Expert Report of Nigel Attenborough

6 November 2009

NERA
Economic Consulting

NERA Economic Consulting
15 Stratford Place
London W1C 1BE
United Kingdom
Tel: +44 20 7659 8500
Fax: +44 20 7659 8501
www.nera.com

Introduction

I, Nigel Attenborough, of 15 Stratford Place, London W1C 1BE, am an economist and I specialise in the field of telecommunications.

I am a Director of NERA Economic Consulting (**NERA**) and Head of its European Communications Practice. I have held this position since 1997, having previously worked as a Senior Consultant and Associate Director at NERA. Prior to this, I worked at British Telecom, latterly as the Head of Regulatory Economics and Competition Policy.

I have a BA in Economics from Cambridge University, an MSc in Energy Economics from the University of Surrey and an MBA from Kingston Business School.

Since joining NERA in 1991, I have directed a wide range of telecommunications and related projects involving costing studies, pricing and regulation. Details of recent projects, with which I have been involved, are set out in my Curriculum Vitae (which is attached as **Appendix B** to this report).

Capital Expenditure on Transmission Equipment

1.1 I have been asked by Gilbert + Tobin, solicitors to Telstra Corporation Limited (**Telstra**), to provide my views on whether Version 2 of the model developed by Analysys Mason on behalf of the ACCC (the **Analysys Model**) provides a reliable estimate of the required level of capital expenditure on transmission equipment if Telstra were to build today an efficient inter-exchange network (IEN). A copy of my instructions is attached as **Appendix A** to this report.

1.2 In doing so, I have adopted a twofold approach. First I benchmarked the Analysys Model's estimate of transmission equipment capital expenditure with those in a number of European models of IEN costs. Then I followed through the calculations in the Analysys Model to see how its estimate of transmission equipment capital expenditure had been derived.

1.3 My findings are that the estimated level of capital expenditure on transmission equipment looks low by international standards and that, within the Analysys Model and its associated documentation, there is insufficient information to allow a full understanding to be reached as to how the Analysys Model derived its estimate and to enable this estimate to be properly verified.[1] The basis for these findings is set out below.

International Comparison

2.1 The Analysys Model contains the following categories of transmission equipment at various points in the IEN network hierarchy:

- Transmission ports, which are the points of entry to transmission systems;
- Multiplexers, which are devices that allow a number of message signals to share the same physical transmission channel;
- Regenerators, which are devices that receive, decode and then regenerate optical signals on long distance transmission links. This enables signal integrity and strength to be maintained and any distortions to be removed;
- DWDM systems, which use different wavelengths of light to enable many optical transmission channels to exist on the same fibre.

2.2 In the Analysys Model total capital expenditure on these items amounts to $145.9 million. The derivation of this figure is shown in Table 1 below. It can be seen that over 60% of the total is accounted for by DWDM equipment.

[1] The associated documentation consists of: Analysys, *Fixed LRIC Model User Guide-Version 2.0*, August 2009 (the **User Guide**); and Analysys, *Fixed LRIC Model Documentation-Version 2.0*, August 2009 (the **Model Documentation**).

Table 1: Total Capital Investment in Transmission Equipment (Analysys Model)

Type of Asset	Location in Analysys Model	Network equipment volume	Total capex cost (AUD)
LE: Ports: PoC-facing - PDH 2Mbps ports	Cost.xls / TA.Core / Columns F & I Row 24	834	1,666,130
LE: Ports: PoC-facing - PDH 8Mbps ports	Cost.xls / TA.Core / Columns F & I Row 25	4,575	11,424,675
LE: Ports: PoC-facing - SDH STM-0 ports	Cost.xls / TA.Core / Columns F & I Row 26	470	1,760,524
LE: Ports: PoC-facing - SDH STM-1 ports	Cost.xls / TA.Core / Columns F & I Row 27	4	21,975
LE/AT1: SDH regenerator	Cost.xls / TA.Core / Columns F & I Row 53	2,411	5,323,488
PoC modern: Ports: LE-facing - PDH 2Mbps ports	Cost.xls / TA.Core / Columns F & I Row 56	834	1,666,130
PoC modern: Ports: LE-facing - PDH 8Mbps ports	Cost.xls / TA.Core / Columns F & I Row 57	4,575	11,424,675
PoC modern: Ports: LE-facing - SDH STM-0 ports	Cost.xls / TA.Core / Columns F & I Row 58	470	1,760,524
PoC modern: Ports: LE-facing - SDH STM-1 ports	Cost.xls / TA.Core / Columns F & I Row 59	4	21,975
PoC modern: SDH multiplexer unit: POC-ring - STM-0	Cost.xls / TA.Core / Columns F & I Row 63	4	9,989
PoC modern: SDH multiplexer unit: POC-ring - STM-1	Cost.xls / TA.Core / Columns F & I Row 64	30	149,832
PoC modern: SDH multiplexer unit: POC-ring - STM-4	Cost.xls / TA.Core / Columns F & I Row 65	133	1,660,636
PoC modern: SDH multiplexer unit: POC-ring - STM-16	Cost.xls / TA.Core / Columns F & I Row 66	123	3,839,440
PoC common: Regenerators	Cost.xls / TA.Core / Columns F & I Row 79	371	819,168
ADM: LAS-ring SDH add-drop multiplexer - STM-4	Cost.xls / TA.Core / Columns F & I Row 87	1	12,486
ADM: LAS-ring SDH add-drop multiplexer - STM-16	Cost.xls / TA.Core / Columns F & I Row 88	53	1,654,393
ADM: LAS-ring SDH add-drop multiplexer - STM-64	Cost.xls / TA.Core / Columns F & I Row 89	29	2,715,701
LAS: Ports: Interconnection-facing - SDH STM-1 ports	Cost.xls / TA.Core / Columns F & I Row 93	133	730,680
LAS/Regional Node: SDH regenerator	Cost.xls / TA.Core / Columns F & I Row 116	800	1,766,400
ADM: TNS-ring SDH add-drop multiplexer - STM-64	Cost.xls / TA.Core / Columns F & I Row 125	70	6,555,142
TNS: Ports: Interconnection-facing - SDH STM-1 ports	Cost.xls / TA.Core / Columns F & I Row 126	157	862,532
Core node common: SDH regenerator	Cost.xls / TA.Core / Columns F & I Row 165	148	612,720
Metro DWDM per element	Cost.xls / TA.Core / Columns F & I Row 166 & 195	255	8,172,797
Long Haul DWDM pt to pt system	Cost.xls / TA.Core / Columns F & I Row 167 & 196	75	16,800,425
Extended Long Haul DWDM pt to pt system	Cost.xls / TA.Core / Columns F & I Row 168 & 197	127	53,072,349
Ultra Long Haul DWDM pt to pt system	Cost.xls / TA.Core / Columns F & I Row 169 & 198	17	11,383,159
		Total	**$ 145,887,943**

Source: Analysys Model, Version 2.0

2.3 Capital expenditure on transmission equipment in the Analysys Model represents just less than 1% of the $15.7 billion total capital investment that the model estimates is required for the IEN as a whole. Based on my experience of other countries, this is a very low ratio and something of the order of 5% might normally be expected.

2.4 The long distances between trunk network switches (TNS) in the IEN in Australia are likely to mean that the ratio of transmission equipment costs to duct and fibre costs is lower than in many countries (although this will be partly compensated by higher regenerator costs, which are positively related to distance as, the longer the distance, the greater is the number of times the signal has to be regenerated to maintain its strength and integrity). Consequently, the low ratio of transmission equipment capital expenditure to total IEN capital expenditure in the Analysys Model does not necessarily indicate that transmission equipment capital expenditure is understated.

2.5 In order to avoid the problems associated with comparing transmission equipment capital expenditure with total IEN capital expenditure, I took a different approach to international benchmarking. This involved calculating the amount of investment in transmission equipment per head of population in the case of four European countries where I

have been involved in building LRIC models of the IEN network and comparing the results with the equivalent figure for Australia.

2.6 The reason for choosing this measure of transmission equipment investment is that:

- The amount of transmission equipment is determined by the level of traffic (voice, data and leased lines) using the network and not by the length of the transmission links. Consequently, with the exception of regenerators (see paragraph 2.4 above), transmission equipment costs are independent of distance. This in turn means that Australia's longer transmission links do not influence the level of transmission equipment capital expenditure per head;

- The comparator European countries are Ireland, Netherlands, Spain and Switzerland. They are all highly developed and therefore likely to have levels of per capita consumption of telecommunications services that are broadly similar to those in Australia;

- As is the case in Australia, the comparator European countries all have mature telecommunications networks with a very high level of fixed network penetration, so use of population rather than the number of subscriber lines will not unduly distort the results.

- The comparator countries range from less populous than Australia to more populous than Australia. This means that Australia is not an outlier in terms of population size.

2.7 For the countries concerned, the data on transmission equipment capital expenditure is confidential. Consequently it is not possible to reveal their individual capital expenditure figures (or even their population levels as this by itself would uniquely identify them). Instead, they are referred to as Country A, Country B etc and their expenditure figures are provided on a per capita basis.

2.8 The transmission equipment capital expenditure underlying the calculations has been revalued at 2008 prices by applying a price index. I was unable to find a suitable European index, so I used the US Bureau of Labour Statistics price index for computer and peripheral equipment manufacturing.[2] It was chosen because, like computing equipment, transmission equipment contains a substantial amount of electronics and hence one might expect the prices of transmission equipment to move in a broadly similar way to those of computing equipment.

2.9 Table 2 below shows transmission equipment capital expenditure per head of population in each of the four European countries and in Australia, where capital investment has been converted to Euros using the annual average AUD to Euro exchange rate for 2008.[3]

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[2] US Bureau of Statistics, PPI Series Id: PCU33411-33411

[3] Since transmission equipment is traded, the use of actual as opposed to purchasing power parity exchange rates is appropriate. The opposite would be the case with, for example, duct, where a substantial portion of the cost is represented by local labour.

For all the countries, the population figures used in the calculation are mid-2009 forecasts that are taken from the CIA World Factbook.[4]

Table 2: Comparison between Australia and Four European Countries Transmission Equipment Investment per Head (Euros)

Country A	13.5		
Country B	9.5		
Country C	8.9	Australia as % of average for European operators	38.6%
Country D	8.9	Australia as % of average excluding Country A	43.3%
Average all 4 countries	10.2		
Average excluding A	9.1		
Australia (Analysys Model)	3.9		

Source: Various European LRIC models; Analysys Model; CIA World Factbook

2.10 It can be seen from this comparison that transmission equipment capital expenditure in the Analysys Model is only about 40% of what might be expected based on experience in the European countries for which data are available. The reason for showing the European country average with and without Country A is that the latter looks to be something of an outlier when compared with the other countries, which all have similar levels of transmission equipment capital expenditure per head.[5] Its presence or absence does not affect my overall conclusion.

2.11 Moreover, the true differential is likely to be greater than that shown above because, other things being equal, one would expect the figure in Europe to be lower than that in Australia as the latter requires a greater amount of regenerator equipment because of the longer transmission links between TNS (see paragraph 2.4).

2.12 Given the difficulties associated with accurately benchmarking other countries, it is not possible to reach a definitive conclusion. However, the above analysis strongly suggests that the level of transmission equipment capital expenditure in the Analysys Model ought to be much higher than it is. At the very least, it indicates the need to understand and verify the transmission equipment cost estimates in the Analysys Model.

Modelling of Transmission Equipment Costs in the Analysys Model

3.1 The Analysys Model is complex and not always easy to follow. Although the associated documentation is quite detailed, its coverage of transmission equipment is less than complete. For example, the Model Documentation devotes less than nine lines to

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[4] https://www.cia.gov/library/publications/the-world-factbook/index.html

[5] Unlike the other countries, Country A had a substantial amount of PDH equipment, which is more expensive than SDH equipment.

DWDM equipment and does not inform the reader how costs are calculated.[6] Meanwhile, the User Guide only makes a cursory and non-exhaustive reference to how the required amount of DWDM equipment is calculated at the local access switch (LAS) level of the network hierarchy[7] and does not describe at all how it is calculated at the TNS level, although this is where the vast majority of DWDM equipment is to be found in the Analysys Model.

Example of Extended Long Haul Point to Point DWDM Systems

3.2 In order to examine further the Analysys Model's calculation of transmission equipment capital expenditure, I looked at the case of extended long haul point to point DWDM systems, which, as can be seen from Table 1, are the biggest item of transmission equipment expenditure, and traced the calculation through the numerous worksheets involved.

(i) Price of equipment

3.3 Starting with the unit price of equipment, I found that one price is quoted for a whole extended long haul point to point system.[8] There is no itemisation of the prices of the different constituent components of the system. In addition, the price is not taken from experience in Australia but is "based on benchmark data sources".[9] A further 15% is then added to cover installation costs, which are capitalised.[10]

3.4 This raises a variety of issues, the relevance of which extends beyond DWDM equipment:

- Since only one overall price is given for the relevant DWDM system, it is not possible to ascertain whether all the requisite equipment has been taken into account;
- The prices used also cannot be verified, as the source is not revealed. In addition, they may not be appropriate for use in Australia. Operators in different countries obtain different prices depending on their purchasing power and the market conditions at the time of purchase. Consequently benchmark prices may not be appropriate. A more reliable approach would have been to ascertain the prices paid for such equipment in Australia;
- The same 15% installation mark-up is used for all types of equipment. In reality, installation cost as a percentage of the purchase price is likely to vary considerably across

[6] Model Documentation pages 104-5

[7] User Guide, page 110

[8] Cell F184 in 'UnitCost.Core' in 'Core.xls'

[9] User Guide, page 153

[10] User Guide, page 153

different types of equipment. Using the same rate for all types of equipment is therefore likely to lead to distortions.

(ii) Volume of equipment

3.5 The calculation of the required number of extended long haul DWDM point to point systems consists of a number of steps which are briefly summarised below:

1. Attention is concentrated here on the network linking trunk network switches (TNS), since only this network has long enough transmission links to encompass extended long haul DWDM point to point systems. The amount of busy hour traffic originating at each TNS, which determines the required capacity of DWDM systems, is calculated based on the number of subscribers that are linked to the TNS.

2. The volume of busy hour erlangs of PSTN and ISDN traffic per subscriber is calculated in a standard way.[11] The input parameters include "Analysys Estimates" the source of which is not provided.[12]

3. All the traffic measures are converted into required numbers of E1 circuits using a standard methodology.[13]

4. In order to determine the destination of traffic from each TNS, a gravity model is used. In a gravity model it is assumed that the volume of traffic between each pair of TNS is positively related to the number of subscribers at the originating and terminating TNS and negatively related to the distance between the TNS.[14] The reason why distance between TNS is assumed to negatively affect the volume of calls is that less contact tends to occur between individuals or businesses the more remote they are from each other geographically. Gravity models are a recognised way of estimating the geographical pattern of telecommunications traffic. However, the results that they produce are sensitive to the precise parameters used to capture the relationship between the level of traffic and the number of subscribers at each of the TNS and the relationship between the volume of traffic and distance.

5. The parameters used in the Analysys Model are simple integers. This indicates that they have not been derived from Australian traffic data or indeed traffic data from any

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[11] For broadband traffic a similar calculation is made to obtain the required level of capacity per subscriber in Kbits per second.

[12] For example, cells H12 and H18 of 'In.Network' in Core.xls

[13] An E1 circuit has a capacity of 2 Mbit/sec

[14] A gravity model assumes that the volume of traffic (V_{ij}) flowing between two TNS (i and j) is given by $V_{ij} = k (S_i^{\alpha} \times S_j^{\beta}) \div D^{\gamma}$, where k is a constant and α, β and γ are parameters relating the volume of traffic to respectively S_i, the number of subscriber lines at TNS i, S_j, the number of subscriber lines at TNS j, and D, the distance between the two TNS.

other country, since studies that use econometric techniques to estimate gravity model parameters from traffic flow data do not produce whole number estimates of the parameters.[15] Moreover, although there is an option in the Analysys Model to use a value of 2 for the distance parameter (which would imply that the volume of traffic between two TNS is inversely proportional to the square of the distance between them), the value is actually set at zero, meaning that no account is taken of distance when determining traffic flows between TNS.[16] The traffic flows between TNS in the Analysys Model are therefore not likely to be correct and consequently the estimates of required volumes of transmission equipment are also likely to be inaccurate. In particular, by setting the value of the distance parameter at zero and thereby ignoring the negative effect of distance on traffic flows, the volume of traffic on longer routes is exaggerated and the volume on shorter routes understated, with consequent impacts on the volumes of different types of equipment required and hence the level of capital expenditure.

6. The Analysys Model then makes assumptions about the structure of rings in the network linking TNS and the traffic flows between different pairs of TNS are mapped on to the rings. Alternative structures are possible, as is acknowledged in the Analysys Model, where is stated that "changes may be made to the ring set up (i.e. to the traffic that is carried on the individual rings".[17] Changes in the structure may in turn affect the level of capital expenditure. Despite this, the choices made in the Analysys Model about the ring structure are not fully explained.

7. Once the traffic flows have been mapped on to the chosen ring structure, the level of demand for E1 circuits on each ring is determined. This is then turned into required numbers of STM-64 transmission units and thence the required number of DWDM systems. A standard approach is used to do this, although the threshold distance levels for different types of DWDM system (metro, long haul, extended long haul and ultra long-haul) are assumptions made in the Analysys Model that are not explained.

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[15] The Analysys Model assumes the values of α and β to both be exactly equal to 1 and that (when distance is taken into account) the value of γ is exactly equal to 2 (see rows 3 and 4 of 'In.TNS.Gravity' in 'Core.xls' and also Model Documentation, page 102). Studies that I am aware of where gravity model coefficients have been estimated based on a particular country do not result in parameters equal to exactly 1 and 2 respectively. Moreover, the value of γ tends to be in the vicinity of 1 and not 2. See Appendix C for references.

[16] All studies that I am aware of that involve estimating the parameters of a gravity model using telecommunications traffic flow information within a country show that distance has a negative impact on the volume of traffic. See Appendix C for references.

[17] See cell A254 in 'NwDes.4.Core.Nodes' in 'Core.xls'. This is similar to the situation with the LAS rings, where the composition of each ring is user defined and can be flexed to take account of changes in ring structure. The User Guide (page 108) also makes it clear that: "The current composition is based on Analysys's estimate as to an appropriate ring structure".

(iii) Conclusion on the modeling of transmission equipment capital expenditure

3.6 From the description of the process involved in determining the price and required volume of extended long haul DWDM systems in the Analysys Model (paragraphs 3.3 to 3.5 above), a number of conclusions can be drawn:

- The User Guide and Model Documentation say little about the derivation of capital expenditure associated with DWDM equipment;
- Only the prices of complete DWDM systems are provided. There is no breakdown of the overall price to enable a greater understanding of how it has been built up and to verify that all the relevant pieces of equipment have been taken into consideration;
- The prices used are based on unknown overseas benchmarks. No account is taken of circumstances in Australia and if and how these might differ from those in other countries. At the same time a uniform 15% installation charge is applied to all types of network equipment, even though in reality this is unlikely to be the case;
- The calculation of volumes relies on a variety of assumptions. While some of these are standard industry assumptions, the sources of others are not known. However, it appears that they are not related to experience in Australia;
- Not all the assumptions are explained or justified. In particular, no reason is given as to why it is appropriate to use a gravity model to estimate the geographical pattern of traffic but then to ignore distance, which is a key element of a gravity model;
- In addition, the choices made in the Analysys Model about ring structure are not explained.

3.7 As a result there is insufficient information in the Analysys Model to enable the estimate of capital expenditure on extended haul point to point DWDM systems to be understood and properly verified. In the case of other types of DWDM systems deployed in the network between TNS, exactly the same conclusion applies, since the treatment of prices is identical and volumes are calculated in exactly the same way apart from the fact that different distance thresholds apply.

3.8 To varying extents the same conclusions apply to other types of transmission equipment. For example:

- The prices used in the Analysys Model for all types of transmission equipment cannot be verified and may not be appropriate to Australia;

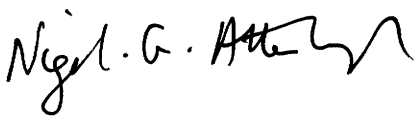
- The same 15% installation cost uplift is applied to all types of equipment. In reality installation costs are likely to vary as a percentage of the purchase price depending on the type of equipment concerned;

- The number of add-drop multiplexers on transmission rings linking TNS is determined by the traffic flows between different TNS and by the assumed structure of the rings. The problems with the application of the gravity model (paragraph 3.5, sub-paragraph 5) and the lack of a full explanation of the choice of ring structure (paragraph 3.5, sub-paragraph 6) are therefore relevant;

- For the network linking LAS, the choice of ring structures in the Analysys Model is again not fully explained. It is stated in the Model Documentation that: "The present ring structures are based on Analysys's interpretation of an efficient manner in which to link together the LAS nodes".[18] However, what underlies Analysys's interpretation is not made clear. Other possibilities are not examined in the Analysys Model. The choice of ring structure is important as it determines the amount of add-drop multiplexing equipment that is required in the network linking the LAS and hence the related capital expenditure.

3.9 From this it can be seen that there are uncertainties relating to the capital expenditure estimates for all types of transmission equipment in the Analysys Model and consequently it is not possible to verify them. Because these estimates cannot be verified and the international benchmarking strongly suggests that they are too low, in my opinion they do not provide a reliable estimate of the required level of capital expenditure on transmission equipment if Telstra were to build today an efficient inter-exchange network (IEN).

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance that I regard as relevant have, to my knowledge, been withheld from the Commission.



[18] Model Documentation, page 94.

Appendix A. Instructions from Gilbert + Tobin

Partner Peter Waters
Our ref 1007977

GILBERT TOBIN
LAWYERS

6 November 2009

By email nigel.attenborough@nera.com

Nigel Attenborough
NERA Economic Consulting
15 Stratford Place
London WIC 1BE

Gilbert + Tobin
2 Park Street
Sydney NSW 2000
Australia
GPO Box 3810
Sydney NSW 2001
T +61 2 9263 4000
F +61 2 9263 4111
DX 10348 SSE
www.gtlaw.com.au

Dear Nigel

ACCC Review of Fixed Line Wholesale Services Pricing 2009 to 2012

Background

We refer to the above matter and our letter of instructions to you dated 1 October 2009 engaging you on behalf of Telstra to prepare an expert report. As you are aware, your expert reported dated October 2009 was submitted to the ACCC in support of Telstra's submission on the Draft Pricing Principles and Indicative Prices.

We confirm that we wish to engage you on behalf of Telstra to prepare an additional expert report setting out your opinion on a number of questions regarding version 2 of the model developed by Analysys Mason on behalf of the ACCC (the **Analysys Model**). The specific questions are set out below.

Instructions

Your expert report should address the following questions:

1 Does the Analysys Model provide a reliable estimate of the required level of capital expenditure on transmission equipment if Telstra were to build today an efficient inter-exchange network (**IEN**)?

2 Is the Analysys Model's estimate of transmission equipment capital expenditure reasonable having regard to other international benchmarks?

3 Is the approach adopted in the Analysys Model in deriving the estimate of transmission equipment capital expenditure reasonable?

Contents of Report

In the preparation of your report you should:

(a) have regard to the *Guidelines to Expert Witnesses for Proceedings in the Federal Court of Australia* (Expert Guidelines) and expressly confirm in your report that you have read those guidelines and that you agree to be bound by them (see enclosed Expert Guidelines);

(b) include a detailed *curriculum vitae* setting out full details of all of your relevant qualifications, expertise and experience;

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(c) include a statement of the questions that you have been asked to address;

(d) set out a list of all documents you have relied on in the preparation of your report;

(e) expressly state all assumptions you have made in preparing your report and the reasons for making those assumptions; and

(f) set out the reasons for each opinion expressed in the report.

Yours faithfully
Gilbert + Tobin

Peter Waters
T 61 2 9263 4233
pwaters@gtlaw.com.au

Appendix B. Curriculum Vitae

Nigel Attenborough

Director

NERA Economic Consulting
15 Stratford Place
London W1C 1BE
Tel: +44 20 7659 8514
Fax: +44 20 7659 8515
E-mail: nigel.attenborough@nera.com
Website: www.nera.com

Overview

Nigel Attenborough has a BA in Economics from Cambridge University, an MSc in Energy Economics with Distinction from the University of Surrey and an MBA from Kingston Business School, where he won the BPP prize.

Since joining NERA in 1991, Nigel has undertaken and directed a wide range of projects for telecommunications companies, regulatory authorities and government departments in Europe, Africa, Asia, Australasia and South America. These have involved a whole variety of topics including market definition and the analysis of competition, the impact of liberalisation, regulation of NGNs, assessment of different regulatory regimes, development of regulatory strategy, pricing strategy, the setting of price caps, tariff rebalancing, price discrimination and price squeezes, universal service, number portability and allocation and spectrum management and allocation. He also has extensive experience of the construction of LRIC models of interconnection costs, cost allocation, accounting separation, efficiency comparisons, benchmarking studies, licence valuations, demand forecasting and financial and price cap modelling, cost benefit analyses and economic impact studies.

Nigel has also testified as an expert witness on: the valuation of BT for the purposes of setting business taxes; the setting of mobile termination rates in Australia; two cases involving the estimation of damages in relation to the delayed start up of and restricted access to submarine cables; the estimation of damages relating to breach of a telecommunications revenue sharing contract in Poland; the estimation of damages resulting from the loss of a mobile telecoms licence in a middle eastern country; and the existence of a price squeeze and the related damages in a case involving mobile phone operators in Belgium.

Prior to joining NERA in 1991, Nigel worked for 5 years at BT, latterly as the head of regulatory economics and competition policy. He provided directors and senior managers with advice and analyses on economic issues relating to regulation and pricing, and also managed teams responsible for policy development and analysis of fair trading and competition issues and for dealings with Oftel on matters relating to financial regulation. Earlier he was an economic adviser to the Department of trade and Industry and to the Monopolies and Mergers Commission.

Qualifications

1988-90	**KINGSTON BUSINESS SCHOOL**
	MBA: Winner of BPP prize
1980-83	**UNIVERSITY OF SURREY**
	MSc in Energy Economics: Pass with Distinction
1968-71	**TRINITY COLLEGE, CAMBRIDGE**
	B.A. Economics

Career Details

Time working in telecommunications industry: 23 years

Time working as telecommunications consultant: 18 years

1997 - present	**NERA ECONOMIC CONSULTING, LONDON**
	Director of NERA and Head of NERA's European Telecommunications Practice
1994	Associate Director
1991	Senior Consultant
1990	**BRITISH TELECOM**
	Manager, Economics and Fair Trading
1988	Manager, Pricing and Regulatory Analysis
1986	Economist/Senior Commercial Analyst
1981	**DTI**
	Economic Adviser
1978	**DUNLOP LTD**
	Corporate Planning Department (secondment)
1976	**MONOPOLIES AND MERGERS COMMISSION (secondment)**
	Senior Economic Assistant/Economic Adviser
1972	**DTI**
	Economic/Senior Economic Assistant
1971	**ARTHUR YOUNG**
	Articled Clerk

Project Experience

Expert witness

- Expert report on Telstra's model of the cost of its local loop infrastructure with particular reference to the cost of providing unbundled local loops (2009);
- Expert evidence in a case where Belgacom, the largest Belgian mobile operator, is being sued by the other operators for implementing a price squeeze and depriving them of customers. The case involves assessing whether there has been a price squeeze and, if so, what is the value of damages (2008-9);
- Expert evidence in an Austrian arbitration case while involves estimation of damages resulting from breach of a revenue sharing contract relating to the Polish long distance telecommunications backbone (2008-9);
- Expert evidence in a case involving the estimation of damages resulting from the loss of a mobile telecommunications licence (2007-8);
- Expert evidence in ICC arbitration case regarding the value of damages suffered by FLAG as a result of being prevented from accessing VSNL's submarine cable landing station in Mumbai (2006-7);
- Expert evidence in connection with AJC's claim for losses to be recovered from its insurance policy as a result of delay to the launch of its submarine cable that resulted from accidental damage (2005-6);
- Expert evidence in connection with judicial review of the ACCC's decision regarding the appropriate mobile termination rate in Australia. Evidence covered how costs should be derived and prices set (2004-5);
- Expert evidence to the Lands Tribunal on behalf of Valuation Office Agency (UK) which, among other things, involved constructing a detailed future cash flow model for BT, as part of producing a rating valuation for BT (1999-2000);
- Appearance before Monopolies and Mergers Commission on behalf of T-Mobile (1998);
- Presentation of T-Mobile's case to Ofcom during an investigation into unfair cross subsidisation (1998);
- Expert evidence on damages caused by the failure of equipment used by an international reseller (1997).

Costing studies

- Construction of mobile operator LRIC models for MOC, the Israel regulator (2009)
- Review and assessment of Telstra's cost model for unbundled local loop services (2008);
- Assessment of BT Openreach's relative efficiency using econometric techniques for Ofcom (2007);
- Construction of LRIC cost model for mobile operator in Pakistan. Results of modelling are to form part of submission to regulatory authority (2007);

- Review and critique of the regulatory authority's mobile LRIC model for Netcom, the Norwegian mobile operator (2006 and 2007);
- Development of methodology for top-down LRIC model for an Italian mobile operator and advice on its implementation (2006 and 2007);
- Construction of bottom-up fixed network and mobile network LRIC models for the Oman telecommunications regulator (2006);
- Development of bottom-up mobile LRIC model for an Italian mobile operator (2005/6);
- Construction of bottom-up fixed network and mobile network LRIC models for the Malaysian communications regulator, MCMC (2005);
- Review of mobile bottom-up LRIC model built for the Romanian telecommunications regulator, on behalf of Orange Romania (2005/6);
- Comparative efficiency assessment of KPN, for the Dutch regulator, OPTA (2005)
- Review of a fully allocated cost model developed by a Israeli mobile operator to estimate its costs of different types of mobile call (including interconnection traffic) and development of top-down LRIC model to estimate mobile termination costs (2004);
- Comparative efficiency assessment of BT's fixed network services, for Ofcom (2004);
- For Korea Telecom, development of bottom-up LRIC model of its access network in a representative sample of areas in order to measure universal service costs (2004);
- Advice to the Chinese Academy of Science on how to construct top down and bottom up LRIC models of the costs of terminating calls on fixed and mobile networks (2003);
- Assessment of the efficiency of NTT West and NTT East for MPHPT, the Japanese Ministry of Communications, (2003);
- Support and assistance to a major European communications operator in its development of a top-down LRIC access cost model (2003);
- For KTF, the Korean mobile operator, the construction of a large LRIC interconnection model for 2G and 3G services (2002);
- Updates of the bottom-up LRIC model of KPN's network costs for OPTA, the Dutch telecoms regulator (2002 and 2003);
- Assessment of comparative cost efficiency for a large European telecommunications operator (2002);
- Assessment and advice on redevelopment of a cost allocation model for a major European cable TV operator (2002);
- Developing a model of the impact of a cost based wholesale access product in the UK for Centrica Telecommunications (2002);
- Validation of costs underlying Eircom's reference interconnection offer for ODTR, the Irish telecoms regulator (2001);
- Construction of bottom-up LRIC models for fixed and mobile networks for CMC, the Communications Commission in Malaysia (2001);

- Construction of a new bottom-up LRIC model of KPN's network, for OPTA, the Dutch regulatory authority (2001);
- Advice to the Irish regulator (ODTR) on the reconciliation of the results of bottom-up and top-down models for the incumbent's costs (2001);
- Construction of unbundled local loop cost model of Deutsche Telekom, for Mannesmann (2000);
- Review of Telecom Italia's estimate of its unbundled local loop charges and its access deficit, for the Italian Telecommunications Authority (2000);
- Advice to the Italian Telecommunications Authority on the definition of an accounting system based on current costs (2000);
- Construction of a bottom-up LRIC model of Eircom's network, for ODTR, the Irish regulatory authority (2000);
- Construction of a bottom-up LRIC model of Swisscom's network, for Bakom, the Swiss regulatory authority (1999);
- Estimate of the costs of different elements of Eircell's GSM network, for Esat Digifone, the Irish mobile telephone operator (1999);
- Interconnection cost study, involving the construction of a bottom-up LRIC model, the review of a top-down embedded direct cost model and the reconciliation of the results, for OPTA, the Dutch regulator (1998 and 1999);
- Estimation, using a hybrid bottom-up and top-down methodology, of LRIC for network and retail services, for Singapore Telecom (1997);
- Construction of a bottom-up model of Telstra's call conveyance and access networks, for the Australian Competition and Consumer Commission (1998 and 1999);
- Estimation of LRIC of France Telecom's conveyance and access networks, for a group of new entrants in France (1998);
- Advice on bottom-up modelling of interconnection costs for NTT in Japan (1999);
- Estimation of the fully allocated, historic costs of terminating calls on Vodafone and Cellnet's mobile networks, for a UK new entrant fixed network operator (1996);
- For O.tel.O, estimation of LRIC for Deutsche Telecom's network Services using a bottom-up model (1997);
- Advice to OFTEL on the methodology and development of bottom-up and top-down models of BT's access and call conveyance network, and reconciliation of the results of the two different approaches (1996 and 1997);
- Estimation of the costs of interconnection and individual services for a regional UK operator and advice on accounting separation and cost allocation (1994);
- Estimating individual service costs for Telefónica in Spain and for the Ministry of Economics in Argentina (1995);
- Modelling the costs of two UK new entrants (1995 and 1996);

- Modelling interconnection and universal service obligation costs for a major European operator (1995);
- Defining and estimating long run incremental costs in the UK (for retail services and for interconnection) using top-down and bottom-up methodologies for Oftel, the UK regulator (1992);
- Modelling the costs of different means of accessing telephone customers, for a UK operator (1995);
- Study of the costs of different mobile telecommunications networks for an Australian operator and, more recently, for a UK operator (1993);
- Study, for a major UK utility, of the costs of outsourcing its telecommunications requirements (1994).

Regulation

- Advice to Ofcom on the possible bases for capacity charging for interconnection to a next generation network (2008);
- Literature review and econometric analysis for Zain as to whether there is a point beyond which the entry of additional mobile operators into a market can have an adverse effect on consumers and the economy (2008);
- Assistance to Belgacom Mobile in abuse of dominance case brought by the Belgian competition authority (2008);
- Development of new licensing regime in UAE, for the Telecommunications Regulatory Authority (2007);
- Assessment of the case for licensing MVNOs in Israel and the need for mandated access terms if such licensing occurred, for the Minstry of Communications (2007);
- Advice and analysis for a Norwegian mobile operator on the basis for setting mobile termination charges and support to them in their negotiations with the Norwegian regulatory authority (2006 and 2007);
- Study for Vodafone on the rationale for and development of a model (using econometric estimates of price elasticities) to estimate the value of a network externality surcharge on interconnection charges in African countries (2006 and 2007)
- Advice to Wind in Italy on a variety of regulatory issues including bundling, issues raised by next generation networks, fixed and mobile interconnection charges, cost modelling and accounting separation (2006 and 2007);
- Advice to T-Mobile in Hungary on the development of MVNOs in Europe, the factors leading to success or failure, when regulation is necessary, the circumstances under which access terms should be mandated and the current circumstances in Hungary and their implications for MVNO development (2006);
- Report setting out the arguments relating to deregulation of broadband services and estimation of the potential benefits from doing so in four European countries using detailed input-output analysis, for a major European operator (2005/6);

- Report for UK mobile operator on the impact of national roaming, to support a submission to the regulator, Ofcom (2004);
- Advice and analysis for BT in assessing Ofcom's proposals for a modified price squeeze test for broadband services (2004);
- Market definition and assessment of competition in all the main communications markets in Malaysia for MCMC, the Malaysian regulatory authority (2004);
- Various studies for Ofcom, the UK regulator, including:
  - construction of model of BT's OSIS costs (2006);
  - identification of possible new uses for certain parts of the radio spectrum and assessment of the respective costs and benefits, in consortium with Red-M, Cardiff University, Roke Manor and BAE (2005/6);
  - estimation of the costs and benefits of allocating particular parts of the radio spectrum to different uses (2004);
  - assessment of the comparative efficiency of BT's network business (2004);
  - assessment of the comparative efficiency of Kingston Communications (2003);
  - construction of a model for assessing the potential profitability of firms renting exchange lines from BT (2003);
  - assessment of the profitability and efficiency of the UK mobile operators (2001);
  - assessment of the efficiency of BT (2000);
  - cost-benefit analyses of the introduction of number portability and equal access into the UK (1993 and 1995);
  - an analysis of BT's incremental costs and, more recently, a separate series of studies looking at existing models for measuring incremental costs of access and call conveyance and how their results can be reconciled (1992, 1996 and 1997);
  - evaluation of telecommunications provision in Wales and its impact on economic development (1992);
  - analysis of the UK and North American markets for resale (1994);
- Advice and analysis for NTT DoCoMo on regulation of mobile telecommunications and, in particular, the level of call termination charges (2003);
- Advice to the Rwanda government on various aspects of the liberalisation of Rwandatel (2003);
- Study for the World Bank of the comparative effectiveness of regulation in different African countries and the implications for future policy (2003);
- Advice and recommendations to CMC in Malaysia on the scale and possible methods of funding the losses made on line and local call services (2002);

- Advice to ComReg, the Irish regulator, on market definition and assessment of dominance in the context of determining which retail services should be subject to price cap regulation (2002);
- Development of a performance contract with the incumbent operator to address the unmet demand and extend the network for the Egyptian Telecommunications Authority (2000);
- Estimation of Telefonica's universal service obligation costs (2000);
- Advice and recommendations to MCMC in Malaysia on the provision of universal service and the measurement and funding of the costs involved (2000);
- Review of Telecom Italia's estimate of its universal service obligation costs, for the Italian Telecommunications Authority (1999, 2000 and 2001);
- Advice on radio spectrum policy in France for the Ministry of Industry (1999);
- Arguments for and against the introduction of mobile number portability and carrier selection and their application in 8 European countries, for Vodafone Airtouch (1999);
- Advice on the regulatory framework and priorities that should apply given the privatisation of the Bahamas Telecommunications Corporation (1998);
- Assistance to Botswana Telecommunications Authority in the development of a performance contract with BTC, and development of regulatory principles and guidelines for telecommunications prices (1998); A cost-benefit analysis of the introduction of mobile network number portability in Hong Kong, for OFTA (1998);
- Advice to Botswana Telecommunications Authority on the development of a strategy to enable it to meet its mandate (mission statement, organisational structure, staff qualifications, outsourcing needs, funding strategy) (1998-99);
- For DG XIII of the European Commission, study of the regulatory and legal issues associated with the creation of a regulatory authority at the level of the European Union (1997);
- Advice on development of costing system and price setting for OSIPTEL, the Peruvian regulatory authority (1996 and 1997);
- For DG XIII of the European Commission, study examining the implementation and impact of the Open Network Provision (ONP) in Member States (1996);
- Advice and recommendations to the Argentine Ministry of Economics on institutional restructuring of telecommunications regulation (1995);
- A study of the implications of EU telecommunications regulation for a major broadcasting company (1995);
- For a French mobile telecommunications operator, a comparative study of the regulation of fixed wireless local loop services in different countries (1996);
- Advice and analysis for CWC in formulating its strategy in the face of different possible future regulatory scenarios (1998);

- Advice on who should pay what for the costs of number portability, for Oftel in the UK and Optus in Australia (1996).

Liberalisation

- Literature review and econometric analysis for Zain as to whether there is a point beyond which the entry of additional mobile operators into a market can have an adverse effect on consumers and the economy (2008);
- Assessment of the interconnection and retail service costs and access deficit of Batelco, the Bahamas telephone company, and their implications, as part of the preparation for future privatisation and liberalisation (2003);
- Advice to the Algerian Ministry of Telecommunications on the introduction of competition in the mobile market via the award of a second GSM licence (2001);
- Analysis of the development of competition in the mobile market and the implications for regulation for the Greek regulatory authority (2000); For Vodafone Airtouch, an assessment of the state of mobile telephone competition in 8 European countries (1999);
- Analysis of the Greek mobile telecommunications market, including analysis of the state of competition and the development of a model to facilitate international mobile tariff comparisons, for EETT, the Greek telecommunications regulator (1999);
- Advice and analysis relating to feasible liberalisation options given the privatisation of the Bahamas Telecommunications Corporation (1998);
- Development of a framework for assessing whether a market is competitive, for regulatory purposes, for a group of new entrants in the UK (1996);
- Modelling the impact of various EU liberalisation measures on Portugal Telecom and examining the effectiveness of a number of alternative strategic responses (1996);
- Advice to Energis on its response to the DTI's consultative document on the liberalisation of UK international telecommunications services (1996);
- Forecasting the development of the UK telecommunications market and the share of different operators for a group of new UK operators (1995);
- Analysing and modelling the potential impact of liberalisation, and the sustainability of existing tariff structures in a competitive environment for Telefónica de España (1993).

Interconnection (for costing studies – see previous section)

- Advice to Ofcom on the possible bases for capacity charging for interconnection to a next generation network (2008);
- Assessment of interconnection cost benchmarking carried out by the NZ Commerce Commission on behalf of Vodafone NZ (2005/6);
- Review of fully allocated current cost mobile network cost model, used for estimating call termination charges, for an Italian operator (2005);
- Expert witness in judicial review of ACCC's decision on mobile termination charges (2004 and 2005);

- Report for UK mobile operator on impact of national roaming, to support a submission to the regulator, Ofcom (2004);
- Review of mobile network cost model, used for estimating call termination charges, for an Italian operator (2004);
- Advice and analysis for NTT DoCoMo on regulation of mobile telecommunications and, in particular, the level of call termination charges (2003);
- Provided advice to the Chinese Academy of Sciences on bottom-up and top-down LRIC cost modelling for fixed and mobile networks (2003);
- Advice on the desirability and feasibility of multiple year price controls for interconnection services and interconnecting leased lines for OPTA, the Dutch regulator (2002);
- Advice on the feasibility and design of a local interconnection roll out policy for OPTA, the Dutch regulator (2002);
- Advice and support to OFTEL in connection with the UK Competition Commission inquiry into charges for calls to mobile phones (2002);
- Advised Telefonica Centroamerica (in Guatemala) in a conflict with the fixed operator about fixed and mobile termination rates. The main focus was the issues affecting the cost of termination on fixed and mobile networks and the implications (2002) for interconnection charges;
- Advice to the Malta Communications Authority on the development of a strategy relating to the implementation of cost based accounting systems in the telecommunications sector (fixed and mobile) (2001);
- Analysis of existing LRIC cost models in Germany, for Mannesmann (2000);
- Regular advice on interconnection charges and cost accounting systems, for a variety of entrants in the UK, including CWC, Scottish Telecom, Worldcom, AT&T and Energis (1991-2001);
- Advice to One2One (now T-Mobile UK) in connection with the MMC inquiry into the price of calls to mobile phones (1998);
- Advice to Esat Digifone on the costs of interconnection, including benchmarking the price of terminating fixed calls on mobile networks and vice versa (1998);
- Advice to Telefonica on how its interconnection costs might be expected to differ from those specified in the benchmarks issued by the European Commission (1998);
- Advice to TeleDanmark on how its interconnection costs might be expected to differ from those of BT (1998);
- Study of the implications of a possible new interconnection charging regime for a regional UK operator (1998);
- Analysis, for Portugal Telecom, of the structure and level of interconnection charges, and the method by which they are set, in 14 European and non-European countries (1996);

- Study of the economic impact of a change in the UK system for determining international interconnection charges, for a new UK operator (1995);
- Advice to a major Asian telecommunications operator on number portability, interconnection and access deficit charges and universal service issues (1995);
- An assessment for Telecom Eireann of different interconnection charging options (1993);
- Helping a new UK operator to negotiate its terms and conditions of interconnection (1992).

Pricing

- Advice to Ofcom on the possible bases for capacity charging for interconnection to a next generation network (2008);
- Advice and analysis for Vodafone in Germany on the setting of mobile termination rates and the underlying costs (2006);
- Support for UPC in justifying its analogue cable TV tariffs to the Dutch Competition Authority (NMa) (2005);
- Development of interconnection price benchmarking system which takes operator and country differences into account for two German mobile operators (2005);
- Development of financial model for setting price cap for SingTel fixed network services, for IDA, the Singapore regulator (2004);
- Assistance to UPC in the construction of a cost model and the use of its output to justify its prices for analogue cable TV services (2003 and 2004);
- Construction of detailed financial models of NTT West and NTT East for the purpose of setting price caps for switched services and leased lines for MPHPT, the Japanese Ministry of Communications (2003);
- Examination of the possible extent of local tariff rebalancing and its implications, for MCMC the Malaysian regulatory authority (2002);
- Advice on the desirability and feasibility of multiple year price controls for interconnection services for OPTA, the Dutch regulator (2002);
- Market analysis, efficiency assessment, construction of a financial model and economic advice to ODTR, the Irish regulator, as part of the setting of a new retail price cap (2002);
- Advice to a European regulator on the development of pricing structures for voice and Internet traffic, and the impact of pricing on competition (2001);
- Construction of a model and forecasts of the revenue, cost and capital expenditure of KPN to estimate the appropriate value of X in the price cap formula for retail telephone service prices, for OPTA, the Dutch telephone regulator (1999);
- Construction of a UK mobile price index for OFTEL, the UK telecommunications operator (1999);
- Advice to Telecom Italia about the acceptability and justification of volume discounts (1999);

- Advice on feasible tariff rebalancing and price controls in Botswana for the Telecommunications Authority (1999);
- Examination of the impact of liberalisation of international telecommunications services in the Bahamas and the extent of rebalancing required to maintain the viability of Batelco, as part of a pre-privatisation study for the Government of the Bahamas (1998);
- Advice on the impact and effectiveness of price regulation in the UK and US, for NTT in Japan (1997);
- Advice on pricing strategy to Orange (1997);
- Analysis of telephone tariffs in Argentina and recommendations regarding future rebalancing options to Ministry of Economics (1995);
- The development of a pricing strategy model for CWC (1994);
- Development of business planning models for several new UK operators (1994-1997);
- Advice to NTL on a wide range of regulatory issues including its price cap review (1991-1996);
- At various times, advice, analysis and modelling work relating to the review of BT's price cap, for Mercury, the cable TV operators and a number of regional new entrants (1992 and 1996);
- Analysis for and advice to Telefonica on the arguments for and benefits of tariff rebalancing (1993);
- Study of the economic impact (including economic efficiency and welfare implications) of a tariff rebalancing programme by Telecom Eireann (1993);
- Assessment of the possible existence of predatory pricing and cross-subsidisation in the leased lines market, for a UK new entrant (1991);
- Assessment of transfer pricing issues and pricing policy for Royal Mail (1991).

Mobile telecommunications (for costing studies – see above)

- Literature review and econometric analysis for Zain as to whether there is a point beyond which the entry of additional mobile operators into a market can have an adverse effect on consumers and the economy (2008);
- Development of demand models for mobile communications in South Africa and their application to assess the size of network externalities (2006/7);
- Estimation of price elasticities of mobile services for a group of European mobile operators (2005);
- Report for UK mobile operator on impact of national roaming, to support a submission to the regulator, Ofcom (2004);
- Advice and analysis for NTT DoCoMo on regulation of mobile telecommunications and, in particular, the level of call termination charges (2003);

- Construction of a LRIC interconnection model for use in Korea to determine the costs to be charged by KTF for the mobile market (2002);
- Advice to KTF on strategic issues (2002);
- In a consortium with BNP Paribas, NERA was selected to advise the Algerian Ministry of Communications on the allocation of a 2G license in Algeria. NERA also provided advice on the valuation of the spectrum (2001);
- Advice as part of a 'due diligence' exercise for PwC India (2001) on behalf of ICICI, who needed to evaluate the potential for funding SCL's (the cellular mobile telephone services provider) expansion and refinancing plans;
- Advice to Ben, a Dutch mobile operator, on the level of call mobile termination charges (2001);
- Construction of bottom-up LRIC models for GSM 900 and GSM 1800 mobile networks for CMC, the Communications Commission in Malaysia (2001);
- Assessment of the economic impact of the UK mobile market for the MTAG (mobile telecommunications advisory group) (2000);
- Analysis and advice to a European operator on the introduction of mobile communications in a subterranean rail network (2000);
- Advice to the Italian Ministry of Communications on the procedures and design of the 3G auction (2000);
- For Vodafone Airtouch, an assessment of the state of mobile telephone competition in 8 European countries (1999);
- Construction of a UK mobile price index, for OFTEL, the UK telecommunications regulator (1999);
- Arguments for and against the introduction of mobile number portability and carrier selection and their application in 8 European countries, for Vodafone Airtouch (1999);
- Analysis of the Greek mobile telecommunications market, including analysis of the state of competition and the development of a model to facilitate international mobile tariff comparisons, for EETT, the Greek telecommunications regulator (1999);
- Advice to One 2 One in connection with the MMC inquiry into the price of calls to mobile phones (1998);
- Advice to Esat Digifone on the costs of interconnection, including international benchmarking of the price of terminating fixed calls on mobile networks and vice versa (1998);
- A cost-benefit analysis of the introduction of mobile network number portability in Hong Kong, for OFTA, the telecommunications regulatory authority (1998);
- Advice on pricing strategy to Orange (1997);
- Estimation of the fully allocated, historic costs of terminating calls on Vodafone and Cellnet's mobile networks, for a UK new entrant fixed network operator (1996);

- Study of the costs of different mobile telecommunications networks for an Australian operator (1993).

Licence applications

- Construction of valuation model (using DCF model of detailed revenue and cost projections based on network roll out plan) for 2nd mobile licence in Algeria for the Algerian Ministry of Communications (2001);
- Development of UPC's business plan in support of its participation in the auction for LMDS licences in Switzerland (2000).
- Advice and inputs into the business and investment plans of Bouygues Telecom, and estimate of the impact on employment and GDP, when it bid for and won the third GSM licence in France (1994);
- Advice and inputs into the business and investment plans of Airtel, and estimate of the impact on employment and GDP, when it bid for and won the second GSM licence in Spain (1995).

Other projects relating to business plans and forecasting

- Forecasting BT's future cash flows for the purposes of determining BT's value for rating purposes, for VOA (2008-9)
- Expert evidence in a case involving the estimation of damages resulting from the loss of a mobile telecommunications licence (2007-8);
- Advice and analysis for VOA in connection with the state aid investigation mounted by the European Commission in connection with the way that the rating assessment of BT had been carried out (2006);
- Expert witness for insurance company regarding assessment of damages relating to delay in completion of trans-oceanic submarine cable (2004);
- Construction of a model and forecasts of the revenue, cost and capital expenditure of KPN to estimate the appropriate value of X in the price cap formula for retail telephone service prices, for OPTA, the Dutch telephone regulator (1999);
- Estimation of employment effects for TIW in respect of its bids for mobile telecommunications licences in Romania, Hungary and the Czech Republic (1997 and 1999);
- Expert assessment of a damages claim relating to the losses incurred by a telecommunications reseller as a result of the failure of its switching equipment (1997);
- Estimation of the impact on employment of liberalising postal services in the UK and France, for UPS (1996).
- Modelling the impact of various EU liberalisation measures on Portugal Telecom and examining the effectiveness of a number of alternative strategic responses (1996);
- Forecasting the development of the UK telecommunications market and the share of different operators for a group of new UK operators (1995); Designing an investment appraisal system for Slovak Telecom and SPT Prague (1995);

- Assistance to Torch Telecommunications in constructing its business plan (1994);
- Estimation of employment effects and advice and analysis in respect of business and investment plans and for the consortia which won the PCN licence in France and the second GSM licence in Spain (1994 and 1995);
- Analysing and modelling the potential impact of liberalisation, and the sustainability of existing tariff structures in a competitive environment for Telefónica de España (1993).

Publications

"Money, Oil and the Sterling Roller-Coaster: An Examination of the Causes of Recent Exchange Rate Changes", MSc Dissertation, *University of Survey*, 1983.

"Employment and Technical Change: The Case of Microelectronic-Based Production Technologies in UK Manufacturing Industry", *Government Economic Service Working Paper* No.74, Department of Trade and Industry, London, 1984.

"Government Regulation and the Development of Public Terrestrial Mobile Communications", MBA Dissertation, *Kingston Business School*, May 1990.

"Economic Effects of Telephone Price Changes in the UK", with Robin Foster and Jonathan Sandbach, *NERA Topics No. 8,* London, September 1992.

"Regulation of Competitive Telecommunications Markets", *NERA Topics No 12*, London, September 1993.

"Pricing and the Development of Competition in UK Telecommunications", published by *Datapro International*, April 1994.

"Measurement and Funding of USO Costs: Some Brief Concluding Thoughts" in "USO in a Competitive Telecoms Environment", *Analysys Publications*, February 1995.

"Are Three to Two Mergers in a Market with Entry Barriers Necessarily Problematic?" with Fernando Jimenez and Gregory Leonard, *European Competition Law Review*, October 2007.

Presentations

"Privatisation and Competition: The Impact on BT", paper Presented to *CPC Conference*, Amersham, May 1991.

"What do Users want from the Regulators", Paper presented *to Networked Economy Conference*, Paris, March 1992.

"Local Loop Competition: The Key Regulatory Issues", paper presented *to 5th Economist Telecommunications Conference*, Vienna, September 1993.

"Pricing and the Development of Competition in UK Telecommunications", paper presented to *AIC Conference on Regulation and Infrastructure*, London, December 1993.

"How should Interconnection Charges be Set?", paper presented to *IIR Conference on Negotiating Interconnection Agreements*, London, April 1994, and also October 1994.

"Regulation and the Development of Competitive City Telecommunications", *AIC Conference on City Telecoms Networks*, London, October 1994.

"Measurement and Funding of USO Costs: Some Brief Concluding Thoughts", paper presented to a *Symposium on USO in a Competitive Telecoms Environment*, Magdalene College, Cambridge, December 1994.

"Telecommunications Liberalisation in the UK", paper presented to *IBC Conference on Competition in Asia's Telecom Markets*, Hong Kong, June 1995.

"Economic and Accounting Issues Relating to Interconnection Charges", paper presented to *IBC Interconnection Conference*, London, September 1995.

"Analysis of Proposed EC Interconnection Directive", paper presented *to IIR Cable Telephony Conference*, London, January 1996.

"Using Incremental Costs for Interconnection Charging" paper presented to IIR Interconnection '96 Conference, London, January 1996.

"Funding of Universal Service and Local Access Costs in the UK", *Vision in Business Conference on Costing and Accounting of Interconnection*, London, January 1996.

"Establishing a Regulatory Regime that Promotes Fair Competition", *IIR Conference on Telecoms Regulation*, London, April 1996.

"Liberalisation and Competition in International Services", *AIC Conference on International Telecoms Pricing and Facilities*, London, October 1996.

"Interconnection Charges: Where have we Come from and Where are we Going?", SMi *Conference on Practical Strategies for the Negotiation of UK and European Interconnection Charges*, London, October 1996.

"Economic Aspects of Interconnection Agreements", *AIC Seminar on Interconnection Agreements*, Frankfurt, October 1996.

"Employment Impact of Postal Services Liberalisation", *Satisfying Consumer Needs in the Global Village: The Postal Challenge*, Global Panel, The Hague, December 1996.

"Setting Interconnection Charges: An Evaluation of the Alternatives", *IIR Interconnection '97 Conference,* London, February 1997.

"Impact of Regulation on Profitability of Telecommunications Investments: The Case of Cable Television Networks", *Aspectos Juridicos de Las Telecomunicaciones,* Instituto de Fomento Empresarial, Madrid, March 1997.

"Long-run Incremental Cost and its Use for Setting Interconnection Charges", *Vision in Business Workshop,* Brussels, March 1997.

"Measurement of Universal Service Costs in Telecommunications", *Centre for Asia Telecoms Conference on Cost Allocation in Telecoms,* Singapore, April 1997.

"Current developments in Interconnection charging" *SMi Conference on Practical Strategies for the Negotiation of UK and European Interconnection Charges,* London, April 1997.

"How Should Interconnection Costs be Measured? *Vision in Business 4th International Interconnect Forum,* Brussels, September 1997.

"The Structure of Reform in Telecommunications Interconnection across Europe", *SMi Conference on UK and European Interconnection Charges,* Brussels, November 1997.

"International Interconnection Rates and Costs", *IBC 1997 International Forum on Interconnection,* Amsterdam, November 1997.

"Evaluation of Different Methods of Determining Costs and Setting Interconnection Charges", *IIR Interconnection Conference,* London, January 1998.

"Measurement of Interconnection Costs and Setting Interconnection Charges", *Institute of Telecommunications*, Warsaw, June 1998.

"Why Use Long-Run Incremental Costs?", *IIR Conference on Allocating Costs in the Telecommunications Industry*, London, July 1998.

"Regulation and Number Portability", *IIR Conference on Developing Effective Regulatory Strategies for Telecommunications Operators*, London, October 1998.

"Using Conjoint Analysis to Forecast Demand and Determine Telecommunications Pricing structures", *IIR Conference on Market Forecasting for Telecommunications Operators*, London, November 1998.

Issues Arising from the MMC Inquiry into Charges for Calls to Mobile Telephones in the UK", *European Mobile Telecommunications Regulation and Competition Law Conference,* Brussels, March 1999.

"Regulation of Number Portability and Carrier Pre-Selection", *IIR Interconnection '99 Conference,* London, March 1999.

"Bottom-Up LRIC Modelling: What Does it Involve and How Can it be Used", *Vision in Business Conference on LRIC and Cost Allocation for Interconnection Pricing,* Brussels, April 1999.

"Number Portability: Challenges and Solutions", *IIR Conference on Technical and Commercial Strategies for Telecoms Operators,* London September 1999.

"Control of Mobile Interconnection Prices", *European Mobile and UMTS Regulation and Competition Law Conference,* Paris, April 2000.

"How Regulatory Considerations Affect Business Plans", *Vision in Business Valuation and Bidding Strategies Workshop,* Paris, April 2000.

"Regulating Wholesale Services: The European Experience", *London Business School Conference on Regulating Wholesale Services Prices,* London, April 2001.

"Competing in a Regulated Telecommunications Environment", *Infocom 2001*, Budapest, May 2001.

"Regulation of Dynamic Industries", *BT Conference on "The New World Order in Regulation"*, London, September 2001.

"Cost Allocation and Recovery for New Services", *IIR Conference on Cost Control and Profitability in Telecoms*, London, October 2001.

"Applying LRIC to Fixed to Mobile Interconnection", *Vision in Business Conference on Network Cost Reduction in Telecoms,* London, November 2001.

"Applying LRIC to Fixed to Mobile Interconnection", *Vision in Business Conference on Network Cost Reduction in Telecoms,* London, April 2002.

"Cost Based Pricing for Mobile Termination", Vision in Business Conference on Mobile Regulation and Competition Law, Brussels, July 2003.

"Implications of Broadband Deregulation for GDP and Employment in Europe: Some Case Studies Using Input-Output Analysis", London Business School Regulatory Seminar, June 2006.

Appendix C. List of documents relied upon

Listed below are all the documents and models that were relied upon in preparing this expert report:

ACCC, *Draft pricing principles and indicative prices for LCS, WLR, PSTN OTA, ULLS and LSS* (**Draft Pricing Principles and Pricing**), August 2009;

Model developed by Analysys on behalf of the ACCC (**Analysys Model**), version 2.0;

Analysys, *Fixed LRIC Model User Guide-Version 2.0*, August 2009;

Analysys, *Fixed LRIC Model Documentation-Version 2.0*, August 2009;

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NERA
Economic Consulting

NERA Economic Consulting
15 Stratford Place
London W1C 1BE
United Kingdom
Tel: +44 20 7659 8500
Fax: +44 20 7659 8501
www.nera.com