The EU Framework Reform Package: A National Regulator's View", Speech to the Communications and Competition Law Conference, Brussels, 20th October, 2008.

European Parliament legislative resolution of 23 May 2007 ([COM \(2006\)0382- C6-0244/2006-2006/0133 \(COD\)](#))

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http://ec.europa.eu/information_society/doc/factsheets/tr9-listofmarkets.pdf

<http://www.ectaportal.com/en/basics651.html>

<http://www.samknows.com/broadband/mapping/mapping.php>

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<http://www.ofcom.org.uk/radiocomms/spectrumawards/>

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"Resilience Benchmarking Project", (Discussion Paper), The Tripartite Authorities, June, 2008.

Collins, Stephen P., "The tripartite approach to business continuity in the UK financial sector", Journal of Business Continuity and Emergency Planning, 2007, Vol.1, No. 2, pp. 118-128

The SunGard Availability Services Website
<http://www.sungard.co.uk/>

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MILLER, Ron, "Standards are the name of the game", SunGard Availability Services, 2008

"From Adversity to Availability: A Practical Insight into Business Risk, Continuity & Information Availability", SunGard Availability Services
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Blakely, Rhys et al, "MI5 alert on China's cyberspace spy threat", The Times, 1st December, 2007

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Green IT

Website

www.london.gov.uk/gla/tenders/docs/environmental_policy.pdf

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"Measuring the impacts of ICT using official statistics", Working Party on Indicators for the Information Society, Committee for Information, Computer and Communications Policy, Directorate for Science, Technology and Industry, OECD, January, 2008. (DSTI/ICCP/IIS (2007)1/FINAL Unclassified)

Herzberg, Frederick, "One more time: how do you motivate employees?" Harvard Business Review, 2008

Website

<http://www.weforum.org/financialarchitecture>
en.wikipedia.org/wiki/Microcredit
<http://www.raeng.org.uk/policy/ict/ict.htm>

Appendix 4: Glossary

1G First Generation Cellular Mobile Wireless The first generation of cellular wireless was based on analogue technology. The systems were designed only to carry voice services.

2G Second generation of mobile telephony systems Uses digital transmission to support voice, low-speed data communications, and short messaging systems.

3G Third generation of mobile systems Provides high-speed data transmission and supports multimedia applications such as full-motion video, video-conferencing and internet access, alongside conventional voice services.

4G Fourth-Generation Cellular Mobile Wireless 4G technologies are still in the early research stage and no consistent industry definition exists yet. Target data rate is over 100 Mbit/s for downlink and 20 Mbit/s uplink. It is likely to be well into the next decade before the technology is commercially deployed.

802.nn Family of wireless standards managed by IEEE (Institute of Electrical and Electronics Engineers); the most widespread developments are in the nn=11 family (WiFi) and the nn=16, (WiMax).

Access Network Electronic Communications Network which connects end-users to a service provider; running from the end-user's premises to a Local access Node and supporting the provision of access based services. It is sometimes referred to as the local loop or last mile, see LLU below.

ADSL Asymmetrical Digital Subscriber Line A digital technology that allows the use of a standard telephone line to provide high speed data communications, Allows higher speeds in one direction (towards the customer) than the other.

ATM Automated Teller Machine "Hole in the wall" for dispensing cash.

Bit-rate The rate at which digital information is carried within a specified communication channel.

Bluetooth Wireless standard for short-range radio communications between a variety of devices such as PCs, headsets, printers, mobile phones, and PDAs.

Broadband A service or connection which is capable of supporting always-on services which provide the end-user with high data transfer speeds. Large-capacity service or connection allowing a considerable amount of information to be conveyed, often used for transmitting bulk data or video or for rapid Internet access. Data rates typically 1 to 20 Mbit/s currently.

CAT Competition Appeals Tribunal.

CELA Central and East London Area An area Ofcom has defined as being “competitive” for high-speed data services.

Contention Ratio An indication of the number of customers who share the capacity available in an ISP’s broadband network, ratios of 50:1 for residential broadband connections and 20:1 for business are typical.

Co-regulation The sharing of regulation between a statutory body (e.g. Ofcom) and its licensees.

Data packet In networking, the smallest unit of information transmitted as a discrete entity from one node on the network to another: Internet Protocol (IP) is based on sending data packets.

Data Centre A facility used to house computer systems and associated components, such as telecommunications and storage systems. It generally includes redundant or backup power supplies, redundant data communications connections, environmental controls (for example, air conditioning, fire suppression) and security devices.

Digital dividend The spectrum that will be released by the switch to all digit television.

Easynet A global managed network, hosting, and telepresence company owned by BSkyB, with customers and offices across the world.

Ex-ante regulation Regulation to address behaviour before it happens.

Fibre Optical fibre, used eg for high connectivity between data centres or where fast response is required. Modern-day optical fibers can carry information at around 14 Terabits per second over 160 kilometres of fibre.

Fibre-to-the-cabinet (FTTC) Access network consisting of optical fibre extending from the access node to the street cabinet. The street cabinet is usually located up to a few hundred metres from the subscriber premises. The remaining segment of the access network from the cabinet to the customer is usually a copper pair but could use another technology, such as wireless.

Fibre-to-the-building (FTTB) A form of fibre-optic communication delivery in which an optical fibre is run directly onto the customer’s premises.

GHz Gigahertz.

GSM Global Standard for Mobile Telephony, the standard in use for 2G mobile systems.

Headline connection speed The theoretical maximum data speed that can be achieved by a given broadband. A number of factors, such as the quality and length of the physical line from the exchange to the customer, mean that a given customer may not experience this headline speed in practice.

HotSpot is a venue that offers internet access over a wireless LAN.

Interconnection The linking of one Public Electronic Communications Network to another for the purpose of enabling the persons using them to be able to:

- i) Communicate with users of the other one; and
- ii) Make use of services provided by means of the other one (whether by the provider of that network or by another person).

Internet A global network of networks, using a common set of standards (the internet Protocol) accessed by users with a computer via a service provider.

IP (Internet Protocol) The packet data protocol used for the routing and carriage of messages across the Internet and similar networks.

ISP Internet Service Provider A company that provides access to the internet.

LLU (Local Loop Unbundling) LLU is the process whereby incumbent operators (in the UK this means BT and Kingston Communications) make their local network (the lines that run from customer's premises to the telephone exchange) available to other communications providers. The process requires the competitor to deploy its own equipment in the incumbent's local exchange and to establish a backhaul connection between this equipment and its core network.

Local Loop The access network connection between the customer's premises and the local PSTN exchange, usually a loop comprised of two wires.

LTE A fourth-Generation Cellular Mobile Wireless technology (4G) that will succeed current 3G networks. The technology enables 100 Mbit/s downlink and 50 Mbit/s uplink speeds and uses an "all-IP" architecture where everything (including voice) is handled as data packets.

MHz Megahertz.

Next-generation core networks (NGN) Internet Protocol based core networks which can support a variety of existing and new services, typically replacing multiple, single service legacy networks.

Next-generation access networks (NGA) Broadband access networks that connect the end-user to the core network capable of a bandwidth quantity and quality significantly in excess of current levels (a benchmark of 20Mbit/s or more is often used).

NRA National Regulatory Authority (Ofcom in the UK).

Peer-to-peer distribution The process of directly transferring information, services or products between users or devices that operate on the same hierarchical level. Important for creating resilience during emergencies.

POP Server “**Post Office Protocol**” **Server**. An internet standard protocol that allows you to receive e-mail from an Internet Service Provider.

POTS Plain old telephone system.

PSTN Public Switched Telephony Network.

Regulatory holiday A commitment by a regulator not to impose measures on a given product or service for a specified period of time.

SLA **Service Level Agreement**. A negotiated agreement between two parties that sets out the standards or levels to which a specific service will be delivered from one (the service provider) to the other (the customer).

SME **Small / Medium Sized Enterprise**. A company with fewer than 250 employees.

SMP Significant Market Power – a regulatory ruling of market dominance.

SMS **Short Message Service**. A communications protocol which allows the interchange of short text messages between mobile telephone devices.

Termination rates The charges one mobile operator makes to another for the final delivery of a call to a handset on its network.

Telecommunications, or Telecoms Conveyance over distance of speech, music and other sounds, visual images or signals by electric, magnetic or electro-magnetic means.

Tier 1 There is no formal definition of “Tier 1 suppliers” in the UK market. Tier 1 is an expression used to define leading global internet network providers who exchange traffic on a “peering” basis – that is, without charge. Here it used in a more informal sense of “telcos who have fibre in the ground”. In the City, this would be BT, COLT, Level 3, Verizon Business, Cable & Wireless, Interroute, Abovenet, Neos Networks, Thus (now Cable & Wireless), Virgin (ntl:Telewest Business), Global Crossing, Geo.

VMWare Virtualisation Software. The expression is derived from the terms “virtual machine” and “software”. VMWare allows one computer’s operating systems and applications to be run in another Set of hardware

VoIP Voice over Internet Protocol. A technology that allows users to send calls using Internet Protocol, using either the public internet or private IP networks.

WDM Wave Division Multiplexing. The combination of several streams of data onto the same physical fibre optic cabling.

Web 2.0 A second generation of web-based communities and hosted services – such as social-networking sites and wikis, which facilitate collaboration and sharing between users.

WiFi hotspot A public location with access to the internet using WiFi technology.

WiMAX A wireless MAN (metropolitan area network) technology, based on 802.16 standards. Available for both fixed and mobile technologies.

Wireless LAN or WiFi (Wireless Fidelity) Short range wireless technologies using any type of 802.11 standard. These technologies allow an over-the-air connection between a wireless client and a base station, or between two wireless clients.

Sources: Ofcom, Netstrategics, online sources.

Appendix 5: ICT Indices

Introduction

The City of London publication, "The Global Financial Centres Index 5", March, 2009, ranks London as the world's leading financial centre. It has a sub-index for infrastructure which also ranks London in pole position, but this includes information on property and amenities as well as telecoms data.

The starting point for further research was the quest for other comparator indices which might throw a more detailed light on ICT elements as they relate to financial centres.

Comparison surveys in the ICT sector which have been identified are mainly at the country level, and are, therefore, of limited use in comparing cities within countries, let alone the financial centres within those cities.

Additional surveys which have been considered are as follows:

- "Knowledge Access Methodology (KAM) Indices", World Bank, 2008
- "Global Information Technology Report, 2007-8",
- World Economic Forum / Insead, 2008
- "E-readiness rankings 2008", Economist Intelligence Unit, June 2008
- "MasterCard Worldwide Centers of Commerce Report", 2008

It should also be pointed out that most of the variables included go well beyond infrastructure technology, and even the technology itself, covering such broad headings as:

- Economic and Institutional Regime
- Education and Human Resources
- Innovation System
- Market Environment
- Political and Regulatory Environment
- Business Environment
- Social and Cultural Environment
- Legal Environment

The WEF / Insead report alone covers 68 variables, many of them nothing to do with technology. The Economist Intelligence Unit report covers "nearly 100 separate quantitative and qualitative criteria" which are not divulged, but the six primary categories into which they are organised tell the same story.

Full details of the surveys are given in the references at the end of this appendix, and in the report bibliography. All are available on-line.

Thirteen tables have been extracted from the three country surveys and reduced to cover just the countries whose cities are considered in this study. These are shown in composite form in Table 2 (Chapter 2). The tables represent the overall indices for each of the surveys, together with those variables which are closely related to ICT and its infrastructure. They will now be considered in turn.

World Bank KAM Indexes

No. of countries covered:	140
Indexes quoted in Table 2:	2
Total variables used in quoted indexes:	12

Two World Bank KAM indices are listed: the Knowledge Economy (KE) Index based on a country's Economic and Institutional Regime, Education and Human Resources, Innovation System and Information and Communications Technology (ICT). Also listed is an individual ICT index. Variables are normalised on a scale of 0-10 relative to other countries in the comparison group. The UK comes 5th and 6th respectively against the other selected countries, but all the leading countries are fairly close together. However, a small number of fairly general variables are used in both cases.

WEF / Insead Networked Readiness Index

No. of countries covered:	127
Indices / Sub-Indices quoted in Table 2:	8
Sub-indices in survey:	68

Of more interest are the World Economic Forum / Insead indices. The overall Networked Readiness Index is built up from twelve component indices including an Infrastructure Environment Index and sixty-eight sub-indices, for which variables are scored on a scale of 1-7. These two indices, together with six relevant sub-indices are listed.

The UK comes 5th and 3rd respectively in the Networked Readiness and Infrastructure Environment Indices against the other selected countries.

The six relevant sub-indices are as follows:

- Availability of Latest Technologies
- Accessibility of Digital Content
- Secure Internet Servers (per 1m. inhabitants)
- Laws relating to ICT
- Government Prioritisation of ICT
- Importance of ICT to government vision of the future

On the first two and the fourth, the UK comes 4th, 5th and 3rd in the control group respectively, the leading scores being very close together. On the third, the sub-index for secure internet servers per 1m of the population, the UK again comes 3rd, only the United States being substantially ahead.

Of more concern, however, are the last two indices. Regarding Government Prioritisation of ICT, the UK comes only 7th in the control group, and 21st out of all the countries covered in the publication. In addition, on the importance of ICT to government vision of the future, the UK only reaches 10th place in the control group and 42nd out of countries overall. On top of this, in both indices, Singapore and the United Arab Emirates come 1st and 2nd in the control group. In mitigation, although the report and indices were only published in 2008, it would appear that some of the data used is at least two-three years old.

EIU E-readiness rankings

No. of countries covered:	70
Rankings / Categories quoted in Table 2:	3
No. of qualitative / quantitative criteria used	< 100

The more recent EIU e-readiness rankings (variables scored 0-10) give the UK joint 4th place in their category for Government Policy and Vision, and 6th in overall ranking in the control group, although the UK is behind Singapore in both rankings. The United Arab Emirates comes 10th in the control group on Government Policy and Vision with a comparatively low score of 6.45 as opposed to Singapore (9.25) and the UK (9). The UK comes 5th in the sub-index for Connectivity against the other selected countries

The EIU have in their most recent analysis changed the factors that affect the connectivity scoring, removing narrowband telephone penetration and adding broadband and mobile phone penetration. They also use broadband affordability – the ratio of a subscription to median household income.

They have also added a new factor – electronic identity cards.

The list of factors measured is now:

- broadband penetration and affordability
- mobile phone penetration
- Internet penetration and security
- PC penetration
- WiFi hotspot penetration
- Electronic ID

These factors are mostly consumer and citizen oriented, rather than focused directly on business services, though Internet security is clearly relevant to B2B as well as B2C financial services.

Commentary

Only the most general conclusion can be drawn from these tables. Even within the indices given, countries' rankings vary quite widely. When countries which have a global financial centre are compared, the UK is in the leading group in terms of information and communications technology.

City based Indices

There are also two city based indexes, the City of London's own Global Financial Centres Index (GFCI), and the Mastercard Worldwide Centers of Commerce (WCOC) Index, which considers the wider aspects of the future of cities. A financial centre will be affected by the hinterland of the rest of the city.

GFCI 4 and GFCI 5

	GFCI 4	GFCI 5
No. of centres covered:	59	62
Indices quoted in Chapter 2:	2	-
No. of "instrumental factors" used:	57	57

Note that GFCI 4 was described in Chapter 2 but that GFCI 5 results have since been published. Both GFCI 4 and GFCI 5 rank London first overall and on infrastructure.

MasterCard Worldwide Centers of Commerce (WCOC) Index

No. of centres covered:	75
Rankings quoted in Chapter 2:	1
No. of dimensions evaluated:	7
No. of indicators / sub-indicators used:	117

Professor Saskia Sassen* was one of the panellists who overviewed this recent large-scale study of major and minor global economic centres.

In a recent lecture, Sassen pointed out that:

"This global economy values and can extract value from the specialised differences of cities. A lot of these state of the art built environments can be thought of as inhabited infrastructures When you say infrastructure, you are alluding to a mix of something which is necessary and indeterminate." (1)

In another recent article, she added that firms that operate in dozens of different countries have to handle the different accounting, legal, financial, insurance and other systems, as well as the management and investment cultures of each country. She continued:

"Insufficiently understood is the fact that cities construct this urban knowledge capital partly in terms of their specific differences. The deep economic history of a place and the specialised economic strengths it can generate increasingly matter in a globalised economy.

".... This.... also explains why the many and very diverse global cities around the world don't just compete with each other but also collectively form a globally networked platform for the operation of firms and markets." (2)

Cities tended to have very different rankings dependent on the indicator. However, in the WCOC Index Aggregate Ranking, Top 30 Cities, London came out at number one by a clear margin, and Dubai did not make the top 30.

Key Points

Surveys comparing the development of ICT in countries show that when countries which have a global financial centre are compared, the UK is in the leading group.

In the economy of the future, cities will collectively form a globally networked platform where their historical and specialised economic differences will increasingly matter and add value.

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Appendix 6: Worldwide Network Operators

Table 3 in Chapter 3 is a table of twenty of the world's biggest network operators and telecommunications companies by country of origin, and the cities of the world of relevance to this report where they have a presence. The "telcos" listed all originate in countries which have global financial centres of interest to this report.

Some qualification should be made about the table. Some major companies, such as Sprint Nextel (USA), or Virgin Media (UK), operate primarily or wholly in their country of origin and are excluded. Others such as Vodafone do not necessarily locate their operating centres in major cities and may operate widely through joint ventures and associated undertakings. Royal KPN has many international and regional partners. An 'x' in brackets indicates a less major presence such as a representative or customer support office. Every effort has been made to ensure the table's accuracy, but specific current information on individual companies is not always readily available.

Notwithstanding the above, it is indicative of the extent to which the major telecommunications companies compete and have the sort of wide-ranging presence unthinkable even fifteen years ago.

Thus, in addition to being the UK's leading company, BT operates in 170 countries. It is Germany's leading supplier of global network and IT services, and operates local fibre optic networks (City Fibre Networks) in four cities including Frankfurt. Ninety per cent of traders on the New York Stock Exchange use BT's voice trading technology.

PCCW Global (UK) Ltd., the UK arm of the Hong Kong company, obtained its Telecommunications Operator Licence in 2001 and provides a number of services including virtual private networks. It regards London as an ideal location for its regional office in Europe, and Asia, particularly China, as the biggest potential market for European companies. With its own presence in Asia, and its longstanding relationships with Asian carriers, it is able to provide its European clients with one-stop shop solutions.

Of the twelve companies regarded as "Tier 1" suppliers by the City of London, half of them are in the table, and have a presence in a number of competitor cities. Nine more of other countries' major telcos have some sort of presence in London. The 12 "Tier 1" suppliers defined by the City of London, as having fibre in the ground in the City but not necessarily connection to the premises, are as follows (in alphabetic order):

- Abovenet
- BT
- Cable & Wireless
- COLT

- Geo
- Global Crossing
- Interroute
- Level 3
- Neos Networks
- Thus
- Verizon
- Virgin Media

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Appendix 7: the Singapore iN2015 Plan⁵⁴

The iN2015 Masterplan

Vision

Singapore: An Intelligent Nation, A Global City, Powered By Infocomm

Innovation

iN2015 will fuel creativity and innovation among businesses and individuals by providing an infocomm platform that supports enterprise and talent.

Integration

iN2015 will connect businesses, individuals and communities, giving them the ability to harness resources and capabilities - speedily and efficiently - across diverse businesses and geographies.

Internationalisation

iN2015 will be the conduit for providing easy and immediate access to the world's resources as well as for exporting Singapore's ideas, products, services, companies and talent into the global markets.

Goals

Singapore's Goals with iN2015

- to be #1 in the world in harnessing infocomm to add value to the economy and society
- to realise a 2 - fold increase in the value-add of the infocomm industry to S\$26 billion
- to realise a 3 - fold increase in infocomm export revenue to S\$60 billion

and

- to create 80,000 additional jobs
- to achieve 90% home broadband usage
- to achieve 100% computer ownership in homes with school-going children

Strategies

Singapore's Strategy with iN2015

54 . www.ida.gov.sg/About%20us/20070903145526.aspx

- To spearhead the transformation of key economic sectors, government and society through more sophisticated and innovative use of infocomm;
- To establish an ultra-high speed, pervasive, intelligent and trusted infocomm infrastructure;
- To develop a globally competitive infocomm industry;
- To develop an infocomm-savvy workforce and globally competitive infocomm manpower.

Opportunities

iN2015 Creates Our Future

... transforming lives & businesses

iN2015 powers partnerships by providing the technology to collaborate, innovate and personalise. This connects local and global needs even as it enriches customers' experiences and helps develop new capabilities.

... fuelling competitive enterprise

Technology is fundamental to the development of ideas that sets a business apart from its competitors. iN2015 helps speed up industry-specific solutions, builds brands, fosters growth and expands and attracts global talent and expertise.

... providing the infrastructure

A next-generation wireless and wired infrastructure will deliver more innovative and trusted services. It will be ultra-high speed, pervasive and intelligent.

... developing human capital

iN2015 attracts and develops an innovative, infocomm-savvy workforce and global infocomm talent, to enhance economic competitiveness and economic growth.

iN2015 Is About Opportunities

iN2015 is for every individual, business and organisation.

Imagine a global city where technology, collaboration and networking connect everyone, everywhere. Imagine a world where services, products and information are just a click away, where streamlined e-processes are an integral part of life and where security and access control are taken for granted.

Imagine a world of seamless interaction and convenience.

Imagine your world.

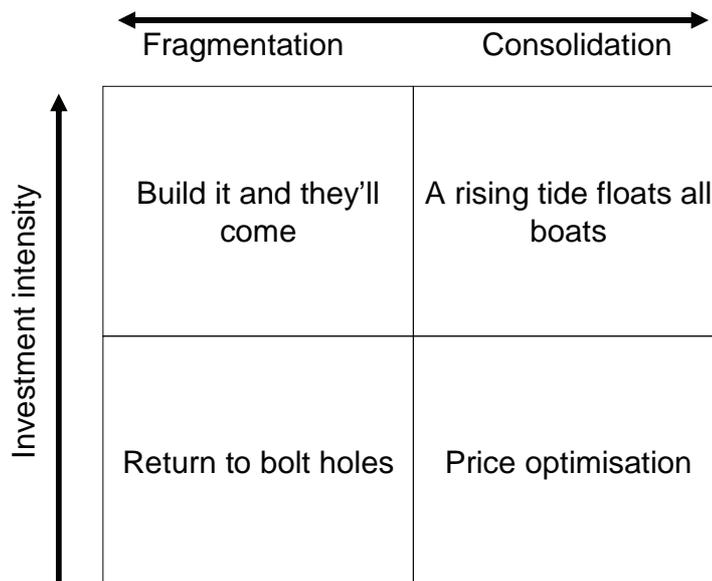
The excitement is just beginning.

Appendix 8: Scenarios for digital communications

The communications industry is faced with some seismic changes in technology, regulation and markets over the next decade. It is far from clear how it will emerge beyond the current business cycle, but investment payback cycles in this industry can be measured in decades and some big bets are being placed by operators and their suppliers now.

These scenarios were developed by a group containing representatives of DSI, SAMI Consulting and Netstrategics Ltd. They are intended – like all scenarios – to paint some possible futures for the digital communications industry in 2015; they are not forecasts. We saw the main determinants of the future of digital communications as the demand from users leading to investment, and the consolidation or otherwise of the ICT industry – which in Europe could follow a different path from other parts of the world.

The Figure below summarises the dimensions of the scenarios.



Build it and they'll come

Fibre optic access networks are a favoured infrastructure project of the digital "New Deal", so there is ample bandwidth. A series of nationalisations of foreign fixed and mobile telecoms operators curbs the enthusiasm of developed world champions for seeking growth in other markets.

Large online service providers such as Google and Microsoft continue to prosper alongside a host of newer providers exploiting the opportunities of new internet-

connected mobile devices, pervasive computing and entertainment content financed by novel business models.

Implications for the City: plenty of fibre but at higher prices

A rising tide floats all boats

The communications industry emerges stronger from the late 2000s recession, having improved efficiency by around 20% by reducing manpower, divesting non-core businesses and investing in Next Generation Networks. Regulators demand a realignment of fixed and mobile operators between wholesale network operators and full-service retail service providers.

Although the fight against spam and malicious actions against networks intensifies, international collaboration and ample resources ensure that this issue remains manageable.

Implications for the City: confusion during re-alignment of suppliers

Return to bolt holes

The drive for local network unbundling and structural separation runs out of steam during the recession, as national regulators look to protect incumbent carriers' investment programmes and would-be challengers scale back on their plans.

Traffic volumes for fixed and mobile operators accelerate, but price competition and regulated returns on fibre access networks keep revenues and margins flat. The pre-recession trend towards global consolidation resumes at a slower pace, but it is the new tigers of the developing world which expand into the mature markets of Europe, North America and Japan, using their low-cost, no-frills business models to compete on price, as their home markets saturate.

Implications for the City: no frills suppliers at lower prices

Price optimization

The threat of business failures drives faster international consolidation. The EU regulator imposes a pattern of strict structural separation and unbundling, but with protection and utility returns for deep-pocketed long-term operators and this becomes the international norm.

Mobile internet applications evolve towards a limited core set based around communications, commerce and social networking, but privacy and information security considerations hamper growth. Consumers opt for value, features and durability of handsets over networked features. High-speed broadband access is widely available, but its take-up was limited by the decline in popularity of broadcast video entertainment as production and marketing budgets declined.

Implications for the City: national fixed line operators retain SMP.