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14 August 2008

Dear Mr. Archbold

We refer to the Authority's Decision 2008-2 published on 31 July 2008 relating to the Authority's Costing Manual Consultation (CV 2005-1) ("the Decision").

Digicel (Cayman) Limited ("Digicel") believes that the approach adopted by the Authority in some distinct parts of the Decision is fundamentally flawed. Digicel has commissioned a review of the Decision by a renowned independent expert, Dr. Chris Doyle, an economist and associate of the University of Warwick (www.cdoyle.com). Dr Doyle is also currently advising the UK Competition Commission in its enquiry into the costs of mobile voice call termination in the United Kingdom.

A full copy of the report prepared by Dr. Doyle is enclosed herewith. Details of Dr. Doyle's qualifications and experience can be found at Page 29 of his report. We would strongly urge the Authority to carefully consider Dr. Doyle's report and to properly address the conclusions reached therein.

We would remind the Authority of the following statement made by it on page 4 of its Decision 2006-2 dated 27 July 2006:

> *"…as a matter of principle, in the absence of a* ***fundamental flaw to the procedural or substantive approach adopted by the Authority*** *in relation to an Application at first instance before it, the Authority should decline to entertain an Application for Reconsideration of a matter that falls outside the list of those subject areas enumerated…" (emphasis added)*

The logical corollary of this clear statement by the Authority is that where there are fundamental flaws in the procedural or substantive approach the Authority will reconsider its approach upon an application made to it. Digicel is strongly of the view that many aspects of the Decision are indeed fundamentally flawed in terms of the substantive approach adopted by the Authority. Digicel's views in this regard are supported by Dr. Doyle's report.

Accordingly, Digicel hereby formally applies for a reconsideration of the Decision insofar as it relates to the following matters addressed in its Decision (please note that the references to Principles and Guidelines are those Principles and Guidelines as set out by the ICT Decision 2005-4)

The annuity approach to depreciation used in the model and approved by the ICTA is contrary to the Authority's first objective of the FLLRIC model – namely that rates determined by the model are "cost based rates for interconnection services" and against Principle 2 that enshrines the important forward looking requirement and Principle 1 that enshrines dynamic efficiency. The annuity approach adopted by the ICTA represents bad regulatory practice.

The cost of capital as set out by the ICTA in its Decision involves numerous errors, all of which work to understate the cost of capital for telecommunications operators in Cayman. The risk free rate, debt and equity betas, and the simple treatment of risk, all appear to bias the WACC in the direction of a low figure, which is in breach of Principle 1.

The averaging of the cost of capital of fixed line and mobile telecommunications network operators is based on flawed reasoning because: (i) only one fixed network is feasible and so any subsequent mobile entrant faces a cost of capital peculiar to being a mobile entrant without a fixed network; (ii), it is accepted regulatory practice that where data is available which allows separate costs of capital to be calculated for separate operations or projects even within the same firm, separate costs of capital should be used as they are in the public interest.

The use of a virtually complete NGN architecture for the fixed network is inconsistent with Principle 2 – it is unlikely to be the least cost option to support the services currently provided

Assets' lives for the mobile cost model have been arbitrarily doubled in most cases and appear well beyond the assets' economic lives. No analysis or data is provided in defence of this decision. This treatment of assets lives violates transparency as advocated by the Authority in Principle 11 and Guideline 6.

The requirement for C&W to also model 3G architecture lacks a rigorous argument that shows that efficient incurred investments at entry time would nevertheless have a fair chance of cost recovery.

- The ICTA's interpretation the scorched node guideline is so flexible so as to make it effectively a scorched earth assumption. The case of the mobile network the Authority is deviating from Guideline 3.

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- The ICTA appears to favour a system of mark-ups using network elements. It has been shown (for e.g. in Australia) that this can lead to bias and incorrect assessments of costs. There is a lack of clarity with regard to the ICTA's reasons for its preferred approach. In this respect the Authority would appear to be violating Principle 11.

The substantive basis upon which these individual reconsiderations are being sought can be found in the enclosed report written by Mr. Chris Doyle. The above paragraphs merely represent a summary of same. You will see that Dr. Doyle's view is that the ICTA's treatment of these issues clearly breaches certain Principles and Guidelines by which the FLLRIC model should be judged and which were published by the ICTA in Decision 2005-4. In summary, we believe that the ICTA's treatment of each of these topics falls significantly short of the standards that would be expected of a reasonable regulator.

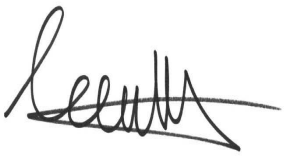
You will be aware that the ICTA has in recent communications agreed to provide Digicel with the express opportunity to provide written comment upon the Authority's Decision and ultimately to seek a reconsideration of certain conclusions arrived at by the Authority therein. Digicel is most grateful for the Authority's express confirmations in this regard.

We should be obliged if the Authority would acknowledge (in writing) receipt of this letter and enclosed report and indicate to us when it expects to provide its decision in respect of this reconsideration request.

Digicel is of course conscious of its general obligation as present in administrative law to exhaust all avenues of redress before availing of its rights to seek Judicial Review through the Courts. Accordingly, we confirm that Digicel will take no action in this regard until such time as the Authority has reviewed Digicel's reconsideration **request** and provided its response in respect of same.

We await hearing from you in terms of the acknowledgement sought above.

Yours sincerely,



Sean Latty
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Comments on the ICT Decision 2008-2: Decision for the Costing Manual Consultation

A report for Digicel

by

Dr. Chris Doyle
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14 August 2008, Final

Table of Contents

About the author 3

1. Introduction 4
1.1. Retained by Digicel 4

2. ICT Decision 2008-2 5
2.1. Purpose of FLLRIC cost model 5
2.2. The C&W FLLRIC cost model 5
2.3. General modelling issues 6
2.3.1. Scorched node 6
2.3.2. Network technology 6
2.3.3. Cost allocation to services 7
2.3.4. Standalone networks 8
2.3.5. Demand assumptions/Projections 8
2.3.6. Asset Lives 8
2.3.7. Annualisation of capital costs 9
2.3.8. Cost of capital 12
2.3.9. Model Transparency 18

3. Conclusion 19

References 20

Annex A: Incremental costing principles 21
A:1 ICTA incremental costing principles 21

Annex B: Overall commentary on the ICTA incremental costing principles 26

Annex C: ICTA guidelines for implementing FLLRIC 29
B:1 ICTA incremental costing guidelines 29

Annex D: Curriculum vitae 1
Qualifications 2
Current and past positions 2
Consulting assignments (in reverse chronological order) 4
Independent economic consultant May 2002-present 4
At Charles River Associates UK Limited (August 2000 – April 2002) 11
At London Economics Limited (October 1999 – July 2000) 13
Independent (November 1992 – September 1999) 14
Papers and publications on telecommunications and related network industries 16
Current teaching and supervision 20
The economics of competition policy 20
Seminar presentations since 2000 20

About the author

Dr. Chris Doyle, *Ph.D., MA (Cantab), B.Sc. (Econ) Hons.*

Dr. Doyle is an Associate of the Centre for Management under Regulation, Warwick Business School and the Department of Economics, University of Warwick in the UK.

He has a Ph.D. in economics from the University of Warwick and has held senior positions at Cambridge University, London Business School, and Gonville and Caius College, Cambridge. He has also held visiting positions at Charles University, Prague; INSEAD in Paris and Queen's University, Canada.

Dr. Doyle's work on regulation and competition issues in telecommunications has been published widely, and he has presented seminars and lectures at numerous universities and major industry conferences.

He has advised numerous clients over many years on regulatory issues in telecommunications and provided advice to operators and regulators in the Caribbean region. He is familiar with operators' accounting procedures and with procedures for assessing long run incremental costs on a forward looking basis. He is currently retained by the Competition Commission in the United Kingdom in relation to matters pertaining to the costs of mobile voice call termination.

He is a joint author of *Essentials of Modern Spectrum Management* published by Cambridge University Press in 2007 with Martin Cave and William Webb.

Further information can be obtained at: www.cdoyle.com
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1. Introduction

In this brief report I comment on some aspects of the ICTA Decision 2008-2 ("the Decision") on the costing manual consultation. **I highlight several areas of weakness in the Decision and raise a number of concerns.**

The reasoning provided by the Authority (ICTA) is often weak and too brief. **In particular I find the directions provided with regard to the treatment of depreciation and the cost of capital to have many shortcomings.**

My analysis concentrates mainly upon the key economic and financial parameters in the Decision. I am not a telecommunications engineer by training and do not comment therefore on technical aspects of the Decision.

1.1. Retained by Digicel

On 11 August I was contacted by Digicel and asked to provide comment on the Decision. To undertake this task Digicel supplied me with:

- Decision 2008-2
- Decision 2005-4
- The Excel spreadsheets containing the C&W FLLRIC model and
- A letter sent by John Buckley, CEO Digicel to Mr. David Archbold, Managing Director ICTA dated 21 December 2007

I am currently an economic self-employed independent economic consultant offering services to a broad range of clients in the electronic communications sector. I also undertake academic research at Warwick University where I hold posts in both the Department of Economics and the Business School.

I have considerable expertise and experience in the telecommunications sector and am familiar with FLLRIC modelling exercises, the cost of capital, depreciation and other related matters. I am currently retained by the UK Competition Commission to advise on matters pertaining to a mobile termination rate case.

2. ICT Decision 2008-2

In Decision 2008-2 the Authority makes a determination on the model, methodology and assumptions used by C&W when developing its regulatory accounts. I note that the Authority also approves the cost of capital, the economic asset lives for network equipment, and the methodology used to calculate annualised capital costs. It is these aspects in particular that I focus upon in this section.

The Authority is critical of many aspects of the model presented by C&W. In particular it is critical of the use of a 2G mobile technology – arguing that a new entrant would install 3G technology.

In this section I appraise the decision of the Authority and identify a number of serious shortcomings.

2.1. Purpose of FLLRIC cost model

The Authority states that the purpose of constructing a FLLRIC model is threefold:

(i) the FLLRIC model will be used to establish cost based rates for interconnection services,

(ii) to ensure that C&W's retail rates are not anti-competitive by providing input to imputation test analysis, and

(iii) to quantify an access deficit if any.

It is critically important to the success of competition in the market that the FLLRIC model is compliant with the Authority's principles and guidelines. The main purpose of this section is to asses whether this is in fact the case. I conclude on the basis of my reading of the Decision that the model, assuming the remedies required by the Authority are implemented, is not compliant with the Authority's principles and guidelines.

2.2. The C&W FLLRIC cost model

The FLLRIC model proposed by C&W has four components:

(i) a fixed network cost module,

(ii) a mobile network cost module,

(iii)a retail cost module, and

(iv) a consolidation module.

The following section deals with some of the economic and financial issues associated with the C&W FLLRIC model and the Authority's directions in relation to these.

2.3. General modelling issues

2.3.1. Scorched node

The Authority has determined that the number and locations of cell sites should not be fixed at the currently existing number or locations. It holds that this is consistent with Guideline 3. Therefore C&W has been directed by the Authority to exercise reasonable discretion with regard to cell sites. However, the Authority has stated that:

"While the Authority would expect the number of cell sites to be similar to those currently deployed when the same network technology is used, deviations may be appropriate to minimise cost or where newer technology is deployed."

In the context of a scorched node model, it seems peculiar to allow for such flexibility, as it would seem to admit the possibility of a scorched earth approach rather than scorched node. It would seem more appropriate to apply Guideline 3 by taking existing cell sites as the network topology and then lay over this the best technology available to provide the grade of service required.

2.3.2. Network technology

C&W has proposed that a NGN network is used for the fixed network and a mix of 2G/2.5G in the mobile network.

2.3.2.1. The fixed network

C&W use of a NGN is in line with international trends, as telcos around the world migrate to all-IP networks. The evolution to all-IP based networks is, however, a very costly exercise and is happening mainly in large high-income markets. A new entrant would likely install soft-switches and replace DSLAMs with MSANs, but if the market demand is not present an entrant would probably install DSLAMs and continue to use tried and tested architectures in the access network – leaving IP installation for the main exchange (the core).

In the context of the cost modelling exercise, serious problems are likely to arise in allowing C&W to apply an NGN. First, the costs of NGNs are variable and changing dramatically (in a downwards direction). However, at present their costs remain

relatively high – and so an entrant into Cayman might choose to delay installing an NGN until costs are lower (exercising the option of delay). Secondly, because NGNs can support a wider array of services than traditional PSTN networks, it makes apportioning common costs and depreciation more difficult. Demands for many of the new services are not known today (such as IPTV). There is a major issue therefore in determining how to factor in demand uncertainty associated with a NGN world. However, the larger number of services permitted by a NGN framework should mean that the costs avoided by removing voice based services – while retaining other services – will be smaller than is found in a PSTN setting. Thus the estimates for voice call termination and origination rates ought to reflect this.

The use of an NGN is inconsistent with Principle 2 – it is likely not to be the least cost option to support the services currently provided, though conceivable a NGN would be the least cost option for new services to be made available in the future. It is not good regulatory practice to base wholesale charges on a network that embodies services for which demand is far from certain.

2.3.2.2. The mobile network

The use of a 2G/2.5G network in the FLLRIC model by C&W is regarded as unsatisfactory by the Authority. The Authority has directed that C&W undertake for the purposes of the FLLRIC modelling the installation of a 3G network. While technologically a 3G network offers enhanced data services and better voice services, it is not clear that an entrant into the Cayman cellular market would choose to install a more expensive 3G network over a 2.5G network. Further, it appears to be interpreting the scorched node guideline very flexibly so as to make it effectively a scorched earth assumption.

In the case of the mobile network the Authority is deviating from Guideline 3.

2.3.3. Cost allocation to services

The Authority raises some questions about C&W's methodology for allocating ISFCs and common costs. It states that it is not satisfied with C&W's approach based on proportionate mark-ups. The Authority also appears to favour a method based on network elements rather than service increments, although this is not entirely clear.

As Gans and King (2003) note – assessing LRIC using elements can lead to bias and incorrect assessments of costs. The Authority does not provide sufficient clarity with regard to the reasons for its preferred approach. In this respect the Authority would appear to be violating Principle 11.

2.3.4. Standalone networks

It is not clear to what extent the model allows for sharing of fixed and mobile networks. **However, it is highly unlikely an entrant in to the Cayman market would find it economic to invest in both fixed and mobile access services.**

2.3.5. Demand assumptions/Projections

I concur with the Authority's position with regard to the treatment of demand. It would appear that C&W has not been sufficiently transparent or consistent. The use of minutes for the ADSL service is inappropriate and the Authority is correct in directing C&W to use other metrics based on packets of data. This would be more consistent with the underlying nature of the model which is based on an all-IP network.

2.3.6. Asset Lives

Pardina, Rapti and Groom (2007) note that "in principle an asset should be depreciated over its expected productive life". However, the treatment of asset lives in the C&W FLLRIC model is not explained or justified and therefore appears arbitrary, perhaps informed by internal assessments by its engineers.

The Authority has increased most of the C&W's asset lives assumptions in the FLLRIC model without providing reasoning or justification. Wheatley (1998) notes that asset life expectancy assumptions have been declining in Europe, and this is likely to be continuing today.[1]

The Authority's determination on asset lives violates transparency as advocated by the Authority in Principle 11 and Guideline 6.

The Authority should use independent consultant engineers and business experts to determine the approximate economic life of the assets included in the model, rather than impose what amounts to arbitrary revisions of C&W's assessments. The use of independent consultants is a practice undertaken by other regulatory agencies such as the Competition Commission in the United Kingdom.[2] Alternatively the Authority should consult on asset valuation and asset lives, as is the case in New Zealand.[3]

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[1] See page 174 and Table 7.4 in Wheatley (1998).

[2] For example, see the Competition Commission report on the regulatory treatment of assets in the water sector available at http://www.competition-commission.org.uk/rep_pub/reports/2000/fulltext/444a8.5.pdf.

[3] See for example the New Zealand Commerce Commission website at http://www.comcom.govt.nz/IndustryRegulation/Gas/CommissionReportsandDocuments/assetvaluation1.aspx.

2.3.7. Annualisation of capital costs

The Authority correctly acknowledges that in telecommunications the recovery of capital costs account for a high proportion of total costs in FLLRIC models. Depreciation of capital is therefore a factor that should be given close scrutiny by the Authority.

It is observed by the Authority that C&W have applied a simple annuity formula based on the PMT function in MS Excel. The PMT formula calculates the payment for a loan based on constant payments and a constant interest rate. When used in the C&W FLLRIC model it calculates the annual depreciation charge at the end of each year arising from capital expenditures made at the beginning, using the weighted average cost of capital as a measure of the cost of capital (the rate of interest faced by C&W).

The standard formula for an annuity reproduced in paragraph 141 of the Decision is incorrect, it should read as follows:

$$\text{Annualised cost} = \left(\frac{WACC}{1 - \left(\frac{1}{(1+WACC)^{\text{Asset Life}}} \right)} \right) * \text{Asset Capital Cost}$$

Two issues arise with regard to depreciation:

1. Is the annuity method an appropriate way to measure depreciation in the FLLRIC model?

2. Are the parameter values applied in the PMT formula in the C&W FLLRIC model reasonable?

I shall take each point in turn:

1. Depreciation of capital assets involves two interrelated components (see Hardin, Ergas and Small (1999)):

a. Physical deterioration through use (or non-use) and obsolescence; and

b. Changing market values.

The market value of an asset is measured as the net present value of income that accrues to the asset and is an indicator the value of the asset on secondary markets. For many

asset classes market values decline over time, as life expectancy diminishes and productive performance is adversely affected by physical deterioration.

Economists argue that the correct measure of depreciation is '*economic depreciation*'. This measures the change in the market value period-by-period. Note that economic depreciation is directly determined by the value of an asset – given by its current market price. The price of an asset on the second-hand market will be influenced by the price of new Modern Equivalent Assets (MEA).

Using economic depreciation would determine a network (fixed or mobile) termination rate that would recover all costs over the life of the network. The result would be a constant charge per minute for termination over the life of the network if it were not for changes in the MEA price of assets. If the MEA price of an asset were to decline by 10% each year, the element of the charge associated with this asset would also fall by 10%.

The annuity approach to depreciation in the C&W FFLRIC is not forward looking. The application of a MEA value in accordance with Principle 2 occurs at only one date in the model – the date associated with entry at time zero. For all future periods, depreciation is charged (implicitly) in relation to the costs associated with previous entry. For the model to be forward looking it ought to incorporate entry in each period and assess MEA values over a period of time stretching out into the future. This would require judgments to be made about price trends for capital assets used in the sector. For example, if prices are expected to fall by 15-20% on an annual basis (which seems a reasonable supposition[4]), then depreciation ought to be significantly higher during the initial phase. This would therefore be reflected in termination rates that declined over time starting from a higher value than is implied in the C&W FFLRIC model.

Hardin, Ergas and Small (1999) correctly demonstrate that the annuity approach to measuring depreciation is:

"completely inconsistent with the concept of economic depreciation".

Table 4.1 below is extracted from Hardin et al. and illustrates two scenarios. Scenario 1 is the depreciation charge measured according to a sensible economic measure of depreciation; Scenario 2 presents the annuity approach.

Table 4.1 extracted from Hardin, Ergas and Small (1999)

[4] Caudill and Gropper (1997) show that quality adjusted real prices for mainframe computers between 1984 and 1994 declines on average by 18-19% per year. It is highly likely that the price of telecommunications equipment has also declines by a similar order of magnitude over the last ten years or more. However, as Caudill and Gropper observed in the case of mainframe computers, real prices for products tended to increase as specifications improved and quality increased substantially. Again this is a feature found in the telecommunications hardware market.

Asset life	Depreciation	Capital value	Cost of capital	Scenario 1: Total capital charge	Scenario 2: Annuity capital charge
1	$20.00	$99.00	$15.00	$35.00	$19.93
2	$19.80	$98.01	$14.85	$34.65	$19.93
3	$19.60	$97.03	$14.70	$34.30	$19.93
4	$19.41	$96.06	$14.55	$33.96	$19.93
5	$19.21	$95.10	$14.41	$33.62	$19.93
6	$19.02	$94.15	$14.26	$33.28	$19.93
7	$18.83	$93.21	$14.12	$32.95	$19.93
8	$18.64	$92.27	$13.98	$32.62	$19.93
9	$18.45	$91.35	$13.84	$32.30	$19.93
10	$18.27	$90.44	$13.70	$31.97	$19.93

The annuity method takes account of the cost the asset and the opportunity cost of capital, but does not take account of the need to invest in order to maintain output levels in line with licence obligations. Hardin *et al* (2007) note:

"The annuity approach is rarely used for the depreciation of fixed assets because as the cost of capital declines over time, the annuity implicitly assumes a back-loaded depreciation profile."[5]

The correct way to calculate costs is to do so using economic depreciation, as the aim of regulator is generally to seek to mimic the outcome of a competitive market. Economic depreciation is consistent with the outcome in a competitive market – a simple annuity is not.

The Authority's decision in paragraph 147 is at best puzzling and at worst contrary to its principles. It appears to be the case that the Authority views the fact a simple annuity gives rise to a "constant level of annualised capital costs" as something more appropriate for rate setting purposes. This is contrary to the Authority's first objective of the FLLRIC model – namely that rates determined by the model are "cost based rates for interconnection services" and against Principle 2 that enshrines the important forward looking requirement and principle 1 that enshrines dynamic efficiency. The Authority's position on a simple annuity represents bad regulatory practice.

[5] The Authority acknowledges the back-loading property in footnote 51 in the Decision.

Ofcom in its Mobile Call Termination Statement (2008) states:

"As in the previous market review, the approach selected by Ofcom for defining paths of cost recovery within the cost model is economic depreciation…Economic depreciation seeks to set an optimal path of cost recovery over time by mimicking the outcomes of a competitive market. Taking account of 3G network rollout, by the end of the charge control period the use of economic depreciation results in a higher per minute cost of terminating calls."[6]

2.3.8. Cost of capital

The Authority presents a discussion on the cost of capital for the firm in the FLLRIC model and correctly acknowledges that it represents a weighted average of the cost of debt and equity, known as the weighted average cost of capital (WACC). Before discussing the treatment of this formula by C&W, it is important to note that academic concerns have been raised about the use of WACC in regulated industries such as telecommunications. Recently Pindcyk (2007) has stated:

"The cost of capital that is typically used in the TELRIC price is the ILEC's [incumbent local exchange carrier] or a hypothetical firm's weighted average cost of capital (WACC), which is simply an average of its expected return on equity (which can be computed using the Capital Asset Pricing Model, or CAPM) and its cost of debt, with the weights being the relative shares of equity and debt. This WACC does not incorporate any adjustment for option value."[7]

Pindyck is alerting regulators and others to the fact that the cost of capital as applied using CAPM and WACC does not incorporate costs associated with real options. Typically incorporation of real option values would lead to higher estimates of the cost of capital – reflecting the value of delay.

The estimate for the cost of capital in the C&W FLLRIC model does not include the cost of delay, and hence will underestimate the true economic cost. Principle 1 will therefore be violated.

The WACC formula used by C&W, expressed in terms of gearing g (the ratio of debt to debt plus equity), is as follows:

$$WACC = (1-g)R_e + gR_d \qquad (1)$$

[6] Pages 140-141 in Ofcom (2008).

[7] Pindyck (2007) page 294.

where R_e is the cost (price) of equity and R_d is the cost (price) of debt expressed as interest rates. It is usually the case that the price of debt is less than that of equity (see Brealey and Myers (2008)).[8]

The cost of capital can be expressed in real terms (that is adjusting for inflation) or nominal terms. I note that the Authority has presented a case for WACC values couched in nominal terms. As Cayman is a tax exempt jurisdiction, the issue of pre- or post-tax WACCs does not arise.

The key parameters in the cost of capital calculation which influence interconnection cost estimates are the:

- Price of equity
- Price of debt, and
- Gearing.

The price of debt is usually determined from assessing yields on government bonds and allowing for a debt premium. The price of equity can be calculated in a number of ways (see for example the discussion in Ofcom (2008) Annex 18 and Wright *et al.* (2003)). C&W has proposed to apply the widely used and familiar Capital Asset Pricing Model (CAPM). This model proposes that the price of equity is as follows:

$$R_e = R_f + \beta(R_m - R_f) \qquad (2)$$

where R_f is known as the risk-free rate (the expected rate of return on a risk free asset), R_m is the return on the market portfolio (market index) and β measures the correlation between the individual stock and the market index which reflects the variability of returns of the equity of the firm in the model compared with the variability of returns of the equity market as a whole. R_m-R_f is known as the equity or market risk premium (the Authority uses MRP).

C&W have also added to the formula in (2) a country risk premium (CRP), thus making the price of equity:

$$R_e = R_f + \beta(R_m - R_f) + CRP \qquad (3)$$

The Authority discusses the CRP and appears not to dispute its inclusion, though it is not clear how it is treated in the Authority's directions. A CRP can be included based on assessments about yields on sovereign funds (e.g. Cayman government issued debt in US dollars compared against US Treasury Bonds).

[8] Chapters 9 and 10 specifically in Brealey and Myers (2008).

The Authority has elected to use a blended WACC – taking an average of estimated WACCs for fixed and mobile network operators respectively. It is not clear what the rationale for doing this is, as mobile and fixed operations are often distinct (though admittedly increasingly convergent). Nevertheless, systematic risk is likely to be higher in mobile than in the fixed market.

The Authority should not blend the WACCs of the mobile and fixed networks if it is to be consistent with Principle 1.

Inspection of the MS Excel spreadsheets shows that C&W has taken two estimates for the WACC in each of its fixed and mobile divisions. These are shown in Table 4.2 below:

Table 4.2: C&W estimates for WACC in the fixed and mobile sectors

	WACC		
	Low	High	Average
Fixed	10.01	11.03	10.52
Mobile	10.70	12.59	11.65

The Excel spreadsheets do not appear to provide further information regarding the values shown in Table 4.2. In particular, I have not seen documentation explaining why the figures in Table 4.2 have been selected.

From my extensive experience of dealing with matters related to cost of capital, the WACCs used in the C&W FLLRIC model are low.

The risk free rate

The risk free rate in the C&W FLLRIC model is taken as the return on certain US Treasury Bonds. The Authority questions the choice by C&W of only a 30 year Bond and the price prevailing at one moment in time.

The Authority is correct to challenge the calculation of the risk free rate, which seems far too simplistic and based on too narrow a selection of bonds (in fact only the 30 year bond).

Ofcom (2008) looked at a broad range of maturities for UK equivalent assets (UK gilts), ranging from one to fifteen years.[9] In Ofcom's analysis it concluded that the nominal risk free rate was 5%. Given the United Kingdom probably has a lower CRP than Cayman, it would be reasonable to suggest that the risk free rate in Cayman is greater than 5%.

[9] See page 366 in Ofcom (2008).

However, the Authority has indicated its preference for a nominal risk free rate of 4.4%, alluding to recent estimates of yields on 10 and 20 year US Treasury Bonds (based on data at the end of April 2008).

My inspection of the US Treasury database shows that at the end of April 2008 yields on 10 year bonds were 3.8% nominal and on 20 year bonds were 4.5% nominal. At the end of July 2008 the figures were 4% and 4.6% respectively. Allowing for a CRP this suggests a nominal rate of at least 5% should be set for the risk free rate in Cayman.[10]

I note also note that inflation in Cayman has increased in recent times and was reported at 3.5% in 2007.[11] Assuming a real return of 2% as applied by Ofcom in the UK, this also suggests that the nominal risk free rate should be over 5%.

The market rate premium

The MRP preferred by the Authority is 6%, based on its assessment of research undertaken by a number of respected academics and practitioners. This seems a fair and reasonable position for the Authority to adopt, though its conclusion is based on far less rigour than is found in larger regulatory authorities such as Ofcom in the United Kingdom.

Beta

On the choice of beta the Authority examines both the equity and debt beta values. The Authority remarks on C&W's proposed values for beta and its data sources, and also comments on the material submitted by Ovum on behalf of Digicel.

Having elucidated the standard theory on beta, the Authority asserts that the value of the asset beta should be 0.5 for fixed operators and 0.7 for mobile operators. No supporting evidence or reasoning is provided by the Authority in arriving at these values. I note that in the case of a mobile operator, an asset beta 0.7 is significantly below the value proposed by Ofcom in the UK (see Table A18.8 below).

I note also that the Authority supposes a mobile operator should be assumed to have gearing of 35% - which is consistent with an equity beta of 1.08 (rounded). The equity beta directed by the Authority is at the low end of the range used by Ofcom in the UK, which has applied a range between 1.0 and 1.6. However, Ofcom assumes that optimal

[10] Source of yield data used: http://www.ustreas.gov/offices/domestic-finance/debt-management/interest-rate/yield_historical.shtml.

[11] As reported in "The Cayman Islands at a Glance", March 2008 available at http://www.eso.ky/docum1/docum51.pdf (visited 14 August 2008).

gearing is 10%, if this value were used in the WACC computation in Cayman as proposed by the Authority the equity beta would be as low as 0.8 rounded – which is far below the consensus position on equity betas in the sector.[12]

Given the significance of beta estimates on affecting the model's predicted interconnection costs, it is unsatisfactory for the Authority to present in only six lines a case for choosing values which seem by international best practice too low.

Gearing

The Authority notes that ideally the optimal gearing for the firm in the FLLRIC model should be used but recognises the difficulty of estimating this in practice. It therefore states that C&W's approach of estimating gearing based on survey data is a "pragmatic and reasonable solution".

I have not seen the sample of firms used by C&W to arrive at its proposed gearing levels. The Authority's exclusion of certain companies in the sample would appear justified. It is unclear whether the gearing average that is calculated is based on a simple arithmetic average or a weighted average.

Debt premium

The Authority notes C&W's calculations and is critical of the sample used to calculate debt costs. The Authority claims in paragraph 211 that the debt premium for "medium grade debt in the utility sector may be estimated to be 1.6%".

In paragraph 211 The Authority adds this value to the risk free rate, which its states as 4.6%, and arrives at a figure for the cost debt equal to 6.2%. I note that elsewhere and in the Table shown in paragraph 212 the risk free rate is stated as 4.4%. Therefore the correct value directed by the Authority appears to be 6%. Adding in the CRP makes the total cost of debt 6.6%.

The Authority's verdict on the nominal WACCs in the fixed and mobile networks are shown in the Table in paragraph 212 reproduced below as Table 4.3.

[12] See for example WIK (2007).

Table 4.3 Authority's direction on WACC

Parameter		Fixed network	Mobile network
Nominal risk-free interest rate	a	4.40%	4.40%
Debt premium	b	1.60%	1.60%
Moody country rating	c	Aa3	Aa3
Country default risk spread	d	0.60%	0.60%
Relative equity market volatility	e	1.5	1.5
Country risk	f = d*e	0.9%	0.9%
Cost of debt	g = a+b+d	6.60%	6.60%
Market risk premium	h	6.00%	6.00%
Gearing	i	45%	35%
Tax	j	0%	0%
Asset beta	k	0.50	0.70
Equity beta	l = k*(1+(i/(1-i))*(1-j))	0.91	1.08
Return on equity	m = a+l*h+f	10.75%	11.76%
Nominal WACC	n = i*g+(1-i)*m	8.89%	9.96%

The nominal values for the WACCs appear low and lie below the nominal pre-tax WACC values reported by Ofcom in March 2008. I choose the pre-tax values as these are representative of the income streams generated by the employed assets. From an economic efficiency perspective we should focus on the earnings potential of the employed capital and not on the distortions brought about by taxation.

Ofcom (2008) in Figure A18.8 (reproduced below) shows that the estimated pre-tax WACC for a mobile network operator in the UK, assessed on a forward looking basis using (original) economic depreciation, was between 12.8% and 16.4%.

The Authority's direction in the Decision indicates a nominal WACC for a mobile operator below 10%, around 40% below the mid-value in the UK.

As risk is likely to be no higher in the UK than in Cayman, and given inflation in the UK was only slightly higher than in Cayman in 2007, I find it extraordinary that the Authority is directing WACCs significantly below those deployed in the UK.

Figure A18.8 Proposed WACC estimate

	Low	High
Nominal Risk-free rate	5.0%	5.0%
ERP	4.5%	4.55
Asset beta	0.90	1.46
Equity beta @ 10% gearing	1.0	1.6
Cost of equity (post tax)	9.5%	12.2%
Debt premium	1.0%	2.0%
Cost of debt (pre tax)	6.0%	7.0%
Corporate tax rate	30%	30%
Cost of debt (post tax)	4.2%	4.9%
Gearing	10%	10%
WACC (post tax nominal)	9.0%	11.5%
WACC (pre tax nominal)	12.8%	16.4%
Inflation	2.8%	2.8%
WACC (pre tax - real)	9.7%	13.2%
Average WACC (pre tax - real)	**11.5%**	

Source: Table A18.8 as published in Ofcom (2008)[13]

2.3.9. Model Transparency

The Authority presents many criticisms on the lack of transparency of the C&W FLLRIC model.

In my experience of working with Excel spreadsheets of this nature in the telecommunications sector in general and in the Caribbean region in particular leads me to agree with the Authority: the model lacks transparency and many causal links are not adequately explained. In particular, the demand side of the model looks particularly weak.

[13] Ofcom (2008) page 374.

3. Conclusion

The Authority's analysis and reasoning is weak in a number of areas and appears arbitrary in some critical areas.

I find the Authority's treatment of depreciation and the scrutiny given to the cost of capital poor.

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Annex A: Incremental costing principles

Telecommunications regulators often make use of the concept forward looking long run incremental costs (FLLRIC) when assessing the costs of specific services. FLLRIC is used because it is a method of calculating costs that best reflects the costs which would feature on a competitive market.

Economic efficiency arguments are used to justify FLLRIC. ICTA presents twelve principles that should be adhered to when constructing FLLRIC estimated. These principles are to be adopted by C&W (Cayman Islands) in its regulatory costing model. The principles are presented below with commentary.

A:1 ICTA incremental costing principles

Principle 1:

Cost Recovery of efficient investments and Dynamic Efficiency

"The FLLRIC methodology should capture those costs for services or network elements that would lead to prices found in an efficient market for provision of such elements or services. Efficient market prices are those than ensure the service provider has the opportunity to recover efficiently incurred, forward-looking costs and encourage the service provider to operate in a cost effective manner. In addition, efficient market prices should provide the right incentives for efficient facilities-based investment, entry and exit."

This principle is acceptable as long as the regulator acknowledges that an efficient market requires conditions that may not be possible in market structures associated with telecommunications.

Principle 2:

Modern equivalent asset

"Forward-looking costs are the costs to be incurred by a carrier in the provision of a service. These costs shall be calculated as if the service was being provided for the first time by a new carrier and shall reflect planned adjustments in the company's plant and equipment. Forward-looking costs ignore embedded or historical costs; rather, they are based on the least cost technology currently available whose cost can be reasonably estimated based on available data. As such forward-looking cost estimates must reflect technologies that are currently operational used and available in the marketplace."

This principle is problematic because it requires the regulator to form judgments about what technologies operators would choose in practice. Regulators are less well informed about telecommunications markets and are prone to errors of judgment. This is especially the case where regulators seek to make judgments about best technologies. It can also be a very costly exercise to determine modern equivalent assets.

Principle 3:

Bottom-up engineering assessment of costs of hypothetical carrier

"The forward-looking long-run incremental costs of services or network elements are to be based upon those costs assumed to be incurred by an efficient carrier operating in the Cayman Islands for the first time. A carrier is deemed to be efficient where the total capital and operating expenditures are those that are necessary and sufficient in order to meet the required demand at a particular grade of service."

This principle is problematic because it requires the regulator to undertake detailed modelling about the optimal network that would be installed by a new Greenfield operator. The possibility for error would amplify regulatory risk.

Principle 4:

Activity based costing

"FLLRIC should include only those forward-looking costs that are incurred as a direct result of providing the service or network element in question. These are referred to as "causal" costs. Conversely, only costs that could be avoided by not offering the service or network element should be included in FLLRIC."

This principle is acceptable so long as the regulator ensures that an operator's FLLRIC model is sufficiently transparent and the assumptions used to apportion costs are made clear.

Principle 5:

Historical and sunk costs are not incremental

"Costs that remain the same whether or not the relevant course of action (e.g., proposed introduction of a new service, proposed reduction or increase in rates, or other changes to existing services) is undertaken are not causal to the course of action and therefore are not taken into account in calculating the incremental costs associated with that course of action. Since costs and revenues that have been realized prior to the start of the course of action cannot be affected by that course of action, incremental costs and revenues do not consider cost and revenue components prior to the course of action. Historical or sunk costs are an example of this type of cost because no action after a decision point can affect costs already incurred prior to that decision point."

This principle is acceptable.

Principle 6:

Service start-up costs

"A FLLRIC study should include all relevant service or element-specific start-up costs, including installation costs."

This principle is acceptable so long as the regulator ensures that an operator's FLLRIC model is sufficiently transparent and the relevant element-specific start-up costs are made clear.

Principle 7:

Volume and non-volume sensitive costs

"The FLLRIC of a service or network element should include both volume-sensitive and non-volume sensitive costs."

This principle is acceptable.

Principle 8:

Increment is entire output

"The FLLRIC of a service or network element is the forward-looking additional costs incurred by an efficient company to provide the entire output of a service or network element, including any required additional resources such as labour, plant, and equipment. These are the direct incremental costs of providing a service. FLLRIC excludes any costs, including any common costs that would be incurred if the service is not produced."

This principle is acceptable.

Principle 9:

Long-run means all costs are variable

"Long-run costs are the economic costs over a planning horizon long enough so that there are no sunk inputs or costs."

This principle is acceptable.

Principle 10:

Common costs

"Common costs are those costs that a carrier must incur in order to operate and are not directly attributable to any particular service or network element or group of services or network elements. C&W has the onus to prove the specific nature and magnitude of any forward-looking common costs. A reasonable assignment of common costs should be applied to all services and network elements regardless of whether the purpose of the FLLRIC cost is a "price floor" or a "price ceiling"."

Under activity based costing principles common costs are effectively the residual costs that cannot be directly attributed in a causal way to individual services. The Authority's principle places the burden of proof on C&W with respect to common costs. This is acceptable so long as C&W's FLLRIC model is sufficiently transparent and the assumptions and cost drivers are made clear.

Principle 11:

Transparency

"The process used to generate FLLRIC cost information should be transparent. In this context, transparency means that the processes for generating cost information are clear and understandable, that the numbers are objective and based on verifiable data, and that any models used in the FLLRIC process are fully documented."

This principle is acceptable and fundamental to the success of a FLLRIC approach.

Principle 12:

Burden of proof

"C&W has the onus to establish to the satisfaction of the Authority that its costing methodology complies with the approved FLLRIC principles and guidelines and produces reasonable results."

FLLRIC in Cayman places the burden of proof on C&W to show that its FLLRIC model is compliant with the Authority's principles. This is acceptable so long as affected third parties also have access to all material non-commercially sensitive data and are able to

appeal decisions. In the absence of third-party oversight and rights of appeal, regulatory risks would be amplified and the risk of regulatory capture would be greater.

Annex B: Overall commentary on the ICTA incremental costing principles

The above requires a definition of an efficient market. The Authority states that an efficient market would result in prices such that a provider has the "opportunity" to recover efficiently incurred forward-looking costs. Importantly the principle also states that efficient market prices "should provide the right incentives for efficient facilities-based investment".

Under Principle 1 both static and dynamic efficiency criteria should be satisfied by the application of FLLRIC. If an entrant at time T invests in facilities that are efficient at the time, it ought to be able to have the opportunity to recover those at a later date.

However, suppose that innovations mean that at time T+X lower cost facilities could be installed by a new entrant. If the operator who entered at time T is now forced to offer facilities at prices prevailing at time T+X, it will not be able to recover the costs associated with entry at time T despite the fact the operator made efficient forward-looking investment decisions at that time. Is this a problem?

It is helpful to look at competitive unregulated markets to address this question. If an early investor attempts to sell elements on the wholesale market at prices prevailing at time T (that is based on historical costs), other investors would choose to come into the market using technology at time T+X and undercut the early investor – presumably driving the early investor out of the market or causing the early investor to lower prices in accordance with the prevailing technology.

In terms of accounting, innovations could lead to early investors making impairment charges – thereby lowering the value of their assets on the balance sheet. This might be termed a windfall loss. By contrast, if future entry is only possible at a higher cost, the early investor might receive a windfall gain.

In competitive markets investors take a view on the likely occurrence of windfall gains and losses – in other words an investor will assess whether it is worthwhile investing today at time T or waiting to invest until some time in the future.

Competitive markets do not feature regulations such as universal service, and so the option to delay is one that can be exercised.[14] In telecommunications markets, which are highly regulated, the option to delay is often not available or is highly constrained. Furthermore, regulatory uncertainty adds an additional cost to investments.

In telecommunications markets the market structure is usually best described by oligopoly – a market featuring a small number of players who strategically interact. While conditions in some oligopolistic markets might approximate those found in highly competitive markets, this is usually not the case in telecommunications.

[14] See Pindyck (2007) who discusses the issue of real options and delay and their significance in telecommunications. See below further discussion in relation to my discussion on the Authority's direction on WACC.

The high level of sunk costs and capital intensity of the sector make it similar to sectors such as pharmaceuticals, where a small number of relatively large firms compete in the market place. In the telecommunications sector competing firms need to make use of rivals' facilities, primarily for call termination purposes. This is a feature not found in the pharmaceuticals sector.

If the cost of terminating calls is determined in accordance with Principle 1, then to ensure that the right incentives for facilities-based investment are in place it is important that the costing is based on efficient investments that occur at times determined by the regulatory process – and not at hypothetical times associated with a fictional competitive market.

Thus, where a regulator issues a licence to operator Y at time T – the costs of terminating calls onto network Y should be determined by the most efficient network to construct at time T. This method of calculating Y's costs may lie below Y's actual costs in the case where Y did not enter efficiently. It is correct that Y should have the opportunity to recover efficient investment costs and no more. This would best reflect the operation of a competitive market.

An alternative approach to measuring Y's costs would be to assess the costs as a moving target and to vary them through time as technology evolves. Thus a regulator could assess the costs at time T+1, T+2, etc. based on the best technology prevailing at those dates. This would mimic the operation of a competitive market place, but it would be highly damaging for investment and dynamic efficiency. Because entry decisions in telecommunications are largely determined by regulators rather than the market – assessing the costs of operators based on best technologies at each moment in time would likely deter entry in the first place – thus compromising universal service objectives and damaging the interests of end users.

Put differently, the application of FLLRIC based on best technology at any moment in time would impose a much greater risk premium and raise the costs of entry, possibly resulting in entry not occurring. The result of this would be to depress competition, lower product variety and damage end user interests.[15]

A simple example serves to illustrate the damage to end users. Suppose there are two operators and each has entered at time T=0 and invested 10 in a capital asset. Assume the capital asset is straight line depreciated over five years (thus a historical cost accounting approach is adopted). The depreciation charge is therefore 2 each period. Termination charges and retail charges will be influenced by the depreciation charge.

Now suppose that an innovation occurs at time 3 and the asset can be purchased for 5 and also has a lifetime of five years. Adopting the FLLRIC principles suggests that this asset would now be valued at 1 each year. If the retail market were effectively competitive – but entry is not feasible (as three players could not survive, whereas two players can survive), would the incumbent operators choose termination charges and retail rates that reflect a lower depreciation charge of 1 associated with the hypothetical

[15] Mandy and Sharkey (2003) also allude to this point in a FCC working paper.

entry? No. If this were the case the firms would not recover their efficiently incurred costs. Thus in a competitive market setting it need not be the case that firms in reality would set prices for elements based on best available technologies.

It is only where entry is economically feasible (though may not be physically feasible – due to spectrum scarcity, say) that current technologies should be used by regulators to determine asset prices.

Annex C: ICTA guidelines for implementing FLLRIC

In ICT Decision 2005-4 the authority also presented guidelines with regard to ensuring that the principles set out for FLLRIC are met.

B:1 ICTA incremental costing guidelines

Guideline 1:

Bottom-up methodology

"The FLLRIC of a service or network element should be developed using a bottom-up methodology. That is, costs should be built up from the costs of the components that would be required in order to deliver those services or elements. The bottom-up approach requires the following steps:

a. specifying the components necessary to provide the volume increment,
b. estimating the volume increment and required capacity of each of these components,
c. dimensioning the components to serve the estimated increment on an efficient, forward-looking basis,
d. determining the cost of different components,
e. estimating the capital costs and operating expenses associated with the different components,
f. quantifying the unit costs of each component, and
g. aggregating the component unit costs by the use made of them by different services or network elements. Routing factors may be used for this purpose pursuant to the definition and requirements specified below."

The guideline is rather general and leaves open to interpretation the type of network that may be used to provide service. It is likely that a range of estimates would fall out from applying Guideline 1. It is important therefore to have assumptions clearly stated and for sensitivity analysis to be presented.

Guideline 2:

Grade of service

"The modelled network should also be capable of providing a particular grade of service. The issue of the appropriate service standards for the mobile and fixed line networks and services shall be addressed in phase two of this proceeding."

This guideline presumably means that licence obligations, service level agreements and customer contracts should steer the grade of service employed in the costing model.

Guideline 3:

Scorched node

"The FLLRIC study shall be based upon the locations of, and planned locational changes to, the existing central office and facilities configuration. "Facilities" shall be interpreted to include feeder routes, central offices, drop wire, network interface devices, and other specific items that make up the facilities of a telecommunications company. This is referred to as the "scorched node" approach. The adoption of this approach does not imply that the modelled equipment located at the network nodes is of the same type or function as the equipment currently situated at those locations; however, the locations themselves are retained."

This guideline states that the authority prefers a 'scorched node' approach rather than a 'scorched earth' approach. In other words, the authority will allow C&W to base costs on its existing (and planned) network topology. This represents a compromise – as the scorched earth approach assumes that an optimal network is configured which may have a different topology to the existing network. The guideline is in line with international practice.

Guideline 4:

Instantaneous build

"Carriers are constantly upgrading, developing and refining their networks. As a result, a carrier's network will at any time include a range of technologies and vintages of equipment types, all of which must interwork. A FLLRIC approach, however, should approximate those costs that would be faced by a new carrier investing in the network at the time of the study. Thus, it is assumed that the network will be fully constructed using the current generation of technology, without any allowance for the need to interwork with previous generations. This is referred to the "instantaneous build" approach."

This guideline essentially advocates writing off legacy effects that might constrain the use of modern equivalent assets. In other words, a new entrant is assumed to construct a network (in accordance with the existing topology) that is unconstrained by past technologies.

Guideline 5:

Total service LRIC (TSLRIC)

"The increment to be modelled is the total service increment."

This guideline states that the relevant increment should be the total volume of the service in question over the long run. It may be calculated by measuring the additional costs associated with a new service, holding the volumes of other services constant. Alternatively, it may be calculated by measuring avoided costs associated with discontinuing supply of an existing service, assuming other service volumes are constant. TSLRIC is sometimes claimed to be equivalent to the use of total-element long-run incremental cost (TELRIC) which has been used by regulators in the United States and much criticised.[16] However, Gans and King (2004) have argued persuasively that TSLRIC and TELRIC are not equivalent.[17] Gans and King argue that TELRIC measures of cost is inconsistent with TSLRIC and can lead to economically inappropriate and biased prices, particularly for termination services.

Guideline 6:

Transparency

"If cost factors are based on historical data, historic averages or rely on ABC [activity based costing principles], C&W must provide the underlying supporting studies, analysis and documentation showing that those historical data, historic averages or the ABC relationships are relevant to the study of forward-looking costs."

This guideline appears sensible and would work most effectively if the key assumptions used were shared with third parties, while respecting commercial confidentiality.

Guideline 7:

Asset lives

"Each FLLRIC study shall identify and provide a basis for the projected economic life used to calculate depreciation costs of the equipment involved in providing the service or element or group of services or elements."

As estimates of TS-FLLRIC are sensitive to assumptions made about asset lives, it is critically important that these are made public to permit discussion so that a sensible

[16] See for example Sidak and Spulber (1997).

[17] Gans and King (2003).

consensus position can be achieved. In the absence of such oversight, there is a risk that a company developing a TS-FLLRIC model will choose values for asset lives strategically and this would likely be to the detriment of end users.

Guideline 8:

Reasonable return allowed based on WACC

"FLLRIC should allow the carrier to earn a reasonable return on its investment as measured by a weighted average cost of capital ("WACC"). The carrier is required to provide support for the forward-looking WACC assumed in its FLLRIC analysis. Among other things, the carrier is required to demonstrate, with specificity, the business risks it faces in providing certain carrier services such as interconnection and access to infrastructure sharing, as contrasted to the business risks it faces when providing retail services in competition with other carriers. Alternatively, or in the absence of sufficiently robust supporting information, benchmarking analysis of the WACCs of similarly situated carriers providing comparable services may be used to support a proposed forward-looking WACC for C&W."

It is good regulatory practice to allow an operator to recover a reasonable and fair return on the regulated assets it employs. In principle this is non-contentious. However, in practice the calculation of a WACC can be complex and typically a range of estimates will emerge.[18] *Benchmarking may be helpful as a check on the plausibility of values generated from models such as the capital asset pricing model (used to compute the cost of equity).*

[18] An excellent account on the cost of capital in regulated industries was produced for regulators in the UK in 2003, see Wright, Mason and Miles (2003).

Annex D: Curriculum vitae

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Contents

Qualifications 2
Current and past positions 2
Consulting assignments (in reverse chronological order) 4
Independent economic consultant May 2002-present 4
At Charles River Associates UK Limited (August 2000 – April 2002) 11
At London Economics Limited (October 1999 – July 2000)....13
Independent (November 1992 – September 1999)....14
Papers and publications on telecommunications and related network industries 16
Current teaching and supervision 20
The economics of competition policy....20
Seminar presentations since 2000 20

Qualifications

Date of birth	Education	Nationality
6 April 1960	Secondary: Xaverian College, Manchester 1971-78, 7 O levels, 4 A levels University: University College Wales, Cardiff 1978-81, First Class honours, Economics – 1st in year University of Warwick 1981-84 MA and Ph.D. in Economics	British

Current and past positions

Year	Current positions	Location
July 2004 - present	Associate Fellow, Department of Economics, University of Warwick and Centre for Management under Regulation, Warwick Business School	Warwick
May 2002- present	Independent consultant economist	

Year	Previous positions	Location
July 2004- February 2007	Senior Research Fellow, Centre for Management under Regulation, Warwick Business School	Warwick
May 2002-June 2004	Independent economic consultant Associate Fellow, Department of Economics, University of Warwick Associate Fellow, Centre for Management Under Regulation, University of Warwick	Warwick
August 2000 – April 2002	Vice President, Practice Head Telecoms, and Director of Charles River Associates (UK) Ltd.	London
October 1999 – July 2000.	Director of Telecoms, London Economics	London
January 1996 – September 1999	Senior Research Fellow, London Business School	London

October 1992 – December 1995	Senior Research Officer, Department of Applied Economics, University of Cambridge	Cambridge
October 1989 – September 1992	Research Officer, Department of Applied Economics, University of Cambridge	Cambridge
October 1986 – September 1991	Fellow, Gonville and Caius College, Cambridge	Cambridge
October 1985 – September 1987	Junior Research Officer, Department of Applied Economics, University of Cambridge	Cambridge
October 1984 – September 1985	Lecturer, Department of Economics, University of Essex	Colchester
	Other previous positions	
January 2003 – June 2003	Visiting Lecturer, London School of Economics	London
January 1999 – March 1999	Adjunct Professor, INSEAD	Fontenbleau, France
September 1991 – March 1992	Visiting Professor, CERGE, Charles University	Prague, Czech Republic
October 1991 – September 1992	Assistant Director of Studies, Gonville and Caius College	Cambridge
January 1989 – May 1989	Visiting Assistant Professor, Queen's University	Kingston, Canada
October 1988 – September 1989	Affiliated Lecturer, Faculty of Economics and Politics, University of Cambridge	Cambridge
October 1985 – September 1986	College Supervisor, St. John's College	Cambridge

Consulting assignments (in reverse chronological order)

Independent economic consultant May 2002-present

Client: ***BBC June 2008 – July2008***
Task: Advise on spectrum auction in relation to digital dividend released (DDR) spectrum.
Client contact: Najma Raja

Client: ***Telecommunications Regulatory Authority, Oman, May 2008 – September 2008***
Task: Advise on spectrum matters, auction design and spectrum pricing.
Client contact: Intercai Mondiale

Client: ***Telekom Polska, June 2008 – July 2008***
Task: A report looking at investment incentives and functional separation.
Client contact: Telekom Polska

Client: ***SingTel Optus Australia, April 2008 – June 2008***
Task: Provide advice and write report on structural separation and the National Broadband Network tender competition.
Client contact: Andrew Sheridan, Optus Australia

Client: ***Competition Commission UK, April 2008 –***
Task: Provide advice on cases of relevance to the electronic communications sector.
Client contact: Marie Clarke

Client: ***Operator in South Africa, April 2008***
Task: Prepare and advise on consultation responses on market power and remedies.
Client contact: AAACS

Client: ***OTE, February 2008 – July 2008***
Task: Report on functional separation. Includes presentations to senior management.
Client contact: AAACS

Client: ***Gibraltar Regulatory Authority (GRA), January 2008 – July 2008***
Task: Assistance on design and implementation of remedies in market reviews.
Client contact: Stewart Brittenden, GRA

Client: ***ComReg, March 2008***
Task: Organized and presented a series of training workshops on spectrum auctions.
Client contact: Triona Kelly, ComReg

Client: ***InfoDev World Bank, August 2007 – November 2007***
Task: Lead Consultant and Team Leader for World Bank training programme on competition policy for COMESA members in Addis Ababa, Ethiopia.
Client contact: Boutheina Guermazi, InfoDev

Client: ***Gibraltar Regulatory Authority (GRA), August 2007 – November 2007***
Task: Assistance on review of Market 16, mobile termination. Cost modeling.
Client contact: Stewart Brittenden, GRA

Client: ***HSL, August – October 2007***
Task: Economic advice to private client in relation to a Chapter II 1998 Competition Act case before Ofcom. Issues: refusal to deal, excessive pricing and alleged abuse of dominance. Market: wholesale termination of SMS.
Client contact: Mark Hay, HSL

Client: ***Dublin Port Company, August – September 2007***
Task: Independent report examining cost of Dublin city HGV exclusion zone.
Client contact: Michael Cleary

Client: ***Eircom, June 2007 – August 2007***
Task: Academic policy paper on structural and functional separation.
Client contact: Victoria Ergus, Eircom

Client: ***Department of Communications, Information Technology and Arts, Australia, March 2007 – May 2007***
Task: Contributor to report "The Analysis of Spectrum Policy Trends".
Client contact: George Barker, ANU

Client: ***Jamaican Fair Trading Commission, April 2007 – February 2008***
Task: Technical training provided to staff and economists in the Fair Trading Commission and the Office of Utilities Regulation on competition policy issues pertinent to network industries. On site workshops, seminars and one-on-one training; development of case study materials.
Lead consultant
Client contact: David Miller, JFTC

Client: ***Falklands Islands Government, December 2006 – present***
Task: Retainer arrangement with the Falkland Islands Government, providing advice on the reform and regulation of the telecommunications and communications sectors. In particular addressing where legislation requires revision and assisting the FIG in negotiations with Cable & Wireless Falkland Islands.
Lead consultant
Client contact: Pete King, Government Secretary, FIG

Client: ***Cable & Wireless Guernsey, December 2006 – February 2007***
Task: Advice in relation to an appeal submitted by C&WG to the Utilities Appeal Tribunal in Guernsey regarding the denial of a 3G licence in a comparative selection contest in June 2006.
Client contact: Jane Langlois, Regulatory Manager, C&WG

Client: ***Major UK broadcaster, Confidential UK, January 2007 – March 2007***
Task: Advice in relation to Ofcom's Digital Dividend Review. Working as part of a team led by David Lancefield at PricewaterhouseCoopers, London.
Client contact: Confidential

Client: ***EBRD for CRC in Mongolia, September 2006 – March 2008***
Tasks: (A) One week training programme for regulatory staff in Mongolia on the following topics: (i) Competition policy – market definition and market analysis relevant to network industries (ii) Price regulation – price caps, price floors and margin squeeze (iii) Spectrum management policy – auctions, secondary trading and administrative incentive prices. (B) Design of the interconnection regime and rates, framework and modeling, plus advice on the application of dominance concept. Implementation and design of regulations dealing with the structural separation of the incumbent operator.
Client contact: Andrew Dymond, Intelecon (Canada)

Client: ***TCRA Tanzania, October 2006***
Task: One week on site training programme for 20 communications regulatory staff in Tanzania on the following topics: (i) Competition policy – market definition and market analysis relevant to network industries (ii) Price regulation – price caps, price floors and margin squeeze (iii) Spectrum management policy – auctions, secondary trading and administrative incentive prices (iv) Interconnection – costs, forward looking LRIC, sender keeps all, ECPR (retail minus) (v) Numbering – economics of portability.
Lead consultant
Client contact: Goodluck Ole-Medeye, TCRA

Client: ***Associates for Research, September 2006***
Task: Organization and presentation of training course on radio spectrum management policy for 20 executives from Thailand, Sweden, Tanzania, Kenya and Luxembourg. Course held at London School of Economics.
Client contact: Charles Opara, Associates for Research Ltd

Client: ***Home Shopping Network Inc. and iBuy TV Limited, July 2006 – August 2006***
Task: Prepared expert economists report on market definition in a competition case involving an alleged abuse of dominance. The focus of the report was on two-sided markets. Worked closely with lawyers from Gibson Dunn & Crutcher.
Lead economic consultant
Client contact: James Ashe-Taylor, Gibson Dunn & Crutcher LLP, London

Client: ***ComReg, June 2006 – September 2006***
Task: Organized and presented a series of training workshops on the new regulatory framework with the focus on market definition and market analysis. Wrote and supplied training manual to assist regulatory staff when conducting market reviews.
Client contact: Caoimhe Donnelly, ComReg

Client: ***Ofcom, May 2006 – February 2007***
Task: Economist contributing to project assessing the dividend associated with fixed links and improved spectrally efficient technologies.
Client contact: Ofcom

Client: ***Gibraltar Regulatory Authority (GRA), May 2006 – March 2007***
Task: Undertaking the 18 market reviews for the GRA in accordance with the 2002 EU Directives.
Client contact: Stewart Brittenden, GRA

Client: ***PriceWaterhouseCoopers, April 2006 – May 2006***
Task: Advise on auction design for Iraq GSM licenses. Wrote report for financial advisors to the Interim Iraq Government.
Client contact: Jitesh Shah, Corporate Finance PWC London

Client: ***Montserrat Government and FCO, January 2006 – December 2006***
Task: Report and site visit advising on the liberalization of the telecommunications sector in Montserrat. Undertook cost study to assess viability of network competition on Montserrat.
Client contact: Francis Kayada, FCO

Client: ***Anacom (Portuguese telecoms national regulatory authority), February 2006 – May 2006***
Task: Advising on the competition implications of the bid submitted by Sonae for Portugal Telecom. Report submitted examining market analysis of the mobile and fixed sectors in the context of the proposed merger. Prepared suggested remedies to address competition concerns.
Client contact: Pedro Duarte Neves, Director, Anacom

Client: ***TAIEX European Commission for the Lithuanian government, November 2005***
Task: Prepare, organize and present workshop on the EU Regulatory Framework on Electronic Communications. This was held on 3 and 4 November 2005 in Vilnius, Lithuania. The focus was on competition policy and market reviews under the European regulatory framework. Course of seminars and lectures presented to members of the national regulatory authorities in telecommunications and energy, and to judges (presented jointly with Professor Martin Cave).
Client contact: Jurate Masiulionyte, RRT, Lithuania

Client: ***Associates for Research, November 2005***
Task: Presentation of training course in the form of lectures and seminars on economic regulation of telecoms; regulation of pricing; joint dominance and the electronic communications regulatory framework in the EC.
Client contact: Charles Opara, Associates for Research

Client: ***British Virgin Islands Government, July 2005 – May 2006***
Task: Retained advisor to the BVI Government on the liberalization of the telecommunications sector. Member of Government liberalization negotiation team. Undertook cost study analysis to assess viability of competition in the cellular market, tariff analysis, and other related issues.
Client contact: Neil Smith, Financial Secretary, BVI Government

Client: ***Public Electronic Communications Network (UK), June 2005 – June 2006***
Task: Economic advice to private client in relation to a Chapter II 1998 Competition Act case before Ofcom. Issues: refusal to deal, excessive pricing and alleged abuse of dominance. Market: wholesale termination of SMS.
Client contact: Rod Kirwan, Denton Wilde Sapte, London

Client: ***Ascension Island Government, June 2005 – May 2006***
Task: Advising on reform of the telecommunications sector. Wrote report for the Ascension Island Government on the status of telecommunications and its regulation in Ascension. One site visit for a week and meetings with local officials.
Lead consultant
Client contact: Michael Hill, the Administrator, Ascension Island

Client: ***European Commission Competition Directorate, June 2005 – December 2005***
Task: Advice in relation to Statement of Objections regarding an Article 82 abuse of dominance case involving two mobile network operators in the UK. Market: national market for international roaming onto cellular networks. Alleged abuse relates to excessive pricing.
Client contact: Manuel Martinez-Lopez, European Commission

Client: ***ITU, May 2005 – September 2005***
Task: Commissioned by the ITU to write a report on spectrum management harmonization in 15 West African states. The report submitted to the WATRA (West African Telecommunications Regulators Assembly) meeting in WATRA validation workshop, Accra, Ghana. Attending were CEOs of the 15 regulatory authorities attached to WATRA.
Client contact: Doreen Bogdan, ITU, Geneva

Client: ***Turks and Caicos Islands Government Attorney General's Chambers, March 2005 – December 2005***
Task: Advising on liberalization of the telecommunications sector. Drafting new licenses and developing framework for competition regime. Three separate visits to assist

government in preparation for liberalized telecommunications markets. Worked closely with legal counsel and external legal support. Helped draft legislation.
Lead economic consultant
Client contact: Kurt Defreitas, Attorney General, TCI Government Executive

Client: ***Falklands Islands Government, August 2004 – present***
Task: Retained by the Falkland Islands Government to advise on the reform and regulation of the telecommunications and communications sectors.
Lead consultant
Client contact: Pete King, Government Secretary, FIG

Client: ***Independent Communications Authority for South Africa, July 2004 – January 2005***
Task: Advising on the design and implementation of a price-cap (on and off-site). Assisting staff at ICASA and drafting consultation report and assisting Commissioners in the public hearings.
Client contact: Tracy Cohen, Councillor, ICASA, Johannesburg

Client: ***Commission for Communications Regulation, Ireland, April 2004 – December 2005***
Task: Advice on the application of remedies, market definition and analysis in market reviews under the new regulatory framework. Drafting notices and assisting in appeals. Close involvement in the mobile access and call origination review and appeal, interconnection review, and retail minus consultation. Advise on the appeal involving Hutchison 3G Ireland and mobile termination.
Client contact: Isolde Goggin, former Chairperson, ComReg

Client: ***Ministry of Economic Affairs, Netherlands, June 2003 – January 2004***
Task: Key economist on team undertaking work on providing a conceptual framework for the application of new spectrum charges in the Netherlands. With Quotient Associates and Tilburg University. Report available at: Final Report.

Client: ***Digicel Aruba (New Millennium Telecommunication Services B.V.), October 2003***
Task: Provide expert testimony in court on the concession fee.
Lead consultant
Client contact: Isaac Waincier, CEO, NMTS

Client: ***Radiocommunications Agency, United Kingdom, April 2003 – December 2003***
Task: Review the economic methodology used to form spectrum prices in the UK, and develop extensions where necessary. Key economist on team. Wrote report submitted to Ofcom and subsequently implemented by Ofcom. With Indepen with Aegis Systems.
Client contact: Phillipa Marks, Indepen

Client: ***Radiocommunications Agency, April 2003 – December 2003***
Project: Contributed as economist to study into the impact of reduced research into electromagnetic contamination. Project led by Quotient Associates with York EMC.

Client: ***ECTEL (Eastern Caribbean Telecommunications Authority), December 2002 – March 2003***
Task: Advise ECTEL Board on the design of new retail price-cap for ECTEL member states. Completed report and made presentation to ECTEL Board in St. Lucia.
Client contact: Anderson Reynolds, ECTEL.

Client: ***Cellular operator in Middle East, November 2002***
Task: Assess call termination charges and tariffs for SMS in Europe and elsewhere. Report for client and on site assistance in meetings with Ministry.
Lead consultant
Project manager: Confidential.

Client: ***New entrant cellular operator in the Caribbean, October 2002 – September 2003***
Task: Provide expert testimony to court and advised on a range of issues connected with licence valuation and interconnection terms. Advising senior management during interconnect negotiations.
Client contact: Jarleth Burke, Jones, Day, Brussels.

Client: ***Hutchison 3G UK, October 2002***
Task: Provide expert opinion and report on spectrum trading. Report submitted to Ofcom.
Project manager: Confidential.

Client: ***Major European ISP, June 2002 – January 2003***
Task: Advice on competition issues related to alleged leverage of dominance by an incumbent telecommunications operator, and submit expert opinion.
Project manager: Confidential.

Client: ***Government of Anguilla, British West Indies, April 2002 – April 2003***
Task: Member of government negotiation team. With Professor Martin Cave completed report "Costs, Price Rebalancing and Competition in the Anguilla Telecommunications Market". Several on site visits and presentations to Government officials and Governor.
Client contact: Kenn Banks, Government of Anguilla.

At Charles River Associates UK Limited (August 2000 – April 2002)

Client: ***Energis plc, January 2002***
Task: Completion of expert report submitted to Oftel, UK telecoms regulator.
I wrote an expert's report "xDSL interconnection at the ATM switch: Pricing methodology" which was Annex 1 of the Energis submission to Oftel in response to the draft Directive "Interconnection with BT's ATM network" published December 21, 2001. Energis manager: Andrea Dworak.

Client: ***UK mobile network operator, December 2001***
Task: Joint-Manager of Competition Commission inquiry on Calls to Mobile
Assisted the preparation during the early stage of submission by operator to Competition Commission. Counsel: Chris Watson at Allen & Overy.

Client: ***Goldman Sachs, June – July 2001***
Task: Visit leading fund managers in the City.
Produced paper examining the consequences of the new EU telecoms directives for spectrum trading. Client was interested in possible ramifications for the German 3G market. Met with over twenty-five different leading fund managers to discuss spectrum trading and other telecoms issues. Goldman Manager: Louis Greig.

Client: ***Victor Chandler International, May 2001***
Task: Modelling of new betting product.
Client required revenue analysis of new betting product. Work involved completion of report and simulations. Victor Chandler Manager: Matthew Avison (now with Littlewoods).

Client: ***Global telecoms equipment manufacturer, April – June 2001***
Task: Expert testimony.
Completed expert report submitted to the US District Court for the Eastern District of Texas, Sherman Division. Provide expert testimony to the court arguing a case for Material Adverse Effect. The client who was a defendant in a class action case brought by shareholders in a US company acquired by the client. The class action was dropped following submission of expert reports. Counsel: Chris Malloy at Skadden, Arps in New York.

Client: ***Partner Communications (Orange) Israel, January – December 2001***
Task: Bid support and strategy in Israeli 2G and 3G spectrum auction.
Principal advisor to UMTS management team (Sharon Haran and Adi Biran) regarding bid strategy. Visited client on two separate occasions to prepare senior management (CEO and CFO) for auction – involved mock auctions and meetings. Completed several notes, and wrote responses to auction rules prepared by the Ministry of Communications (MoC). MoC implemented suggestions made regarding bid forms. Partner manager: Sharon Haran.

Client: ***Elektrim S.A., December 2000 – January 2001 (Polish energy group with telecoms interests)***
Task: Expert Testimony.
Wrote and submitted an expert report to the International Court of Arbitration of the International Chamber of Commerce. Cross-examination took place in New York, January 30, 2001. The client was a respondent/counter-claimant in a dispute involving an acquisition. Testimony related to an alleged material adverse effect. Counsel: John Gardiner at Skadden, Arps in New York.

Client: ***Nigerian Communications Commission*** **(with Radio Spectrum International),** ***September 2000 – January 2001***
Task: Design GSM spectrum and assist implementation.
Principal advisor and auction designer for world's first ascending clock spectrum auction. Liaising with leading auction academic Professor Peter Cramton, I specified the auction rules and wrote significant portions of the Information Memorandum. Led bidder workshops and bidder briefings, and worked with Executive Vice Chairman Ernest Ndukwe to determine auctioneer increments. NCC manager: Ernest Ndukwe.

Client: ***FirstMark Communications UK Limited, September 2000 – November 2000***
Task: Bid support and strategy in UK BFWA spectrum auction.
Working with Professor Peter Cramton led a team that provided bid support to the client for the UK BFWA spectrum auction. A simple Bid Track Tool (BTT) was designed using Excel and visual basic programming. The BTT was designed to be used independently by the bid team, comprising the UK Senior VP (Keith Cornell) and other senior managers. Conducted mock auctions with staff and provided detailed guidance on strategy. FirstMark manager: Keith Cornell.

Client: ***Omnitel*** **(*Vodafone*)**, ***September 2000 – October 2000***
Task: Bid support and strategy in Italian 3G spectrum auction.
Working with Professor Peter Cramton led a small team that provided bid support to the client for the Italian 3G spectrum auction. A sophisticated yet user-friendly Bid Track Tool (BTT) was designed using Excel and visual basic programming. The BTT was designed to be used independently by the bid team, comprising the CEO and other senior managers. Conducted mock auctions with the CEO and CFO, and provided detailed guidance on strategy. Omnitel manager: Giovanni Strocchi.

Client: ***British Horseracing Board (BHB), August 2000 – January 2001***
Task: Write and submit report to the Gambling Review Body
Undertook detailed cost-benefit analysis investigating merits of allowing gambling in public houses in the UK. Work involved modelling and survey design. Results presented to the Board at the BHB, and subsequently submitted by the BHB to the Gambling Review Body, chaired by Professor Alan Budd. BHB manager: Tristram Ricketts, Secretary-General to the BHB.

Client: ***Energis plc, August 2000 – October 2000***

Task: Advise on strategy in Bow Wave Process (local loop unbundling)
Undertook software modeling of strategic options for the bow wave process. Provided client with user-friendly software to analyse different scenarios for assessing local loop unbundling. Energis manager: Paul Roberts.

At London Economics Limited (October 1999 – July 2000)

Client: ***Meridian Communications Limited, March – July 2000***
Task: Expert testimony.
Completion of report "The Economics of Mobile Telephony: Elements, Costs, Objective justifications, and Access Pricing". This was submitted to the High Court in Ireland in a case presided by Justice O'Higgins. I was cross-examined in the High Court, Ireland on July, 15, 2000. Counsel: Dominic Dowling.

Client: ***GroupTrade.com, January – May 2000***
Task: Quantifying the benefits of business to business e-procurement for small to medium sized enterprises in the UK.
Undertook detailed modeling to quantify the benefits of business to business e-procurement. Co-authored the report "Business-to-Business e-procurement: Small and medium sized enterprises" with Paul McShane. GroupTrade manager: Dominic Owens.

Client: ***Telecom New Zealand, January – April 2000***
Task: Report submitted to Ministerial Inquiry into Telecoms, New Zealand.
I co-authored a report with Nick Carver (then at Quotient Communications) for the client entitled "The Dynamics of Local Access: Telecommunications in New Zealand". The report examined in detail different access technologies and described likely evolutionary paths for market structure. The report was submitted to the New Zealand Ministerial Inquiry into the telecoms sector.

Client: ***Victor Chandler Business Services, April – July 2000***
Task: Modelling of lottery style betting product.
Client required detailed modeling of a new lottery style betting product. Presentations made to interested parties. Statistical work undertaken in collaboration with Dr Michael Pitt at University of Warwick. Victor Chandler manager: Paul Pullinger.

Client: ***Worldcom, February – March 2000***
Task: Expert report and submission to the European Commission.
Completion of report: "Pricing principles for call origination and access services" which was submitted to the European Commission. Detailed economic analysis of call origination services. Worldcom manager: Barney Lane.

Client: ***One.Tel UK Limited, January – April 2000***
Task: Bid support for the UK 3G spectrum auction.
Client required bid support and market analysis to prepare and participate in the UK 3G auction. Work was carried out in close collaboration with joint Managing Directors

Bradley Keeling and Jodee Rich. Software designed to aid bid team, and mock auctions and simulations undertaken. One.Tel manager: Jodee Rich.

Independent (November 1992 – September 1999)

Client: *UUnet, September 1999*
Task: Report.
"European telecommunications operators and internet access: market structure and economic issues". UUnet manager: Sally Weatherall.

Client: *Department of Telecommunications, Advanced Level Telecom Training Centre, Ghaziabad, India, July 1999*
Task: Lectures on telecoms regulation.
With Dr Tim Kelly of the ITU presented a course of lectures to over twenty five managers. DoT manager: Mr. H.P. Meena.

Client: *Telecom Italia, March 1999*
Task: Report.
"A study on interconnection between fixed and mobile networks: developing strategy". Presented to senior management in Rome. Telecom Italia manager: Giovanni Amendola.

Client: *European Commission, December 1997 – June 1998*
Task: Expert Report.
A report was produced looking at MVNOs with respect to a number of economic and regulatory issues associated with the implementation of the EU telecoms regulatory framework, especially with regard to interconnection and access. EU manager: Richard Crawley.

Client: *OECD Competition and Consumer Policy Division, May 1995*
Task: Report.
"The economics of access pricing" with Dr Mark Armstrong. Presented to OECD conference on Competition and Regulation in Network Infrastructure Industries, Budapest, May 1995.

Client: *British Telecom, March 1995*
Task: Report.
"Review of the UK telecommunications market structure" with Robert Browne and Ian Burnett.

Client: *UNDP, May 1994*
Task: Report.
"Telecommunications: privatization and regulation in the UK".

Client: *HM Treasury, December 1993*

Task: Report.
"Network access pricing" with Mark Armstrong.

Client: ***Bell South Enterprises, November 1992***
Task: Expert Report.
"The development of PCS in the UK: lessons for the FCC" appendix to submission to a FCC Docket on PCS.

Papers and publications on telecommunications and related network industries

Spectrum Auctions and the Role of Reserve Prices
Paper to be presented to ITS Europe conference Rome September 2008.

Administered Incentive Prices and the Management of Radio Spectrum: Theory and Applications
Paper to be presented to ITS Europe conference Rome September 2008.

Functional, Structural and Legal Separation: Is Divorce cheaper than Trial Separation?
Paper to be presented to ITS Europe conference Rome September 2008.

Structural separation and investment in the National Broadband Network environment
A paper for Optus Australia, June 2008, available at www.optus.com.au

Contracting across separated networks: lessons form theory and practice
Communications and Strategies No 4, 2007 (with Martin Cave).

Essentials of Modern Spectrum Management [book]
Cambridge University Press, August 2007 (with William Webb and Martin Cave).

Market prices boost efficiency
Policy Tracker, Spectrum, pp. 10-12, March 2007

Collective Dominance, Market Analysis and the 2002 EU Framework Directive:
The case of mobile access and call origination in Ireland
Digital Economic Dynamics: Innovations, Networks and Regulations, edited by Paul J.J. Welfens and Mathias Weske, chapter 7 pp. 141-170, Springer Press 2007.

Where are we going? Technologies, markets and long-range policy issues in European communications
Information Economics and Policy, pp. 242-255, 2006
With Martin Cave and Luigi Prosperetti.

Convergence and Spectrum Licensing
Trends in Telecommunications Regulation, chapter 6, ITU Geneva, December 2004.

On the design of the GSM auction in Nigeria – the world's first ascending clock auction
Telecommunications Policy, vol. 27 (5-6), 383-405, June-July 2003.
With Paul McShane.

Licensing of 3G mobile systems: Chairman's report
ITU News, Issue 9, 2001, Geneva, September 2001.

Local loop unbundling and regulatory risk
Journal of Network Industries, vol. 1, no. 1, June 2000.

Liberalisation of utilities and evolving European regulation
Economic Outlook, vol. 24, no. 3, 18-26, April 2000.
With David Coen.

London's growth sectors: telecommunications – ahead but watch out for Amsterdam
The New Statesman, April 10, 2000 (London Supplement).

Vodafone-Mannesmann is just the beginning
The Wall Street Journal, editorial features, February 11, 2000.

Virtual moves in mobile markets
Telecommunications, February pp. 55-57.

A European Market for Electricity?
Monitoring European Deregulation, Annual Report Number 2, published by CEPR/SNS, November 1999. Multi-author study. Introductory chapter.
With Martin Siner.

Bandwidth and minutes exchanges
European Telecommunications Intelligence Bulletin, vol. 1, no. 1, 12-13, November 1999.
With Toby Robertson.

Designing economic regulatory institutions for European network industries*
Current Politics and Economics of Europe, vol. 9, no. 4, 83-106, 1999.
With David Coen.

The Economics of the Media: The Convergence of the Transition Countries with EU Member States, published by the Research Centre of the Slovak Foreign Policy Association, Bratislava, May 1999. (Book of 211 pages.)
With Martin Cave, Zdeněk Hrubý andAnton Marcincin.

Market structure in mobile telecommunications: the receiver pays principle and qualified indirect access*
Information Economics and Policy, vol. 10, no. 4, 471-488, December 1998.
With Jennifer C Smith.

Liberalizing Europe's network industries: ten conflicting priorities
Business Strategy Review, vol. 10, no. 1, 55-66, autumn 1998.
Reprinted in Italian in *Management Publications,* Editiones PMP.

Europe's Network Industries: Conflicting Priorities (Telecommunications)
Monitoring European Deregulation, Annual Report Number 1, published by CEPR/SNS, September 1998. (Book of 258 pages, plus xxii.)
Lead author of Part 1 (140 pages), other authors: Lars Bergman, Damien Neven and Lars-Hendrik Röller. Co-author on part 2 with Jordi Gual, Lars Hultkranz and Len Waverman.

Social obligations and access pricing: telecommunications and railways in the UK
Chapter 8 in *Opening networks to competition: the regulation and pricing of access*, edited by David Gabel and David F. Weiman, Kluwer Academic Press, 1998.
With Mark Armstrong.

Programming in a competitive broadcasting market: entry, welfare and regulation
Information Economics and Policy, vol. 10, no. 1, 23-39, March 1998.

Self regulation and statutory regulation
Business Strategy Review, vol. 8, no. 3, 35-42,Summer 1997.

Promoting efficient competition in telecommunications
National Institute Economic Review, no. 159, 82-91, January 1997.

Sectoral regulation: telecommunications in the EU
Journal of European Public Policy, vol. 3, no. 4, 612-28, December 1996.

The access pricing problem: a synthesis
Journal of Industrial Economics, vol. XLIV, no. 2, 131-150, June 1996.
Reprinted in *Economic Regulation*, edited by Paul L. Joskow, Edward Elgar Publishing Limited, 1999, chapter 24, pp. 673-692.
With Mark Armstrong and John Vickers.

The pricing of access in networks: theoretical and practical issues
Rivista Internazionale di Scienze Sociali, vol. 103, no. 1, 27-38, 1995.

Some efficiency aspects of price regulation
European Transactions on Telecommunications, vol. 6, no. 4, 415-420, 1995.

British Telecom
Chapter 4 in *Welfare consequences of selling public enterprises: an empirical analysis*, edited by A. Galal, L.P. Jones, P. Tandon, and I. Vogelsang, Oxford University Press, 1994.
With Manuel Abdala, Ingo Vogelsang, Leroy Jones and Pankaj Tandon.

Access pricing in network utilities: theory and practice

Utilities Policy, vol. 4, no. 3, 181-189, 1994.
With Martin Cave.

Common carriage and the pricing of electricity transmission
The Energy Journal, vol. 13, no. 3, 63-93, 1992.
With Maria Maher.

Current teaching and supervision

The economics of competition policy

Ten lectures third year economics undergraduates at the University of Warwick – Intermediate economics of competition policy: theory and practice course, since 2003. Supervision of MBA dissertations and doctoral students.

Seminar presentations since 2000

Digital Dividend Review and Switchover – Where are we now?
Keynote presentation to Westminster eForum "After Whitehaven – Next Steps for the Digital Dividend Review" conference, London, 30 January 2008

Vertical separation and value
Presentation to Telecom Separation – Regulatory & Financial Implications conference, Le Châtelain All Suite Hotel, Brussels, 17 October, 2007

The Liberalisation of Spectrum Management: What needs to be done?
Presentation to GSM Association, 19 June 2007

Spectrum Policy changes in the UK and lessons for the Netherlands
Presentation to Trends en ontwikkelingen in de ether WTC Rotterdam, 6 June 2007

Pricing Radio Spectrum
Presentation to ARICEA meeting in Cairo for COMESA, Cairo, 22 May 2007

The Price of Radio Spectrum: Using Incentive Mechanisms to Achieve Efficiency
Presentation to ITU Workshop Market Mechanisms for Spectrum Management, Geneva, 22-23 January 2007

Review of EU Spectrum Policy
Presentation at Improving the Regulatory Framework for Electronic Communications: Challenges for the Next Decade, conference of CBKE (University of Wrocław), CIL (Hungarian Academy of Sciences), WIK, under auspices the Polish regulator UKE, University of Wrocław, Wrocław, 18-20 October 2006

Joint Dominance and the Electronic Communications Regulatory Framework in the EU
Presentation to JUS Forum Telecom (Norwegian Lawyers), Oslo, 5 November 2005

An Examination of Collective Dominance Under the New Electronic Communications Regulatory Framework
Presentation to Gibson Dunn Annual Competition Conference, Brussels, Belgium, 11 October 2005

The Implementation of Spectrum Trading in the UK

Presentation to National Communications Authority Annual Conference, Budapest, Hungary, 16 September 2005

EU Policy, Mobile and Broadband: Lessons for West Africa
Presentation to WATRA CEO Forum, Accra, 8 September 2005

Regulation and Competition: Price controls and other regulatory instruments in telecoms and water
Presentation, St. Andrews, 13 May 2005

Towards a New Era in Spectrum Management
Presentation to Global Symposium for Regulators, ITU, Geneva, 8 December 2004

Regulation and Competition in Telecoms and Water
Warwick Business School, 29 November 2004

The New Regulatory Framework in European Telecommunications: Paving the way for competition
LINK Centre, WITS Business School, Johannesburg, South Africa, 22 October 2004

The Economics of Spectrum Pricing
Department of Economics, University of Warwick, 16 January 2004

The Theory and Practice of Spectrum Pricing
London School of Economics, 3 November 2003

The New EU Regulatory Framework for Electronic Communications: Market Definition
Roundtable presentation to Faculdade Economia da Universidade Nova de Lisboa, Portugal
3 February 2003

Market Definition and Dominance
Presentation to the ITU Competition Policy Workshop, Geneva, 20-22 November 2002

Government Objectives for Broadband Access: Is Policy Consistent?
Presentation to CEPR/ECARES The Evolution of Market Structure in Network Industries Final Conference, Université Libre de Bruxelles, 8/9 November 2002

Spectrum Trading: Where, When and How?
Presentation to international conference on Convergence in Communications Industries, Warwick University, 2-4 November 2002

Mobile Telecommunications and Competition Policy: Comparing Australia and the United Kingdom

International Telecommunications Society, Madrid, 9 September 2002.

Spectrum fees, charges and auctions
On the move the CEPT 10th annual conference, Vienna, 17-19 April 2002

On the design of the GSM auction in Nigeria – the world's first ascending clock auction, Competition in wireless: spectrum, service and technology wars conference, organized jointly by PURC, CIBER and PPRC (University of Florida) and the Global Communications Consortium (London Business School), Gainesville, Florida, 19-20 February 2002

Chairman of ITU Workshop on Licensing of Third-Generation Mobile, Geneva, 19-20 September 2001.

On the design of the GSM auction in Nigeria – the world's first ascending clock auction
International Telecommunications Society, Dublin, 2 September 2001.

European MVNOs
Wireless 2001, New York City, 13-14 June 2001.

Spectrum auctions
African Telecommunications Summit, Accra, Ghana, 26-29 April 2001.

Pricing mobile services and MVNOs
Phillips Tarifica 6th Global Pricing Congress, Barcelona, 15-16 February, 2001.

Telecommunications services location
Globalization and the Location of Economic Activities, organized by IESE, Barcelona, held in Sitges, Spain, 27-28 October 2000.

e-procurement: evaluating benefits for SMEs
Telecommunications Policy Research Conference, Alexandria, Virginia, USA, 23-25 September 2000.

Telecommunications: moving away from sector specific regulation
CEPR Policy Session on network industries, Royal Economics Society, St Andrews, July, 2000.

The microeconomics of the Internet
Presentation to the Society of Business Economists Annual Conference The Global Economy in a Wired World, 13 June, 2000.

General economic principles of deregulation of Europe's network industries

Opening lecture in the Fortis Bank Chair series, FETEW, KU Leuven, 3 February, 2000.