



**Cost Accounting and Pricing Principles
in Finnish Digital TV Transmission**

**Condensed Report to FICORA for
Public Consultation**

**by
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09 September 2005



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1 INTRODUCTION

1.1 Background and structure

1.1.1 This report on cost accounting and pricing principles in digital TV transmission services in Finland describes work carried out by Europe Economics and Quotient Associates under FICORA case number 34/230/2005.

1.1.2 It is notable that FICORA does not have the powers to set prices *ex-ante*, and consequently does not undertake a period price control review in the traditional regulatory sense. The analysis and the recommendations in this report take this into account. We aim to provide a robust and practicable basis of principles for FICORA to utilise when undertaking *ex-post* assessment of Digita's wholesale prices.

1.1.3 The structure of the report is as follows.

- Chapter 2 sets out our understanding of the market for digital TV transmission in Finland.
- Chapter 3 contains a technical analysis of the network. Within Chapter 3 the first section describes the network and services provided. The second section discusses cost structures and possible ways of allocating capital costs to different network elements. Finally, we discuss possible ways of pricing the infrastructure pricing factors and rehearse possible future changes to the network.
- Chapter 4 describes a range of cost accounting and pricing principles that we consider relevant to digital TV transmission in Finland.
- Chapter 5 describes the criteria we use for choosing among the different options and sets out our recommendations under two different assumptions.
- Appendix 1 gives a glossary of the technical and economic terms used in the report, and Appendices 2 and 3 explain, respectively, alternative approaches to depreciation and to calculating the cost of equity.

1.1.4 This public version of the report omits material presented and analysed in the original report, especially in chapter 3. The omissions have been made to protect commercially sensitive information of Digita and Digita's clients.



2 THE MARKET FOR DIGITAL TV TRANSMISSION IN FINLAND

2.1 Introduction

2.1.1 In this chapter we briefly describe the market in digital TV transmission in Finland. We take as given any regulatory decisions already made in this market, and obligations applied to the incumbent. We emphasise this point because they are important factors in the choice of appropriate cost accounting and pricing principles.

2.1.2 The main sources of information for this chapter are:

- a memorandum on the market by the Ministry of Transport and Communications (MTC)¹;
- the subsequent decision by FICORA² that the incumbent operator, Digita Oy, has Significant Market Power (SMP)³; and
- information provided by Digita related to their services.

2.2 Regulatory and Policy Objectives

2.2.1 Our understanding of FICORA's objectives in the regulation of communications markets derives from material published by FICORA and from discussions with FICORA representatives.

2.2.2 At the highest level of policy the principal aim of FICORA is to promote the development of an information society in Finland. Within that, economic regulation aims to promote and protect competition, benefiting end users through better quality products, greater choice and lower prices. Economic regulation must ensure that competition in the market is effective and that companies comply with their statutory obligations regarding pricing and conduct.

2.2.3 FICORA is responsible for

- defining relevant communications markets on a regular basis;
- analysing the effectiveness of competition in each market;
- designating operators, where necessary, as SMP;
- imposing special obligations on operators with SMP; and

¹ http://www.ficora.fi/suomi/hmv/M18_LVM_muistiop_PAA.pdf

² http://www.ficora.fi/suomi/hmv/M18_Digita_paatosop_PAA.pdf.

³ See Glossary



- undertaking *ex-post* wholesale price assessment.

2.2.4 The aim of imposing obligations on operators with SMP is to relieve the effects of a lack of competition in a way that is not unreasonably onerous upon the companies concerned.

2.3 The Current Position

2.3.1 Digital broadcast transmissions in Finland are offered mainly through terrestrial and cable networks. Satellite is available, but only on a small scale. Even cable transmission is available only in relatively densely populated areas in certain towns and cities. Thus, terrestrial transmission is, effectively, the only way to achieve national broadcasting coverage.

2.3.2 Supply-side substitutability between terrestrial and cable is not economically feasible. That is to say, a cable network operator cannot easily provide terrestrial transmission, or *vice versa*. There are three main reasons for this:

(a) Large investments are involved, and in Finland it would not be economically viable to construct overlapping cable or terrestrial transmitter networks suitable for national distribution.

(b) The provision of network services in terrestrial mass communications requires a licence, and cable operators could not realistically obtain such a licence because of a shortage of suitable frequencies. Digital technology intensifies the use of frequencies, but no relief is expected for the current shortage of frequencies until analogue transmission is switched off.

(c) The technologies and infrastructure required differ substantially from one platform to another.

2.3.3 The MTC has thus decided that transmission services in terrestrial and cable networks are separate markets. Further, the MTC has judged that there is no substitutability between analogue and digital transmission services at the wholesale level. Finally, because regional digital TV transmission services are provided as a part of the national multiplex (see Glossary), digital TV transmission in Finland has been judged to be a single national market, separate from other transmission services.

2.3.4 Digita Oy is the only licensed network operator and provider of terrestrial digital television broadcast services in Finland. It not only owns and operates the infrastructure needed for transmission, but it also holds the only licence to the multiplex carrying spectrum itself. At the moment large parts of the bandwidth available for television broadcasting are taken up by analogue TV transmission, leaving room for only three multiplexes of digital TV transmission. This position will change in the relatively near future, specifically in August 2007, when analogue TV transmission is scheduled to cease.

2.3.5 The digital TV transmission network now covers 99,9 percent of the population. One of the three multiplexes, however, covers only 74 percent of the population. The three



multiplexes carry television and radio channels as well as data services. The current state of the network and the services carried are discussed in more detail in chapter 3.

2.4 Regulatory obligations on Digita

- 2.4.1 Given MTC's decision that the national market for terrestrial digital television transmission services should fall within the scope of *ex-ante* regulation, FICORA has investigated and found that, because of the legal and technical barriers involved, Digita has SMP in the market for terrestrial digital television transmission services. FICORA has therefore imposed the following obligations on Digita, which collectively are important in the selection of suitable cost accounting and pricing principles.
- 2.4.2 **Obligation to release capacity** in the terrestrial digital transmission network to broadcasters and telecommunications service providers. Digita cannot refuse access to content licence holders.
- 2.4.3 **Obligation to publish delivery terms and tariff information** regarding the multiplexing, transfer and transmitter network services needed for the digital transmission of television and radio programmes.
- 2.4.4 **Obligation to apply cost-orientated and non-discriminatory prices and terms of trade.** Cost orientation in Finland is interpreted to mean the cost of providing a service plus a reasonable return on capital invested. Efficiency considerations normally need to be taken into account so that operators do not impose the costs of (for example) outdated equipment or of wasteful management practices on users.
- 2.4.5 **Obligation to use cost-accounting procedures.** Digita is free to choose its preferred system, but it has to submit to FICORA a description of the procedures used, showing the main categories of costs and the rules by which such costs are allocated to different products or services.
- 2.4.6 **Obligation in relation to accounting separation.** Accounting separation requires all operations related to the multiplexing of digital channel bouquets, digital transmitter network services, nationwide analogue transmitter network services and both digital and nationwide analogue transfer services of programmes to be treated as one entity, separate from other services provided by Digita. The separation of assets is to be drawn up at book value including depreciation, and Digita must also submit its accounting separation principles to FICORA.

2.5 Future Developments

- 2.5.1 Although the focus of this report and the proposals we make relate to the current situation, it would be imprudent not to consider the possible implications of imminent major changes to the transmission market.
- 2.5.2 The principal change expected is the cessation of analogue TV transmissions in Finland, which is scheduled for August 2007. This single event has the potential to alter much of



the landscape in which digital TV transmission takes place today. It gives rise to two main consequences.

- 2.5.3 First, shutting down analogue TV transmission will release enough spectrum for more than double the present number of multiplexes for digital broadcasting (not just of TV but possibly of other services too). New licences to own and operate them could therefore be made available either for digital TV or for other digital broadcasting services.
- 2.5.4 Secondly, if new licences are made available and are awarded to companies other than Digita, the presence of competition, even if the new entrants use some of Digita's infrastructure, will significantly alter the nature of the market and the roles and power of the players. MTC and FICORA plan on reviewing the market after August 2007.
- 2.5.5 This study does not try to pre-empt the results of that analysis. However, the potential presence of direct competition (whether or not it is effective in the short term) is relevant to this project because the recommendations we make to FICORA for the period up to August 2007 may well affect the willingness of new players to compete with Digita after that date.



3 THE DIGITAL TV TRANSMISSION NETWORK

3.1.1 This chapter has been summarised from the original confidential report, to protect commercially sensitive information of Digita and certain aspects of national security. Some of the changes have been highlighted. The chapter discusses:

- (a) The overall digital TV and radio network structure in Finland and the key cost elements involved;
- (b) Which costs can be clearly associated with digital TV transmission, and which are shared across other operations;
- (c) Costs specifically related to the switchover from analogue-plus-digital TV transmission to all-digital; and
- (d) Potential future changes to the cost structure.

3.1.2 The purpose of this chapter is to identify the main cost components and to understand the network to the level required for regulatory costing and pricing **principles** to be applied to it. We emphasise that this report deals only in principles. We have not seen any of statement of actual costs incurred by Digita, nor have we attempted to estimate them. A more detailed study of the network and cost structures may be necessary when FICORA applies the chosen principles to Digita's cost accounts.

3.1.3 This chapter uses a large number of technical terms and acronyms, and we therefore draw attention to Appendix 1, which explains them in non-technical language.

3.2 Network and Services

3.2.1 Digital terrestrial TV (DTTV) has been broadcast in Finland since 27 August 2001 and now covers some 85-90 per cent of the land mass and 99,9 per cent of the population. This is achieved from Digita's 36 main transmitter stations and 13 sub-stations. Digita has an on-going programme to add digital TV transmission to remaining main transmitter stations. The extension in 2005 involves installing Multiplexes A and B to further main stations and relay stations. In addition, further relay stations will be built 2005-2006 to ensure adequate coverage. Some of these will involve conversion of existing analogue relay stations, others will be developed at new locations. Analogue TV is currently broadcast in parallel with DTTV but, as we have already noted, is to be switched off in August 2007.

3.2.2 With DTTV, several TV channels are simultaneously broadcast on a single carrier signal in the form of a multiplex. TV channels within a single multiplex can be from one or more TV companies, and can be broadcast at different bit rates (with correspondingly different



picture quality at the domestic receivers); and different transmitter sites can carry different TV channels.

3.2.3 Three multiplexes are currently licensed in Finland, multiplexes A, B and C.⁴

3.2.4 A simplified network diagram for that part of the Finnish DTTV service that is operated by Digita is shown in Figure 1. Although Digita is responsible for the digital encoding, multiplexing, microwave/fibre distribution and UHF broadcasting of all three multiplexes, the TV companies are permitted to perform their own encoding and to use other telecommunications networks in place of Digita's.

Figure 1: The DTTV network (within the dotted line) operated by Digita in Finland showing the network architecture and the main elements.

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3.2.5 The network operates as follows:

- (a) National digital TV content and radio is delivered in electronic form to Digita's national compression and multiplexing centre. Each TV or radio channel is encoded (compressed) and then assembled (multiplexed) into one of the three multiplexes.
- (b) The transport stream is then transported over Digita's national distribution network, either directly to a transmitter station, or via a regional re-multiplexing facility.
- (c) At the re-multiplexing facilities, the content of a multiplex can be modified through the insertion of advertisements or by the addition of a new channel for one already contained within the multiplex. This allows regional programmes or advertisements to be added to a multiplex.

3.2.6 At each transmitter station each multiplex is converted into a separate RF signal and broadcast from mast-mounted antennae.

3.2.7 Relay stations receive the radio signals broadcast by another transmitter station and simply rebroadcast the signals either on different frequencies or on the same frequency. There are currently 25 digital relay stations.

3.2.8 Network monitoring and control facilities are located at the multiplexing facilities and at the Transmitter stations. These are connected back to the central network management and control centre.

⁴ Details of services carried on each multiplex have been removed from the public version.



- 3.2.9 Some of the TV channels within Multiplex B and C are conditional access channels. Digita receives the information required for the generation of the EMM and ECM conditional access packets from the content provider, and generates the packets using the information provided. They are then inserted at the Digita multiplexing facilities.
- 3.2.10 We now describe the key functionality and equipment architecture of the major network elements.

The national compression and multiplexing centre

- 3.2.11 Figure 2 shows the main MPEG equipment, at the DVB system layer, for the three multiplexes.
- 3.2.12 Figure 2 shows how the digital video channels, with accompanying digital stereo sound signals, are presented to the input of the encoding and statistical multiplexing system. Additional stereo radio channels are also presented into the system.
- 3.2.13 Multiple digital video, audio and data sources are multiplexed together to achieve an optimum picture quality for a given overall multiplexed bit rate. This optimal statistical multiplexing has to take place at the same physical location as the compression encoding because there is a feedback loop between the multiplexer and the encoders to control this statistical process. This feedback loop requires a low time delay, which in turn means that all the equipment must be co-sited.

Figure 2: Main equipment components for Multiplex A at the national compression and multiplexing centre

[Removed from public version]

- 3.2.14 [Discussion of technical details and redundancy policies removed from the public version]
- 3.2.15 After leaving the national compression and multiplexing centre, the statistically multiplexed digital signals then pass over the distribution network to each of the Digita UHF transmitter stations.

Re-multiplexing facilities and Transmitter Stations

- 3.2.16 Figure 3 shows the MPEG/DVB equipment detail for a re-multiplexing facility and for the transmitter station for Multiplex C.
- 3.2.17 The re-multiplexing facility may also delete some of the incoming national content and add in new regional content in the space released. This local programme deletion and insertion process may require a small change to the incoming multiplexed bit-rates in order that the local programme insert will exactly fit into the multiplex.



Figure 3: key DTTV equipment components used for Multiplex C.

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3.2.18 During re-multiplexing, the service information (SI) packets are aligned to correspond to the final outgoing multiplex.

The Transmitter Station

3.2.19 The main DTTV components of the transmitter station are the COFDM modulators, UHF high power amplifiers, and the RF combiners and antennas as shown in Figure 3.

3.2.20 The COFDM modulators convert the digital data stream from the re-multiplexer into an OFDM signal ready for broadcasting. The high power amplifiers then amplify the modulator output to provide the necessary RF power. Up to this point each multiplex uses a separate set of equipment. Next, the high power RF signals from each multiplex are combined together before being fed up the mast. For convenience we refer to the modulator and high power amplifier together as the RF transmitter, and the combiners and antennae as the antenna system.

3.2.21 As illustrated in Figure 3, redundancy is also used here to guard against equipment failures.

Network Monitoring and Control

3.2.22 The network management system provides a comprehensive monitoring of equipment throughout the network, and allows for the remote control of equipment. Service monitoring is in fact extensive but is shown only briefly in Figures 2 and 3. All monitoring and control signals are fed to the central Network Monitoring and Control (NMC) facility.

3.2.23 The NMC facility is replicated at other locations.⁵

3.3 Cost Structure and Attribution of Costs

3.3.1 In this section we consider how costs can be assembled and attributed to the different multiplexes. The costs of the distribution network are left until the next section as they can conveniently be broken down by TV company.

DTTV equipment costs – the principles

3.3.2 The system description provided in the previous chapter makes clear that the equipment associated with DTTV can, to a large extent, be separated from equipment associated

⁵ The locations are not revealed for reasons of security.



with other services. Figure 4 shows how the DTTV network can be broken down into network elements and further separated by multiplex.

- 3.3.3 In Figure 4 each coloured box corresponds to a different DTTV network element. The colours show which can be separated by multiplex (A coloured red, B coloured green, and C coloured blue), which are shared between multiplexes (grey) and those that are shared by both DTTV and other services (white). In the case of the DTTV monitoring and control element some software services are shared between DTTV and other services. In the case of DTTV antenna systems some Transmitter stations have separate DTTV antenna installations whilst others use shared systems. These elements are shown shaded half grey and half white to reflect this.

Figure 4: DTTV network elements

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- 3.3.4 A base cost can be derived for each network element from the constituent equipment costs. There may be slightly different configurations at different locations within the network, but in our view it is adequate to use the average cost per network element.
- 3.3.5 RF transmitter costs vary with their RF power rating. If the costs per individual transmitter are relatively easily available, these could be used at the cost of some complexity in the model. If they are not, we suggest that two classes of RF transmitters be considered; those with an RF power rating of less than 2.5 kW, and those with a higher rating.
- 3.3.6 Similarly, the antenna system should be divided into two types, one for broadcasting three multiplexes, and one for two multiplexes.
- 3.3.7 Not all equipment costs are directly separable by multiplex. They, and the suggested approach to costing, are:
- (a) Where extra RF transmitters are used for redundancy, it makes sense to attribute the cost of the spares equally among the others;
 - (b) At transmitter stations the outputs of the RF transmitters are combined and radiated by a common antenna system. In this case the total cost of the antenna system can be attributed equally to the multiplexes broadcast from the system (either Multiplex A and B or all three are broadcast). Where the antenna is shared also with analogue TV transmissions, we suggest that each analogue channel be counted as equivalent to one fifth of a multiplex until analogue transmissions are switched off in 2007;
 - (c) Some of the equipment at the network monitoring and control centres is likely to be specific to individual multiplexes with the rest being common to DTTV. However, we would not expect significant differences between the multiplexes. We suggest that the total equipment costs here be divided equally between the three multiplexes. The costs associated with the network used to transport the monitoring and control data can also be divided equally between the multiplexes;



- (d) The distribution network carries digital and analogue TV signals as well as other services. This is discussed in section 3.4.

Base network element costs

- 3.3.8 DTTV equipment costs can be broken down into functional network elements (such as re-multiplexing) and by multiplex. The base cost of each network element is derived from the cost of its constituent parts averaged across the network where appropriate. Where the network element is not directly separable between multiplexes, the cost per network element for each multiplex is determined as per points (a), (b) and (c) above.
- 3.3.9 Table 2 provides a summary showing how costs can be attributed to the different elements, the number of instances of each element, the key items of equipment associated with each, and an indicative estimate of equipment lifetimes. There may be a one off software licence fee associated with some equipment for which a shorter lifetime of would be appropriate.
- 3.3.10 The breakdown by network elements is needed to enable costs to be attributed to the different TV companies, as even within the same multiplex different companies can use a different set of elements (see the example in Figure 5).

Multiplex-specific operational costs

- 3.3.11 Some operational costs may also be associated with the individual multiplexes as follows:
 - (a) DTTV equipment maintenance: where maintenance is provided through a contract with the vendor or a third party, maintenance costs will be separable by equipment and therefore by multiplex in the same way as in Figure 4.
 - (b) Software licences: annual software licences will be specific to individual equipments and therefore attributable to individual multiplexes.
 - (c) Electricity consumption: the RF Transmitters will consume a significant amount of power (albeit less than analogue transmitters). It may be possible to meter their supply. Alternatively, the cost can be estimated from the equipment rating and the time in use. These costs would be most easily attributed to multiplexes in equal shares as for the RF Transmitter equipment costs. An average electricity cost will be needed for both classes of RF transmitters.
 - (d) Cooling system: the cooling system used with the RF Transmitters will use power and water, and it may be possible for the running costs to be estimated. If the operational costs of the different cooling systems cannot be easily separated out, the costs would be most easily attributed to multiplexes in equal shares as for the RF Transmitter equipment costs.
 - (e) Depending on how different the costs are, it may be appropriate to determine the average cost for both power classes.



Shared infrastructure costs

3.3.12 At each physical location in the network where DTTV equipment is operated there are further capital and operational costs related to the buildings and other infrastructure. In many cases these locations are shared with other Digital services such as analogue TV and the provision of other telecommunications facilities. Two questions therefore arise with respect to attribution of these costs. Firstly, how to share them between the DTTV service and other services and, secondly, how to apportion the DTTV share of costs between the different multiplexes.

Attribution to DTTV

3.3.13 TV signals are usually broadcast from significant heights in order to achieve wide coverage. Other radio services (cellular radio, mobile radio and fixed microwave links for example) often use antennas at much lower heights. Furthermore, the cost of the mast itself will be a significant proportion of the infrastructure costs at the main Transmitter stations.

3.3.14 We therefore suggest that consideration be given to attributing costs directly associated with the mast structure (feeder cables and antennas have already been accounted for and allocated above) amongst all antennae mounted on the mast in proportion to the height at which each antenna is located.

3.3.15 Differences arising from the nature of the DTTV equipment have already been taken into account. Thus the remaining shared infrastructure costs, both capital and operational, can only be attributed to the different services on the basis of more general characteristics. Three⁶ possible approaches are:

- (a) To share in proportion to the cost of DTTV equipment as a percentage of the cost of equipment for all services using the particular site;
- (b) To share in proportion to the floor space occupied;
- (c) To share according to the height at which the antennae are mounted. (This method would fail for any services which did not require an antenna, so one would need to establish whether they make a material difference to costs).

Attribution to multiplexes

3.3.16 Once the infrastructure costs are attributed to DTTV, there remains the question of further splitting the cost between the different multiplexes. Given that there are no major differences between the multiplexes which have not already been taken into account, it is

⁶ A fourth approach would be to share costs in proportion to the revenues received by Digital for all its services. However, this would not conform with the requirement for charges to be cost-based.



suggested that the remaining shared infrastructure costs at each physical location be shared between all elements in all multiplexes in proportion to the “base cost” (see below) of each element at that location (bearing in mind that more than one network element can be located at the same physical location, and power required per multiplex can vary according to individual locations).

- 3.3.17 An alternative, and simpler, approach would be to sum these costs over all physical locations and to distribute them across all network elements in all multiplexes in proportion to their “base cost”.
- 3.3.18 The term “base cost” refers to the total costs (equipment, operational, etc) directly associated with each element.
- 3.3.19 We favour the simpler approach suggested in 3.3.17 for the sole reason that it is simpler.

Digita’s Equivalent TV transmitter (ETV) system

- 3.3.20 Digita currently operates a system of allocation of shared infrastructure costs, which allocates the joint costs of masts, feeders, buildings, main and backup power, cooling and their joint maintenance costs to different services provided from the transmitter stations based on the power of the transmitter used by each service. We may consider this ETV system as an alternative approach to allocating the shared (joint) infrastructure costs to DTTV and to different multiplexes.
- 3.3.21 Digita has derived ETV values for different types and power categories of transmitters based on analysis of typical cases of causality and requirements.
- 3.3.22 In a nutshell, the system then works as follows. First the total shared infrastructure costs and the total ETV points at each station are estimated. The total shared infrastructure costs are then allocated to the services provided according to the share of the total ETV points that service commands at that station. For example, say Service A used transmitters worth 10 ETV out of a total of 100. It would then pay 10 percent of the total shared infrastructure costs at that station, and all other services would pay 90 per cent. Now if the service were to expand to use transmitters worth 15 ETV, the total at the station would increase to 105. Service A would now pay 15/105 of the total cost pot (14.3 per cent), while the other (unchanged) services would pay 90/105 (85.7 per cent).
- 3.3.23 In this way the ETV system always recovers the total shared infrastructure costs at each station, but the allocation of that total to customers may change with the addition (or removal) of users of the station infrastructure.
- 3.3.24 We are not in a position to comment on the analysis behind the ETV point estimates per transmitter, though in principle the capacity of the transmitters is a useful basis as it relates to their power use, space requirement and required height on the masts. Assuming the ETV value derivation is done in an objective and transparent way, which FICORA would have to verify, this method does provide a viable alternative, and one that has the advantage that it is already implemented.



3.3.25 Without access to details of Digita's costs, we are unable to compare the allocation of infrastructure costs which would result from the calculation suggested in 3.3.17 with the allocation which would result from ETV. We considered whether one approach rather than the other would give Digita an incentive to incur inefficient infrastructure costs or to allocate them unfairly, and concluded that they do not.

Overheads

3.3.26 There are further general costs associated with management, staff, office costs and so on, not included in the previous shared infrastructure costs. In the absence of any specific relationship to DTTV costs the obvious approach is to share these costs in proportion to DTTV equipment costs, and then across all elements in all three multiplexes in proportion to their base cost. This is a commonly used and acceptable methodology when these "non-attributable" general overhead costs are a small part of the total, as we assume them to be. There is no hard and fast definition of what might be meant by small. In this case we suggest that small would be 10 per cent of total costs or less.

Switchover costs

3.3.27 For the deployment of all-digital TV there will be additional costs associated with the planning of the digital network (coverage planning, and design and procurement activities), and the need for some special engineering measures⁷ during the period over which both analogue and digital TV channels are broadcast.

3.3.28 These costs relate only to digital TV and are necessary to allow the efficient broadcasting of all multiplexes. It is therefore suggested that these costs, capital and operational, be shared across all elements in all three multiplexes in proportion to their base cost.

Final network element costs

3.3.29 The proposals above enable both a capital and an operational cost to be assigned to every element in the DTTV network. In the next section we consider how these may be attributed to different TV companies, and will base this on the network elements through which content from a particular company passes.

3.3.30 There is a feed back loop of content through the network monitoring and control equipment at the network monitoring centre. The final step therefore is to reallocate the

⁷ These could include temporary antennas for digital emissions where it is not possible to combine the analogue and digital signals onto the existing antenna, and additional filtering to the analogue emissions to prevent interference to the new digital broadcasts.



total costs, both capital and operational, derived for this particular network element across all other network elements in proportion to their base cost. We suggest that the network used to carry data to and from the NMC centres be included as part of the NMC centre costs.



Table 2: Proposed breakdown into DTTV network elements and the basis for assigning DTTV equipment costs to each

[Removed from the public version]



3.4 Attribution of costs to TV companies

TV companies

- 3.4.1 Costs must eventually be turned into a charge for each company that uses Digita's DTTV network. Thus, the costs already derived for each multiplex (other than distribution network costs, see section 3.4.8 to 3.4.14) have to be attributed to the different companies.
- 3.4.2 Figure 5 shows the elements in Digita's network that would be used in a multiplex by a national broadcaster, and by a regional company broadcasting a single channel over a limited area. The cost attributable to a company that clearly uses all elements associated with the multiplex is simply the total costs calculated for the multiplex.
- 3.4.3 However, the regional TV company only uses a subset of the network elements. The costs chargeable to the company therefore relate only to those elements. Furthermore, with the exception of the regional compression element, it shares all these elements with other companies.
- 3.4.4 Figure 5 is a schematic description of how a regional TV company would use regional compression.

Figure 5

[Removed from public version]

- 3.4.5 Since picture quality depends upon the bit rate available to the company's channel within the multiplex, a reasonable method of attributing costs is to base it on the proportion of the capacity used at each element. Within a statistical group within a multiplex the bit rate per channel changes continuously, thus the average bit rate allocated to the channel would be the correct measure. For fixed bandwidth signals, it would simply be the fixed bandwidth.
- 3.4.6 The costs attributable to the regional TV company would therefore be the proportion of multiplex capacity allocated to the company's TV channel, times the costs allocated to each network element through which the company's TV channel actually passes. However:
- (a) The capacity allocated to a TV company is not necessarily fixed.
 - (b) Different TV companies broadcast for different amounts of time, and it may be appropriate to apportion the cost per hour differently to different times of the day. This apportionment, however, is related more to market demand rather than any technical attributes of the network.
- 3.4.7 In calculating the proportion of multiplex capacity used one could base this on either the total capacity available or the total capacity sold. We prefer the basis of total capacity



available because it gives Digita an incentive to sell the available capacity and not to invest in capacity which is clearly beyond market requirements. Calculating the proportion on capacity sold could also lead to a situation of uncertainty, where customers face changing prices, or potential over or under recovery of costs where prices for existing customers are set by long term contracts.⁸

Distribution network

- 3.4.8 The distribution network consists of all the links carrying TV and radio signals between compression and multiplexing facilities and the transmitter stations. Parts of the network are based on capacity leased on fibre networks and parts on microwave links owned and operated by Digita. It is understood that the network carries digital and analogue TV signals as well as traffic for other services. Figure 6 illustrates how signals relating to a regional TV company are carried over part of the distribution network.⁹
- 3.4.9 In principle it would be possible to identify the route followed by the signals for each multiplex, and each TV company, and the corresponding equipment and costs. However, since digital TV signals can be interfaced to and carried by standard telecommunications transmission equipment, the need to identify which specific equipment is used by a particular signal is less important. On this basis, three possible approaches to sharing the costs between different TV companies can be identified. The first two require that the total capital and operational costs of the distribution network be determined.
- 3.4.10 The first method takes the straight line distance between every interconnection point in the network, multiplies it by the capacity on that link (in Mbits/s), and sums the result for every link to give a measure of the total network capacity in km*Mbits/s. The same process is then followed for the signals related to each TV company (or radio company). The cost attributable to the company is then proportional to the proportion of total network capacity used by the company. As before, where the signal is carried within a multiplex transport stream, the capacity occupied would be the average capacity occupied within the multiplex.
- 3.4.11 In Figure 6 the thick blue lines represent the routes over which signals relating to a regional TV company would be carried.

Figure 6

[Removed from the public version]

⁸ We acknowledge that in principle our preferred approach increases Digita's risk and to that extent raises its cost of capital. But in practice we doubt whether the effect of this one feature would be material.

⁹ Programme tables and monitoring and control data are also carried over the network. These form a relatively small proportion of the traffic and we ignore them for the sake of simplicity.



- 3.4.12 The second method is simpler and recognises that the distance cost component in telecommunications systems has become smaller with time. In the second method the network capacity metric is therefore computed simply as the sum of the capacity across each link, and the capacity used by the company is computed in the same way. The attributable cost is then given by the proportion of network capacity used.
- 3.4.13 In either case in calculating the proportion of capacity used one can either take the total capacity of the distribution network or the total capacity sold. (For the same reasons as we explained in 3.4.7, we prefer available capacity as the basis of calculation.) In both cases it might be necessary to take account of the duration of capacity usage where this differed significantly between the different users (indeed Digita already computes some charges on a time basis with different rates for different times of day).
- 3.4.14 The third approach would be to use market rates for capacity on telecommunication networks, and use these to determine the charge appropriate for use of Digita's Distribution network. This, however, might not be taken as a cost orientated approach. It would depend on the competitiveness or the extent of regulation of the telecommunications fibre networks. If they have been deemed competitive, the market price should reflect costs. If, on the other hand, they have been deemed non-competitive and are regulated, cost orientation can be verified via that route.

Radio broadcasts

- 3.4.15 The costs to be associated with radio broadcasts can be calculated in exactly the same way as for TV broadcasts, taking account of the bandwidth occupied by the radio signals.

Data services

- 3.4.16 Data services, such as electronic programme guides and software upgrades to viewer's equipment, are also carried over the multiplexes. The issue with software upgrades is whether they can be categorised as content, and therefore come under regulation. We are not equipped to form a view on this matter. If, however, they were to become under regulation, we would expect them, and other data services, to be costed in just the same way as TV broadcasts, and calculated simply from the ratio of the bandwidths used.¹⁰

3.5 Other Possible Pricing Factors

- 3.5.1 We consider the possibility of time of day of the broadcast, length of the contract period and geographical location of the broadcast as pricing factors, especially in relation to the cost orientation and non-discrimination obligations of Digita.

¹⁰ The bandwidths involved are small compared to those of the TV channels.



Time of day

- 3.5.2 At the moment Digita's transmission prices differ depending on which time-of-day-slots are purchased. A strict interpretation of cost-orientation obligation would rule this out, as we see no clear technological reason for production costs to differ by time of day. However, selling capacity during the night at the same price as for the peak hours may make it impossible to sell night-time capacity. In this case, charging the same price per hour of broadcast could potentially lead to under-recovery of costs. Therefore some flexibility in the interpretation could be appropriate, facilitating *overall* cost recovery in a non-discriminatory manner.
- 3.5.3 Further, if the network is dimensioned for prime-time requirements, that would affect the total cost of the network, and would mean that some capacity is sold only for prime-time. In our view this would cost-justify a higher rate for prime-time. To look at the issue another way; satisfying the higher demand for prime-time would require opening of a full new multiplex, and the cost of which would have to be recovered from only the prime-time users.
- 3.5.4 Also for the economically efficient allocation of broadcast time, the price would tend to vary according to the time of day, as demand is likely to be higher in the prime time than in the night. Indeed, there are many good economic reasons why, in order to sell any capacity at all during the night-time, the price for that capacity should be lower than at other times. It is probably worth less from the content providers' perspective.
- 3.5.5 We consider time of day *is* a relevant factor for pricing. To facilitate this, we recommend that FICORA implement a flexible interpretation of the cost-orientation obligation with regard to price variation across time of the day. It would not, in our view, be appropriate to require pricing based on cost-recovery on an hour-by-hour basis. We see 24 hours as the smallest unit of time over which to judge cost-orientation of prices. This would allow prices to vary during the day, but in a way that would not over-recover the total costs of the capacity provided. Non-discrimination of the charges would be assured by checking that (a) all charges are cost-orientated on the same principle of 24 hours, and (b) all users face the same price per unit of capacity at a given time in the day.
- 3.5.6 We suggest that it may even be appropriate to consider one week as the minimum unit of time over which to assess cost-orientation. In the same way that some times of day attract more demand than others, it may be that some days of the week are also more attractive than others. This is an empirical matter, which we suggest is best left until actual demands are known.

Length of contract

- 3.5.7 There can be substantial transaction costs associated with renewing or setting up new contracts for service. Longer contracts can also reduce business risk. We therefore regard length of contract as having a cost impact, and therefore a legitimate price impact.



It would be for Digita to show that the extent of discounts given to longer contract periods is justified by the avoided costs.

Geographical location

3.5.8 Costs may well vary by geographic region. Land and building costs vary, as do maintenance costs because of varying weather conditions. Our view is that regional price differentials would be justified in proportion to demonstrated cost differences. In principle it should not matter if regional broadcasting prices are higher in remote regions than in urban areas, or *vice versa*, provided they relate to cost differences. Geographical cost differences should not, however, be relevant for customers purchasing nationwide transmission services.

3.6 Future Changes

Extension of the digital network

3.6.1 Over the period to August 2007, the digital TV network will be extended to provide coverage to all regions of Finland. Additional network elements will therefore be added to the network and these will fit within the proposed costing structure.

3.6.2 In addition, relay stations will be brought into operation and our view is that these should be treated as a new network element. As with the rest of the DTTV network, the DTTV equipment installed at these stations will be specific to digital TV and therefore easily separable from any other equipment costs associated with the station. Where the station is shared with other services there will be infrastructure costs to be shared between them. The same approach as adopted for shared infrastructure costs (section 3.3.12-22) would be appropriate.

Market developments

3.6.3 The most likely future changes to the transmission market are the addition of new TV companies broadcasting on an existing multiplex, the addition of a new multiplex, and the upgrading of the network to enable new facilities. The first two of these will fit within the proposed costing structure.

3.6.4 Upgrades are likely to include the addition of new functionality either through upgrades to existing DTTV equipment or the addition of new equipment. As such it is likely that these changes would fit within the same generic cost model proposed here. However, other potential future changes such as DVB-H (which envisages TV broadcasting to “mobile” TVs and mobile phones) may well involve inter-connection and interaction with other networks. It is likely that any related use of the DTTV network and any additional equipment could be accommodated within the proposed costing structure.

3.6.5 Where broadcast and non-broadcast services are integrated in this way a different regulatory regime and a different costing methodology might be appropriate. This issue lies beyond the scope of the present study.



3.7 Summary of recommendations for network-related and network infrastructure-related costs.

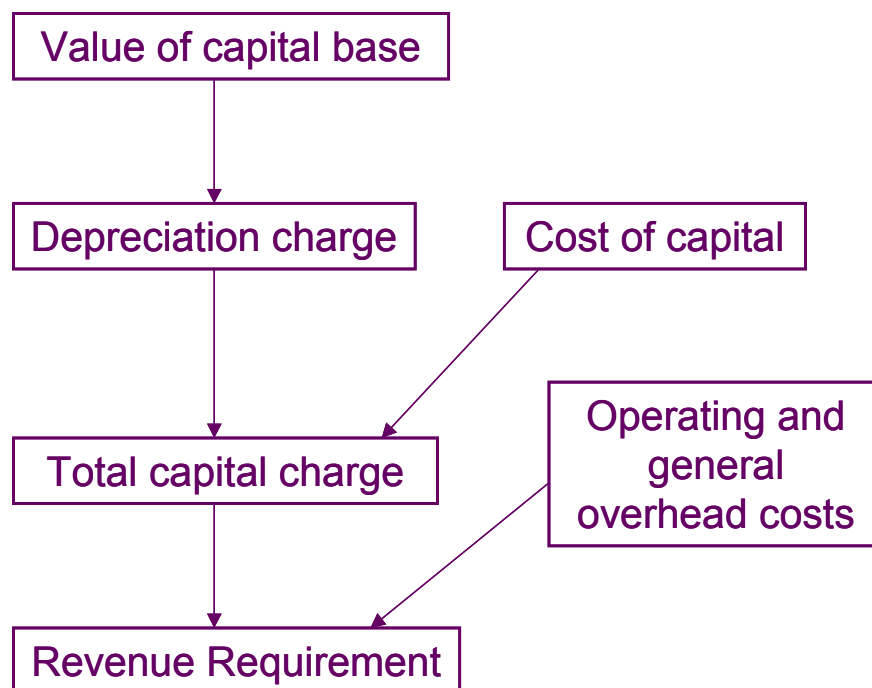
- 3.7.1 Treat as much of the costs as possible as directly related to each multiplex.
- 3.7.2 Allocate the direct costs of each multiplex to customers in proportion to volume used.
- 3.7.3 Where network infrastructure costs are common to more than one multiplex, or to all three multiplexes, divide and allocate the costs equally by the number of multiplexes involved.
- 3.7.4 For network infrastructure costs, including management and switchover costs, first choose between two main options for allocation. The first may be defined as the Europe Economics/Quotient option, the second as the Digital ETV option.
- 3.7.5 The Europe Economics/Quotient option is as follows:
 - (a) To allocate infrastructure costs to DTTV as a whole (i.e. separately from analogue and other services) allocate mast-related costs in relation to mast heights at which transmission takes place; and allocate non-mast-related costs either in the same proportion or in relation to the ratio of DTTV to non-DTTV base costs.
 - (b) To allocate to multiplexes, allocate in proportion to base costs associated with each multiplex.
 - (c) To customers, allocate in proportion to capacity used against capacity available.



4 OPTIONS FOR COSTING AND PRICING

- 4.1.1 This chapter describes the different options available for regulatory costing and pricing of network services. It follows the logic that a regulator would go through, and the choices available, in a price setting exercise where prices are required to be cost-orientated. It discusses the options available and the trade-offs involved in choosing one method over another.
- 4.1.2 The first step is to place a value on the operator's assets, or the capital cost base. This cost base then has to be spread over its useful life, i.e. annualised. A reasonable return on the capital base (cost of capital) has to be determined and added to the depreciation charge to bring about the total necessary capital charge or cost to be recovered in that period. Finally, allocating relevant operating and general overhead costs to the regulated products or services and adding them to the capital charge produces the total revenue requirement. Figure 7 summarises this process. The remainder of this chapter describes the various choices available at each step.

Figure 7: The regulatory costing process



- 4.1.3 As we mentioned in Section 2, FICORA has no power to determine the prices that Digita charges to customers. But it has an obligation to verify that Digita's prices are cost-orientated, and the steps described above enable FICORA to start such an assessment. They enable FICORA to assess whether Digita's total revenues are in line with what it needs to earn in order to cover its cost of capital. Cost of capital is a concept of economics that describes the return a business needs in order to attract equity and debt finance, in efficient proportions. Required profit, or return to shareholders, is treated as a cost that the business has to recover, along with all other costs.



4.2 Valuing the Capital Base

- 4.2.1 It is first necessary for the regulator to decide whether to value the regulatory asset base by reference to historic costs or current costs. Historic costs measure what was originally paid for the assets, less accumulated depreciation. Current costs aim to measure the value of assets today, in current terms.

Historic Cost Accounting

- 4.2.2 Historic cost accounting (HCA) uses the *book value* of the asset, which is the cost that the operator originally paid for the asset, less the depreciation charged since the asset was acquired.
- 4.2.3 This technique has the advantage that the cost is already recorded in the company's accounts, so that existing accounting systems can be used in calculations. It also has the advantage that the operator's accounts have normally been verified independently by auditors.
- 4.2.4 However, HCA has the disadvantage that it does not take into account accumulated price inflation or possible technological and price changes. Thus HCA does not reflect the cost of assets that a new competing entrant would have to finance. A second disadvantage from the regulator's point of view is that reliance on the operator's accounts gives him a material information advantage over the regulator.

Current Cost Accounting – revaluation of assets

- 4.2.5 Current cost accounting (CCA) is generally more complicated than HCA because it involves more choices, largely about the question of what is meant by “current”. CCA aims to consider the present value of the network, which requires a revaluation of HCA assets to take account of inflation, price changes and (possibly) changes in technology. It should therefore reflect the costs that a new entrant would incur if it were to build the network today.
- 4.2.6 CCA ensures that prices are competitive if the price of modern equipment has declined over time, with the incumbent matching the prices that a new entrant would charge. CCA can also ensure allocative efficiency, since both consumers and operators take into account the present-day cost of resources when making their purchasing decisions.
- 4.2.7 However, this approach has its disadvantages, arising from the fact that regulatory cost investigations normally have to start from the HCA basis on which the operator's assets are valued. The process of revaluation from HCA to CCA can be complicated, and the final CCA value calculated will depend on the method used for revaluation. A further complication is that the operator may be (and often is) continuing to use assets which are fully depreciated assets, i.e. have a nil value under HCA. Revaluing these assets is rarely straightforward, and the result will again depend on the chosen methodology and its implementation.



4.2.8 The various methods available for re-valuing assets to CCA are described below.

Replacement Costs

- 4.2.9 Gross replacement cost measures the current value of the whole (or a part of a) network i.e. it answers the question: what would it cost to build it today? Net replacement costs value the assets by considering the current cost of an asset with similar characteristics and age. If the asset under consideration is already fully depreciated (i.e. has a net book value of zero) but is still being used, a net replacement cost of zero is normally assigned to it. Other approaches, such as assigning a fixed percentage of asset depreciation to it, can also be used.
- 4.2.10 If an asset of similar characteristics is available for comparison, this method can be fairly straightforward. However, if the asset is no longer traded in the market, ascribing a market value is no longer meaningful.
- 4.2.11 In this case, and as a standard in some forward looking pricing methodologies, a Modern Equivalent Asset (MEA) valuation is used. This technique does not consider individual asset components but considers the overall functionality provided, and attempts to assess the cost of providing equivalent functionality (and within that equivalent capacity and/or quality of service) to that provided by the asset being valued. MEA has the key advantage that the resulting capital costs would most closely correspond to a new entrant's costs.¹¹
- 4.2.12 The key disadvantage of MEA is that it may be difficult to define what the MEA should be. If there has been rapid technological progress, so that assets with the same capacity and the same technology are no longer available, the current price of the MEA would need to be adjusted for the differences. This sounds simple in principle but may be difficult in practice. Adjustments for differences in quality, efficiency and capacity can also add an element of arbitrariness to the calculation.

Deprival Value

- 4.2.13 Deprival value looks at the value that the asset brings to the firm, either by being kept in operation or by being sold. The calculation is based on the economic value (EV) and the net realisable value (NRV) of the asset. If the EV is higher than the NRV, the company would rationally keep the asset in use. If EV is less than the NRV the asset would be sold. However, it can be difficult to determine what exactly the economic value of the asset is, separately from the other inputs into production.

¹¹ Operating expenditure associated with the assets might require corresponding adjustments, e.g. if the MEA can be expected to be more automated or require less maintenance than the old assets.



4.3 Annualisation

- 4.3.1 We come now to the second tier of Figure 7.
- 4.3.2 Once the value of the asset base has been determined, its life has to be assessed so that an annual depreciation charge can be determined. There are a variety of profiles available. Key considerations in deciding which profile to use for a particular asset include likely movements in asset price over the life of the asset, annual revenue generated from the output of the asset, and annual running costs.¹²
- 4.3.3 Here we report only those options that we consider most relevant to the task at hand. Other options are briefly described in Appendix 2.

Straight line depreciation

- 4.3.4 Straight line depreciation is by far the most commonly applied method. It spreads the depreciation associated with an asset evenly over the asset's estimated lifetime. A flat rate is deducted every year based on the following formula

$$\text{annual depreciation} = (\text{original value} - \text{salvage value}) / \text{useful life}$$

- 4.3.5 Thus, an asset acquired for €1,100,000, with an estimated life of 10 years and a salvage value of €100,000, would attract a depreciation charge of €10,000 per annum.
- 4.3.6 The depreciation rate is defined as the reciprocal of the life of the asset in years i.e. $1/n$
- 4.3.7 This method is most useful when the usability of the asset is fairly constant over its lifetime but may not be a realistic choice if the contribution of the asset to revenues is not constant, or if running expenditures vary systematically over the life of the asset. A further weakness is that this approach normally considers only the historical cost of the asset, which may not reflect current market conditions.
- 4.3.8 The straight-line approach nevertheless serves as the base method of accounting depreciation, to which adjustments can be made according to the nature of the assets and prices over the asset life.

¹² Annual revenue and running costs are important in order to be consistent with the accounting concept of accruals, where costs and revenues are matched with each other and dealt with in the profit and loss account of the period in which they relate. Rising annual depreciation in the life of the asset would be more consistent with an asset whose revenue gained from output is increasing with time. Looked at another way, if revenue generated from output of the asset was falling and running costs increasing, the resultant "profit" may not cover the depreciation later in life as defined by the chosen schedule. The true profit would be overstated earlier in the asset's life and understated later.



Economic Depreciation

- 4.3.9 Economic depreciation involves an assessment of the changing market value of the asset, which is the net present value of the stream of future income that the asset is expected to provide.
- 4.3.10 Economic depreciation will generally result in more of the depreciation being incurred in the early years of an asset's life (compared with straight line depreciation). The differences may be relatively small where a wide range of asset lives is to be considered; for a single equipment vintage, the differences may be significant.
- 4.3.11 Although from a theoretical standpoint economic depreciation is the correct approach to adopt, it is difficult to calculate with any degree of accuracy, since it is highly information-intensive. We considered two other prominent methods described briefly below.

Simple annuity and tilted annuity

- 4.3.12 The annuity method takes into account not just the cost of the asset, but also the interest that the capital invested in the asset could have earned if it were invested elsewhere. It differs from straight-line depreciation in that the asset cost and financing costs are recovered together in equal annual sums through the asset life. Under straight-line depreciation, only the depreciation charge is deducted in equal sums, and the financing cost (i.e. the cost of capital) is calculated separately. For purposes of determining costs and setting prices based on costs, the two methods would produce the same overall result over a period of time.¹³
- 4.3.13 The *simple* annuity calculation assumes that the purchase price of new equipment is unchanged throughout the asset's lifetime. A refinement of the annuity approach is the *tilted* annuity approach, which takes into account future trends in the prices of equipment and therefore in service prices. This approach results in more depreciation at the beginning of the asset's life if a negative price trend is anticipated (for example because of technological changes). Further tilts can be added according to the nature of the asset base, e.g. to take into account of productivity and price changes.
- 4.3.14 We understand that Digita already uses the simple annuity approach, and we see no reason for FICORA to adopt a different approach.

Infrastructure Renewals Accounting

- 4.3.15 Renewals accounting offers an alternative way to define the annual charge for capital depreciation. It differs from other methods in that the infrastructure asset network is

¹³ This is not to say that there is no virtue in the annuity or tilted annuity methods. Where, for example, tax incentives are given for investment, it may well be in a company's interest to adopt the standard or tilted annuity approach.



considered as a single system to be maintained into perpetuity, rather than a collection of individual assets with independent asset lives and maintenance requirements.

- 4.3.16 Infrastructure assets, for example trenches and pipes for water distribution, or high pressure long-distance gas pipes, or high-voltage electricity pylons, all of which have very long lives, pose a problem for traditional accounting methods because their actual useful lives are difficult to assess.¹⁴ In addition, rather than being replaced, they might be repaired or have renewal work done on them on a regular basis. Infrastructure renewals accounting provides a way to cost these assets on an annual basis.
- 4.3.17 The infrastructure renewals charge (IRC) is the annual charge against profits, calculated as the average forecast infrastructure renewals expenditure (IRE) over several years. The expenditure must cover the maintenance of current and future services of the entire system of infrastructure assets, and therefore includes both depreciation and expenditure on repairs. Though some guidance can be taken from historical repair costs, the IRC requires an estimate of *future* expected maintenance costs.
- 4.3.18 Although we recognise that Digita has some very long lived assets, it has many others that are not. If we are right that only a small proportion of its total assets might be susceptible to infrastructure renewals accounting, there is no compelling case for applying it.

4.4 Cost of Capital

- 4.4.1 Once the value of the capital base is established, the rate of return applicable to the capital invested has to be determined. The allowed rate of return applied to the value of the regulatory asset base gives the allowable profit. The cost of capital should reflect the opportunity cost of the funds invested in the assets; or, putting it another way about, it represents (in the case of Digita) the rate of return that an investor would expect from that particular company, given its risk profile compared with other investments that he/she could make.
- 4.4.2 Cost of capital is usually computed from (a) the weighted average cost of debt for the various forms of debt held by the company, and (b) the cost of equity – i.e. the return that shareholders require in order to invest in the company. The cost of capital usually assumes that the company has “efficient” levels of debt and equity, i.e. does not hold a excessively high proportion of either.
- 4.4.3 The weighted average cost of capital (WACC) is widely considered to be the only rigorous way to calculate the cost of capital for regulated companies. It is calculated by using the following formula

¹⁴ And some utility operators admit that they do not have accurate records of their underground assets, some of which may be more than 100 years old.



$$WACC = r_e \cdot \frac{E}{D + E} + r_d \cdot \frac{D}{D + E}$$

where r_e is the cost of equity, r_d is the cost of debt and E and D are the total values of equity and debt respectively.

- 4.4.4 There are several options for each of the parameters identified in the WACC equation. For example, equity can be calculated using economic (market) value or book value and the debt/equity ratio can be calculated using the current ratio or some other optimal ratio.

Cost of debt

- 4.4.5 The company's cost of debt is usually easily obtained from its statutory accounts. A regulator would normally take the company's cost of debt as a given unless there is reason to think that the amount of debt carried is excessively high or low.

Cost of equity

- 4.4.6 The cost of equity, r_e , is most often determined from the *Capital Asset Pricing Model (CAPM)*, using the following equation:

$$r_e = r_f + \beta_e \times P_m$$

where r_f is the risk free rate

β_e is the risk relative to market risk

and P_m is the market premium

- 4.4.7 In plain language the model calculates the cost of equity as the risk free rate, plus a premium that assesses *overall* stock market risk relative to the risk free rate, plus a further factor (beta) that measures the *company* risk relative to the overall market risk. Values for some of these parameters are more easily obtained than others.
- 4.4.8 The risk-free rate is usually taken as the rate on medium to long term government bonds. These would characteristically correspond to the least risky investment available over the life of the asset base. The rate itself publicly available, daily, in the financial press.
- 4.4.9 The premium for market risk is usually (and easily) obtained from published stock market analyses. It describes the expected increase in yield of a stock market investment over the yield of a risk-free investment.
- 4.4.10 The Finnish exchange might be thought of as having low volumes of trade, and being dominated by transactions relating to only a handful of companies. However – and conveniently – the Finnish Energy Market Authority has recently compiled a study of the risk premium applicable in Finland. We see no reason why FICORA should not use the values obtained in that study, at least as a starting point.



- 4.4.11 The beta measure of company-specific risk is generally the most difficult parameter to calculate for non-listed companies such as Digita. We suggest it should be estimated by reference to sectoral betas and/or comparisons from other countries. Brokers' analysts reports are a good source of analytical material. Estimating a beta for Digita need not be a time-consuming exercise.
- 4.4.12 There are alternatives to the CAPM model for determining the cost of equity. These include the dividend growth model, comparable earnings method, distributed cash flow method and arbitrage price theory, and are briefly described in Appendix 2.
- 4.4.13 Nevertheless, the WACC approach described above, with CAPM used for calculating the cost of equity, is the most widely used in modern regulatory practice, and is the approach we recommend FICORA should adopt.

4.5 Operating Costs

- 4.5.1 Operating expenditure is always in "current" basis, in that it is taken as given for the year, plus or minus any adjustments for efficiency. These adjustments can be especially relevant if the regulator believes that the regulated company's monopoly position has enabled it to become inefficient,¹⁵ or if it has invested heavily to reduce maintenance or supervision.
- 4.5.2 Much of the operating expenditure associated with Digital TV broadcasting can be directly associated with the network assets or activities as discussed in chapter 3. Joint and common operating costs would have to be attributed to different components and customers using one of the approaches discussed below.
- 4.5.3 Once the annual capital charge and the cost of capital have been determined, operating expenditure is added to produce the total costs allowed. Because the costs include the profit element (the cost of capital) the total costs equal the company's revenue requirement. If the calculations have been correctly done, and Digita achieves exactly the revenue estimated, FICORA will have regulated Digita to its cost of capital, which is, according to economic theory, the return that the company could expect in a fully competitive market.

4.6 Pricing Methods

- 4.6.1 There remains the question how, within allowed revenue limits, FICORA should determine the prices that Digita charges to users of its services.
- 4.6.2 Chapter 3 suggested ways in which the direct costs of DTTV could be calculated and then allocated to users. However, in any substantial organisation, and certainly in Digita's

¹⁵ "The best of all monopoly profits is a quiet life", Sir John Hicks (1935), Nobel Laureate in Economics 1972.



case, joint and common costs, especially those related to stations and towers, and to a lesser extent management costs, could make up a large proportion of total costs.

- 4.6.3 If we are right on this point, methods of allocating joint and common costs become particularly pertinent.

Fully Distributed Costs (FDC)

- 4.6.4 The FDC methodology distributes all directly attributable, joint and common costs fully to the company's products or services in accordance with some specified allocation method. It has, potentially, an arbitrary element to it because joint and common costs are, by definition, not directly attributable.

- 4.6.5 Fully distributed costs are simpler to calculate than most others. Accountants like them because they exhaust all costs across all products and services, they ensure that the company recovers all its (historic) costs, and they reflect the costs of the current network, not some modern equivalent network that the company does not have. Since FDC methods normally use only historic costs, they can easily be checked against the audited accounts of the incumbent.

- 4.6.6 A serious weakness of FDC is that the methodology is effectively controlled by the incumbent, leaving other players suspicious about the allocation basis of costs. A high level of transparency is required in order to allow regulators to assess where there might be inefficiencies and/or distortions. Regulators could undertake separate FDC exercises for themselves, but they would still be largely reliant on cost information from the incumbent.

- 4.6.7 Worse still, the use of historic costs ignores the fact that the costs of establishing and operating a network today be very different from those of the incumbent's established network. FDC calculations could be modified using efficiency adjustments as a substitute for costing a modern network, and conceptually it is possible to use a fully distributed cost approach with current costs but neither step is straightforward. The information advantage still lies with the incumbent, and the effort involved in adapting his FDC model is better deployed on forward-looking cost models, which we describe later.

- 4.6.8 Where there is actual or prospective competition, new entrants often need to decide whether to build their own network resources or to interconnect on negotiated terms with the incumbent's network. If the incumbent's network costs are assessed on an FDC basis, the price signals sent to new entrants could be highly misleading.

- 4.6.9 For all these reasons, best modern regulatory practice eschews the use of FDC.

Stand alone costs (SAC)

- 4.6.10 This version of FDC allocates all the shared and common costs to a single regulated product. The rationale here is that these are the costs that the incumbent would bear if he were producing only the regulated product. This can be divided by the number of units



produced to give an Average Stand Alone Cost (ASAC). In practice ASAC serves merely to provide a notional upper price bound.

Non-accounts based costs

4.6.11 We now turn to cost-based price-setting methods that do not depend on the full allocation of historic cost.

Marginal cost pricing

4.6.12 Marginal cost pricing requires that prices be set equal to short run marginal cost (the cost associated only with producing an extra unit of output). This allows the operator to recover only the extra variable costs incurred, and none of the fixed, joint or common costs. Marginal cost pricing, therefore, effectively provides a lower price bound and thus sits at the opposite end of the spectrum from stand alone costs.

4.6.13 Prices equal to marginal costs are, essentially, what one would expect to see in an effectively competitive market. Prices based on marginal costs lead to welfare maximisation (i.e. they benefit consumers) and an economically efficient allocation of resources, but are difficult to implement because of the difficulty of costing unit changes in output.

Forward looking costs (FLC)

4.6.14 The FLC approach expresses the cost of producing an additional product or service, rather than the additional unit of output used in marginal cost calculations. For example, in this case, one would price the transmission of an additional bouquet of channels, whereas marginal cost pricing would deal rather with the cost of providing an additional minute of transmission for an existing channel, or opening of new channel on an existing multiplex. In addition, all costs are measured in the long run, with all inputs, including capital costs, treated as variable. Forward looking costs can also be expressed per unit of output if necessary, by dividing the increment by the number of units, giving Forward Looking Average Costs, FLAC.

4.6.15 There is no one right way to implement FLC that makes all others wrong. The additional product or service can be defined in several ways as seems most relevant for the analysis. The network which serves as the starting point for FLC modelling can be defined either as the network actually operated by the incumbent or as a new “ideal” model configured to a specific topography and profile of users. (And there are a variety of techniques available for defining the ideal network.) Using the existing network is generally referred to as “top down” modelling, and defining a new one from scratch is generally referred to as “bottom up” modelling.

4.6.16 FLC would take into account the variable and fixed costs attributable to the additional service. In addition, a mark-up for the common costs would be added to compensate for those parts of the costs that were not directly attributable. Various methods to do this are discussed below.



- 4.6.17 The key strength of FLC is that it reflects the price that a competitive market would assign, using up-to-date technology and costs, and therefore sends the correct “build or buy” signals to users and new entrants alike. And allowing the incumbent to recover his forward looking costs provides him with the right incentive to upgrade his network while at the same time not over-compensating him for doing so.
- 4.6.18 FLC calculations can be complex and information-intensive. They also require a number of technical assumptions that may be open to challenge. However, much depends on the complexity of the network and services modelled, as well as the level of detail deemed necessary. In this case, we suggest that building an FLC model for Digita’s network is much less complex than for (say) a telecoms network. Furthermore, given the relatively short horizon for the project, we recommend that FICORA should go for the simplest, most robust techniques rather than for great refinement.

Attribution of joint and common costs

- 4.6.19 FLC and most of the other options discussed above require an attribution of joint and common costs to the services provided. There are a variety of ways to achieve this, the most relevant of which we describe below.

Volume Based Costing (Equal Proportionate Mark Up - EPMU)

- 4.6.20 Probably the most frequently used method of allocating joint and overhead costs is to identify volume or other service characteristics which drive costs, and allocate joint costs and overheads to different services or customers in proportion to them. This method, known as Equal Proportionate Mark Up, or EPMU for short, is often used in telecommunications to allocate common costs in proportion to number of calls or minutes. In other applications the relevant cost drivers could be a proportion of direct labour employed, or a proportion of productive capacity utilised. The significance of the word “proportionate” is perhaps self-evident in context. The implication of “equal” is that no weighting or other adjustment is applied to the proportion itself. All users are treated equally in proportion to the demands they make or services they consume.
- 4.6.21 The validity of the cost driver(s) selected has a crucial effect on the value of this approach. If the cost driver selected genuinely affects costs, so well and good. If the relationship is questionable, the result will be no better than an accounting-based convention. It must be recognised that, sometimes, robust cost drivers are simply not available for certain overhead costs.

Activity Based Costing (ABC)

- 4.6.22 Activity based costing aims to allocate joint and common overhead costs of service provision on the basis of a different approach to the cause of the cost. Whereas this has traditionally been done using a variety of volume-based and revenue-based approaches, here services and products are seen as a series of activities that consume resources and generate costs.



4.6.23 A clear cause-and-effect relation is determined between activities and services, in such a way that outputs and costs are linked together. This process allows a higher proportion of indirect costs to be allocated objectively, and avoids some of the arbitrariness of volume-based approaches. It can be very effective in allocating overhead *labour* costs, but requires that employees or groups of employees objectively state in some form of questionnaire how they spend their working time. It can thus be resource-intensive to administer, and not all costs can be accurately ascribed to particular services or groups of services.

The Efficient Component Pricing Rule (ECPR)

4.6.24 The ECPR was developed as a way of discouraging inefficient entry by adding an opportunity cost mark-up to the cost of providing a given service. ECPR has been particularly useful calculating access prices. It is essentially a “retail-minus” concept, where the costs which the incumbent would not need to incur (the “avoidable costs”) when a new entrant seeks access are subtracted from the retail price to give the relevant access price. Some argue that, since the access price is effectively tied to the retail price, ECPR can be helpful in protecting entrants against predatory pricing. This depends, however, on regulatory vigilance!

4.6.25 The ECPR concept can be used to allocate common costs on top of FLC. The common costs are then normally allocated according to the relative profitability of the corresponding retail services.

4.6.26 ECPR has come under criticism for two main reasons. First, it creates no incentive for the incumbent to reduce his costs or his prices. If the incumbent is inefficient, the entrants pay a higher price. Second, if the inefficient access price is higher than the stand-alone costs, the entrant may choose to bypass the incumbent’s infrastructure entirely. The entrant’s price may then be higher than if he had paid an efficient (lower) price for using the incumbent’s infrastructure.

4.6.27 Finally, ECPR requires sensitive information from the incumbent on margins and marginal costs, which the incumbent may try to withhold or manipulate.

Ramsey Pricing

4.6.28 Ramsey pricing provides a methodology for assigning joint and overhead costs between various components or services.¹⁶ It can be used as a supplement to any of the techniques outlined above by allocating those costs cannot reliably be attributed by the technique chosen.

¹⁶ Ramsey pricing is named after American economist Frank Ramsey, who first described the technique in "A Contribution to the Theory of Taxation," *Economic Journal*, March 1927.



- 4.6.29 Ramsey pricing recognises that more price-sensitive consumers of a product will react more strongly than less price-sensitive consumers to changes in prices. As prices diverge from (rise above) marginal costs, the welfare loss increases. Conversely, the lower the price elasticity of demand, the lower is the welfare cost from increases above marginal costs.
- 4.6.30 To minimise the allocative inefficiency that arises because of the divergence of prices and marginal costs, the mark-up prescribed over marginal cost in Ramsey pricing is inversely proportional to the price elasticity of demand. To put it more simply, more cost is allocated to less price-sensitive services and *vice versa*.
- 4.6.31 Ramsey pricing has the disadvantage, which can be severe, that price elasticities, and therefore the Ramsey mark-ups, may be difficult to determine. Price elasticities may vary over time and over various uses for the same service. In addition, Ramsey pricing implies that consumers who are dependent on a service (i.e. whose demand is inelastic) pay more, which in some circumstances might be considered unfair. The United States Interstate Commerce Commission has long used a variant of Ramsey pricing to establish interstate rates for the carriage of goods by rail, but there have been few successful uses of Ramsey pricing in EU regulatory regimes.

4.7 Proposed principles

- 4.7.1 Although we recognise that in one particular situation the use of HCA would be appropriate,¹⁷ the use of CCA is required where an element of competition is envisaged.
- 4.7.2 Our first recommendation is therefore that FICORA begin work on revaluing Digita's DTTV assets to CCA. In our view, an MEA (Modern Equivalent Asset) assessment is likely to be the least problematic approach. We do not know precisely what in-house resources FICORA has available to do this. If its resources are insufficient, FICORA may wish to contemplate conducting the exercise jointly with Digita or engaging external support.
- 4.7.3 We recommend a simple annuity approach to depreciation (which is the technique that Digita already uses).
- 4.7.4 We recommend FICORA begin work soon on establishing a weighted average cost of capital (WACC) for Digita, using the capital asset pricing model (CAPM). Some inputs to the model will need to be estimated, but we do not envisage that that would be a serious problem.
- 4.7.5 We recommend that FICORA should start to allocate resources to build a Forward Looking Cost (FLC) model.

¹⁷ The situation is one in which Digita's current monopoly of DTTV extends indefinitely, and we cover this in Chapter 5.



- 4.7.6 Our view is that the allocation of joint and common costs should use the EPMU principle. It is not perfect in context, but it is reasonably robust and is much less difficult to implement than the other techniques we reviewed.
- 4.7.7 It is important to understand that the techniques we recommend in Chapter 4 relate to the DTTV business as a whole. They do not attempt to allocate costs down to the level of the individual multiplex or customer. These allocations, which were dealt with initially in Chapter 3, are now synthesised with our Chapter 4 recommendations in the final Chapter, to which we now turn.



5 SYNTHESIS OF RECOMMENDATIONS

5.1.1 This chapter sets out our overall recommendations for FICORA, based on the background and reasoning set out in Chapters 2, 3 and 4. Although our recommendations aim to provide a workable solution for immediate implementation, we also take into account changes to the network and to the DTTV market that are due to take place in the near future.

5.2 Criteria for Evaluation

5.2.1 Three broad groups of criteria are used to evaluate the appropriateness of the different options identified:

- economic and regulatory criteria, to evaluate the general desirability of the different approaches;
- the wider policy goals set for the market and the obligations imposed on Digita; and
- the nature of Digita's physical network.

5.2.2 Determining the “best” form of regulation almost always involves trade-offs, and the overall optimum can rarely be achieved. For example, rate of return regulation might achieve allocative efficiency, but might not achieve productive efficiency, because rate of return regulation does not normally give companies a strong incentive to reduce costs.

5.2.3 The cost accounting and pricing methods that FICORA uses should be in line with good regulatory practice in general and with EU practice in particular. The Better Regulation Task Force in the United Kingdom, to quote only one example, has identified five principles that should be embodied in good regulatory practice: transparency, accountability, proportionality, consistency and targeting (i.e. meeting objectives). To this we would add practicability when, as is so often the case, regulatory resources are limited.

5.2.4 Practicability in this case is closely linked to proportionality and consistency. The measures that FICORA decides to take should be of appropriate scale to the costs identified and the risks posed. And they should be capable of implementation within the available time scale and resources. It would be of little benefit for FICORA to spend considerable resource developing a methodology for the short term if there is a likelihood of longer-term changes. Transparency and accountability encourage us, in our recommendations, to favour clear-cut rules and procedures over complex models.

5.2.5 FICORA must verify that the prices that fall within its jurisdiction must be cost-orientated and non-discriminatory. The Communications Market Act 2003, however, leaves the exact meaning of cost-orientation open to interpretation on a case-by-case basis. In the present case, interpretation of what is meant by cost-orientation is relevant to such



considerations as time-of-day or day-of-week congestion, which does not influence production costs *per se*, but could be relevant to opportunity costs.

- 5.2.6 Costing and pricing principles might differ, possibly quite substantially, as between an old and mature network to a modern network that is still growing and developing. In a mature network, the use of historic cost may well be appropriate if assets are not expected to be replaced very often, and might even be maintained in perpetuity. On the other hand, in a newer, rapidly developing network, or one subject to rapid technological progress, current cost methods would normally be more appropriate.
- 5.2.7 The most important of all market characteristics is the presence or prospect of competition to provide all or some of the services the incumbent offers. If a prospect of competition exists, prices set for the incumbent operator have to provide the correct incentives for efficient new players. In particular they have to enable a new entrant to determine whether he should seek access to the incumbent's assets on a commercial basis, or invest in assets of his own. If the incumbent's assets, or a significant part of them, are deemed essential facilities, unlikely to be replaced or to face competition (i.e. if they represent a mature natural monopoly), regulatory pricing approach would concentrate on maximisation of consumer benefit through tight price control and on non-discrimination between different users.

5.3 Future scenarios and present choices

- 5.3.1 The analogue switch-off and the possible availability of additional multiplex licences after 2007 will give rise to changes in market conditions. It would be sensible for FICORA to invest in a regulatory process that could meet the needs of this new environment as well as the current environment. We see three likely outcomes post 2007:
- (a) No new licences are offered, or there is no third party interest in taking them up. Digita thus retains its monopoly for the foreseeable future.
 - (b) One or two firms take up the new national multiplex licences and Digita retains SMP.
 - (c) There are sufficient new entrants into the market, such that, post 2007, at least some parts of the DTTV market can be deemed competitive. Even in this scenario, we envisage that Digita is likely to remain the only company owning the largest transmission towers needed for nationwide broadcasting (because we do not envisage that it would be economically viable for a third party to replicate them).
- 5.3.2 Yet the new environment is shaped by the cost accounting and pricing principles chosen today because these will be visible to third parties contemplating entry. Pricing according to fully distributed historic costs might lead to low prices and discourage new entry. Certainly the signals thereby sent to potential entrants might not lead to economically efficient entry.
- 5.3.3 If the second or the third scenario (i.e. some form of new entry) is both feasible and encouraged, in line with FICORA's regulatory and policy objectives, the cost accounting



and pricing methodologies chosen today should facilitate efficient entry. This implies using procedures aimed at mimicking the results of a competitive market where, by definition, efficient signals are sent to potential entrants. In turn this would mean evaluating costs based on a forward-looking current cost methodology.

- 5.3.4 The following sections describe our recommendations for each of the three scenarios.
- 5.3.5 We begin with the case where there is no prospect of competition. In practice, this would be the same situation as if FICORA chose not to take account of what might happen beyond the two-year time span of the current market structure. In these circumstances FICORA would simply regulate Digita's prices down to a level at which the company achieved its cost of capital and no more. The process is that which is shown diagrammatically in Figure 7.

5.4 Regulating to cost of capital

Valuation of the asset base

- 5.4.1 If Digita were to retain its monopoly position into perpetuity, there would be no need to incur the complications of translating the book values of Digita's assets into a current cost basis. The reason for using current costs is the presence of actual or potential competition, and the current costs are used as a basis for mimicking and facilitating that competition. Translating from HCA to CCA with no competition in sight would incur all the cost without achieving the benefits.
- 5.4.2 Furthermore, if there are no potential competitors to consider, the main theoretical shortcomings of using historic costs do not matter either. There is no need to send signals to entrants, or for regulated prices to reflect current price movements.
- 5.4.3 HCA has also been criticised on the basis that it might not ensure asset replacement in the long run. In our view, however, the use of CCA does not by itself guarantee this either – it merely indicates what it should be. There is nothing to stop FICORA dealing with lack of investment whenever it feels it should do so. Criticism of HCA has focused on the claim that it might introduce discontinuity in the face of rapid technological change. In our view this is not a feature of digital TV transmission that appears to be relevant.
- 5.4.4 Finally, it has been said that HCA does not necessarily ensure financial renewal in the future, or take into account of lack of investment in the past. We do see this issue as potentially relevant. But tackling it in an HCA setting is, however, perfectly feasible by assessing the efficiency of investment schemes and by determining a cost of capital adequate to allow further investment. We develop these ideas below.
- 5.4.5 If Digita is to retain its monopoly status for the foreseeable future there is no theoretical reason why HCA should not be used. Even where theoretical arguments are finely balanced between HCA and CCA, we would favour HCA on grounds of practicality.



- 5.4.6 Thus, for this first scenario we recommend using HCA to determine the value of Digita's asset base.
- 5.4.7 FICORA would, however, remain reliant on data provided by Digita on its asset values. FICORA would have to satisfy itself that the capital expenses (and operating expenses) are being efficiently incurred, as well as robustly and objectively allocated to each part of the service. This step requires an assessment of efficiency.

Assessment of efficiency

- 5.4.8 The assessment of efficiency need not be confined to forward looking or other current cost based methodologies. The nature of rate of return regulation is that the incumbent is allowed to recover, over time, all its capital and operating expenditure. However, it is also entitled to earn a return on capital expenditure. It therefore has an incentive to invest in capital-intensive production techniques, perhaps at the expense of more economically efficient split of labour and capital.
- 5.4.9 A further reason for capital efficiency assessment under the HCA methodology is to identify past under-investment or the presence of heavy investment cycles.
- 5.4.10 Efficiency assessment could be done in several ways. One would be to undertake or commission an expert external assessment of Digita's network. Another, simpler approach would be to compare Digita's network and components with other similar networks to highlight any significant differences, which then could be further investigated. This benchmarking approach has the difficulty of establishing a suitable comparator, and might have to be adjusted for any statutory obligations on Digita regarding redundancy policies or obligations to provide coverage in times of national emergency.

Annualisation

- 5.4.11 As discussed in section 4 of this report, the mix of assets types and lives employed in the Digita network suggests that there will be no great difference between the results of the straight line and annuity approaches to depreciation. The technical analysis has not led us to believe there is any need to deviate from simple and straightforward depreciation methods.
- 5.4.12 We therefore recommend that FICORA adopts Digita's simple annuity approach to depreciation.
- 5.4.13 If FICORA felt strongly that it had other reasons for adopting a method of its own, our view is that there would be no strong argument against the straight-line depreciation method.

Cost of Capital

- 5.4.14 Next we consider WACC, with CAPM used for the value of equity, as the most rigorous and also feasible way of determining the cost of capital for Digita. We have seen the



methods FICORA applies to determine WACC values for the telecommunications operators, and see no reason why they should not be carried over to Digita.

- 5.4.15 The beta-value in the CAPM measuring risk of investing in Digita relative to other equity investment would have to be estimated, because Digita is not a listed company. This, however, is a common exercise in regulatory economics. It is accepted that estimated or sectoral betas are unavoidable, provided that they are based on sound analysis and comparisons.
- 5.4.16 If Digita retains its monopoly position for the long-term future, its cost of capital should reflect this secure position while at the same time enabling it to secure sufficient funds for future investment.

Operating Costs

- 5.4.17 As per Figure 7, operating costs are added to the allowed cost of capital and annual depreciation charge to make up the total annual revenue requirement.
- 5.4.18 Because, in this scenario, Digita's assets are valued on an existing HCA basis, the treatment of operating costs does not involve any special adjustments. We would therefore recommend that Digita's operating costs be taken as given, subject to general efficiency adjustments and to making sure they are correctly allocated.
- 5.4.19 If the steps in section 5.4 are followed, FICORA will have calculated what total revenue for DTTV Digita is entitled to earn in order to achieve – but not to exceed – its cost of capital. The requirement for cost-orientation will thus have been satisfied at the highest level. There remains, however, the question how the total revenue should be split across DTTV customers in order to respect the principle of cost-orientation at the customer level.

5.5 Distribution of costs across DTTV Customers

- 5.5.1 As discussed in chapter 3 of this report, many costs can be directly attributed to different network elements and services, and to the use that customers make of them. However, shared costs, both network-related and non-network related, may make up a large part of Digita's total cost base. If they do, their objective allocation to different network elements and different customers is important. We now deal separately with network and non-network pricing factors.

Network pricing factors

- 5.5.2 Sections 3.3 and 3.4 give a detailed description of how we propose all the various costs should be attributed to different network elements and customers. In the language of chapter 4, this approach corresponds to the Equal Proportionate Mark Up (EPMU) method of cost attribution, in which costs are allocated in proportion to the use that customers make of a given resource. We considered other possible methods – Activity Based Costing, the Efficient Component Pricing Rule and Ramsey pricing – but our view



is that these do not deliver enough benefits over EPMU to justify the added complication.¹⁸

- 5.5.3 We recognise that Digita has invested significant resource to develop the ETV system (Chapter 3) for the allocation of shared network infrastructure costs. Provided that FICORA is satisfied that the ETV values are objectively derived, we see no reason for rejecting this approach.¹⁹
- 5.5.4 Our recommendation to FICORA is therefore to utilise the analysis contained in chapter 3 to minimise infrastructure costs that are not directly attributable to DTTV, and to use Digita's ETV system to allocate the remainder.
- 5.5.5 To divide the cost into individual customer charges, we recommend following the analysis of section 3.4. This means an allocation based on proportion of available capacity used, plus a charge for any additional equipment costs, e.g. for regional content provision. For the distribution network, market prices for capacity on telecommunications networks can be used, unless there is a reason to doubt their competitiveness. If there were such doubt, we would recommend the simple approach of dividing the total capital and operating cost of distribution according to the capacity used.

Non-network pricing factors

- 5.5.6 Section 3.5 of this report considered the validity of non-network pricing factors, which could lead to differences in prices between otherwise similar customers, from the point of view of cost orientation and non-discrimination. To summarise our conclusions:
- (a) We consider time of day is a relevant factor in pricing. It is our view that cost orientation should be interpreted over at least 24 hours, or on a weekly basis, in a way that would allow prices to vary according to the time of the day and/or day of the week.
 - (b) The length of contract may also be a relevant factor for pricing, as there can be substantial administrative costs involved in setting up new contracts. Longer contracts can also reduce business risk. It should, however, be for Digita to show that discounts given to longer contracts are justified by the costs avoided.
 - (c) Geographical cost differences would in our view be justified in proportion to *demonstrated* cost differences. Geographical cost differences should not, however, be relevant for customers purchasing nationwide transmission services.

¹⁸ In addition, both the Efficient Component Pricing Rule and Ramsey pricing could be challenged on the grounds that they are not wholly cost-orientated.

¹⁹ Although the analysis in chapter 3 finds some of the costs currently handled by the ETV system, such as cooling and electricity consumption, more directly attributable to multiplexes.



5.6 Post 2007 – a hypothesis

- 5.6.1 In the light of discussions held with FICORA and Digita during the course of this study, we have reached the view that it would be short-sighted of us to assume that the current Digita monopoly of DTTV services will last for any substantial period of time.
- 5.6.2 Although we understand that no final decisions have been reached, we believe it is at least possible that, once analogue transmissions have ceased in Finland 2007, one or more new multiplex licences may be offered. We also understand that a number of third parties (i.e. companies other than Digita) may be interested in acquiring such licences. We make no assumption that any such licences would be offered or taken up immediately after the analogue switch-off: There is no reason why Digita should not remain the sole holder of DTTV multiplex licences until (say) the transition to all-digital transmissions is felt to have settled down.
- 5.6.3 However, it seems to us that *if* the DTTV landscape is to change, possibly substantially, within (say) the next three to four years, we have a duty to FICORA to take that into account. We emphasise again that anything FICORA does, on our recommendation, to regulate DTTV prices between now and 2007 will have an impact on the possible emergence of competition if and when the government decides that new licences are to become available.
- 5.6.4 To develop our recommendations, we therefore hypothesise that:
- one or more new multiplex licences will be offered some time after 2007;
 - one or more third parties will emerge to take up the licences, and that these parties are acceptable to the government as licence-holders; and
 - these new entrants will compete against Digita for some or all of the services that Digita now provides (i.e. that the DTTV market will not be divided up in such a way that they do not compete)
- 5.6.5 The question then arises: what assets and infrastructure would new entrants own or acquire, and, conversely, what assets and infrastructure of Digita might they seek to use, on a negotiated basis, in order to offer service? Within the scope of this study it is not possible to say. To a large extent, the use that a new entrant seeks to make of Digita's infrastructure will depend on the prices charged for it, compared with the cost that the entrant would incur if he built or otherwise acquired his own.
- 5.6.6 Nevertheless, it seems to us highly unlikely that any new entrant would seek to duplicate all or part of Digita's network of 38 tall masts that are used to provide national DTTV coverage. To the best of our knowledge the masts are correctly located for the purpose they serve, and are capable of accommodating additional transmitter equipment. There would be no overall economic gain to Finland from their duplication, so in the hypothetical future envisaged here, we treat the masts as an essential monopoly facility which would fall to be regulated in perpetuity.



- 5.6.7 Based on our current knowledge, however, we see no reason why every other service that Digita provides should not be susceptible, at least in principle, to competition.
- 5.6.8 In such circumstances, modern regulatory best practice would require:
- accounting separation between Digita’s “masts business” and every other part of the DTTV service
 - regulation of the masts business down to its cost of capital (exactly as described in section 5.4)
 - the regulation of access prices to levels which conform to the business’ cost of capital
 - the application of FLC to the other parts of the DTTV business, which we now discuss in more detail.

5.7 The Potentially Competitive Business

- 5.7.1 We make the further assumption that, immediately after the possible award and take-up of new DTTV licences, Digita would still retain Significant Market Power, at least for a period of time. It owns a fully-functioning network and has a substantial amount of technical and commercial experience in the DTTV field, while a new entrant would require time to establish his own equipment and validate his ability to offer a reliable service.
- 5.7.2 If Digita retains SMP in a potentially competitive market or set of sub-markets, then FICORA is entitled, indeed has a duty, to regulate Digita’s prices and terms of trade. However, it seems to us unlikely that Digita might be asked to provide only one single service – different users might require different service components in different combinations and quantities, and Digita would have an obligation to supply them.
- 5.7.3 It would be impossible for FICORA to estimate in advance what services might be required and to determine whether Digita’s prices met the SMP conditions. Our suggestion therefore is that FICORA should first equip itself with an FLC model – based on the current structure of the network – of the Digita “non-masts business”, i.e. the potentially competitive components, and should then use that as a point of reference against which to judge Digita’s prices.
- 5.7.4 It may make sense for FICORA to require Digita to make the equivalent of a telco Reference Interconnect Offer (RIO). Such an offer should describe and price the elements of service that Digita could reasonably expect a third party to seek and that Digita is capable of supplying. It should not contain only a single bundled service offering.



5.8 Principles

- 5.8.1 We recommend FICORA undertake a sequence of steps applicable in principle both to the appraisal of HCA costs for the non-competitive business and to the construction of an FLC model for the competitive business.
- 5.8.2 The first is **accounting separation**. We understand that some degree of accounting separation is already practised, in that Digita's transmission business (which is legally susceptible to regulation) is separated in an accounting sense from Digita's other, non-regulated, business activities. If it is envisaged that Digita will remain a monopoly supplier of DTTV services for a substantial period of time, there is no obvious need to develop the separation that already exists.
- 5.8.3 However, if it is intended that parts of the Digita DTTV business be opened up to competition, then the prospectively competitive parts need to be separated from those parts which will remain a monopoly. Our hypothesis is that "the masts business" may remain monopolistic, in which case it should be separated in an accounting sense from all other parts of Digita's regulated business. Separation implies the grouping of revenues, costs, assets and liabilities under the relevant separate businesses.
- 5.8.4 We do not have enough detailed information about Digita to recommend whether or how the prospectively competitive business activities might be further separated. This is a matter for discussion between FICORA and Digita. Our recommendation is merely that the accounting separation should be sufficiently thorough to permit FICORA to discharge its regulatory obligations. We envisage that FICORA would need at least to be able to check the pricing (against costs) of the most frequently required services or groups of services that new entrants might wish to buy.
- 5.8.5 The second step is to re-assess Digita's current network in terms of **modern equivalent assets (MEA)**. This step would need to be undertaken regardless of whether Digita remains a monopoly supplier of DTTV services or is made subject to competition. In the event that Digita remains a monopoly, we suggest that an MEA assessment would provide FICORA with insights into Digita's efficiency, so that customers could be sure that they were not paying needlessly high prices. In the event that parts of Digita's business are opened up to competition, the MEA assessment would be needed to inform the construction of an FLC model.
- 5.8.6 To be clear, we do not propose that FICORA should attempt to re-design the current network, but should use MEA assets within the existing network design. It could well be that many of Digita's existing DTTV assets are already MEA. We do not know what resources FICORA has to attempt an MEA assessment in-house. If it does not have suitable (or sufficient) resources, an MEA assessment is easily subcontracted to a third party specialist firm.
- 5.8.7 The third step, which would follow on from an MEA assessment, and might logically be combined with it, is to **reassess the operating costs** (often referred to as operating



expenditure, or opex for short) associated with MEA. This would be an important part of the FLC model. To the extent that re-appraisal might result in an opex figure quite different from that which Digita incurs now, it has the potential to be contentious. It does not imply that Digita has to reduce its opex to the adjusted level, but it does imply that Digita could recover only those adjusted costs, not necessarily the costs that it is incurring now.

- 5.8.8 The fourth step is to **estimate a WACC** for Digita. We have seen the methods FICORA proposes to use to calculate WACC for telcos. These are sound and feasible, and we see no reason why they should not be carried over to Digita. We recognise that Digita is not a quoted company, so that its beta value (the riskiness of Digita relative to the riskiness of equities generally in Finland) will have to be estimated.
- 5.8.9 There remains the question of what activities should be taken into account for purposes of estimating WACC. Our view is that, for the case in which Digita remains a monopolist in the supply of DTTV services, the whole company should form the basis of assessment. We acknowledge that Digita undertakes some activities which fall outside the scope of regulation, but we understand that these are small in relation to the whole, so we suggest that in the monopoly scenario the whole business is the correct basis of assessment.
- 5.8.10 Where parts of Digita become subject to competition it would be theoretically correct to assess beta separately for the monopoly and competitive parts of the regulated business. In practice we think this would be difficult, and we therefore recommend that:
- beta should be assessed for the business as a whole; but that
 - a simple adjustment be made to reflect the fact that the competitive side of the business carries more risk than the monopoly side.
- 5.8.11 If Finnish comparators (of monopoly/non-monopoly businesses) could be found, that would be preferable, but if not, then overseas comparisons and economic literature could be used to provide a basis for an estimated difference. We envisage nothing more complex than that, if the business as a whole carries a beta of X , then the competitive side of the business carries a beta of X plus, and the monopoly side a beta of X minus, where X is determined by comparison and/or literature search. Assessing beta for any non-quoted company, and even more for parts of a non-quoted company, is at best an imprecise science.
- 5.8.12 Finally, and for the FLC model only, there remains the question of allocating joint and common costs across the monopoly and non-monopoly parts of Digita's business, and, when it becomes relevant in practice, to different competitive services. As we explained in section 4 of this report, there exist a variety of techniques for doing this. None, by itself, fulfils all necessities or gives one right answer that makes all others wrong. We considered Activity-Based Costing, the Equivalent Component Pricing Rule and Ramsey Pricing (paragraphs 4.6.21-30), but these in our view fail the test of practicability, in that they are more information-intensive than FICORA might be able to accommodate.



5.8.13 We therefore recommend, at least for the first few years of regulation, an EPMU (volume-based) cost allocation. We emphasise again that we do not know the extent of Digita's joint and common costs as a proportion of the total costs, so we suggest that FICORA be willing to reconsider its position when the numbers themselves are known.

5.9 Next Steps

5.9.1 Our recommendation is that FICORA should make a start immediately on:

- (a) Calculating a value of WACC for Digita as a whole, and assessing that against Digita's recent and current returns on capital employed.
- (b) Checking on the allocation of costs as between different DTTV users of the current Digita network.

The accomplishment of (a) and (b) will enable FICORA to complete preparatory work for the December 2005 decision.

- (c) Deciding a working hypothesis that Digita either will or will not become subject to competition within (say) the next four years, and if yes, where competition might arise.
- (d) Checking the current state of accounting separation and deciding in the light of (c) whether and where the line of accounting separation needs to be redrawn.
- (e) Beginning, or commissioning, an MEA assessment of Digita's current network.
- (f) Depending on the hypothesis adopted at (c), assessing and acquiring resources for the construction of an FLC model.



APPENDIX 1: GLOSSARY OF TECHNICAL TERMS

Term	Meaning
Accounting separation	The preparation of separate accounts for different businesses and parts of businesses run by the same company or group of companies, so that the costs, revenues, assets and liabilities associated with each part of a business (and transfers between them) can be separately identified and properly allocated. Accounting separation has been widely adopted in economic regulation, so that regulators can verify that (for example) third parties requiring access to an incumbent operator's network pay a fair price for that portion of the network that they require to use.
Analogue	The direct representation of a waveform signal, as opposed to digital, which is a coded representation.
Annualisation	See depreciation
Antenna system	The combination of equipment that takes the digital RF signal and broadcasts it. The equipment used to encode and decode signals for transport across a communications network according the Asynchronous Transfer Mode standard.
ATM codec	
Bandwidth	The physical characteristic of a tele-communications system that effectively indicates the speed at which information can be transferred. In analogue systems, it is measured in cycles per second (Hertz or Hz) and in digital systems in binary bits per second. (Bit/s).
Bit rate	The rate at which information is carried in binary bits per second.
Broadcast or emission	The radiation of RF TV or radio signals from a suitable transmitter for reception by domestic receivers.
COFDM	Coded Orthogonal Frequency Division Multiplexing – the method by which digital TV channels are coded on to the RF signal.
Common costs	In this report, costs which are ascribable to, or caused by, all the activities of a business. See also joint costs.
Compression	The process by which digital video and associated stereo sound is encoded to the MPEG 2 standard.
Conditional access channels	TV channels the decoding of which in a domestic receiver is under the control of the TV company.
Cost of capital	The rate of return that could be earned in the capital market on investments of equivalent risk. In general, the higher the riskiness of a firm's activities, the higher its cost of capital, since investors typically require compensation for greater risk. For a firm financed by debt and equity, the cost of capital will be a weighted average of its cost of capital (WACC) from both sources.
Depreciation	A term of accounting and economics which recognises that the usefulness, and therefore the value, of the assets of a business are likely to deteriorate over time and defines the amount to be charged against profit for a given year.
Digital signal	In this report the coded representation of a waveform signal by binary digits (ones and zeroes), as opposed to analogue, which is the direct representation of the waveform.
Distribution network	The network over which multiplexed signals are carried from a head-end to the transmitter stations. Note, where signals pass through a re-multiplexer, the links between the head-end and re-multiplexer are



Term	Meaning
DVB	usually referred to as the contribution network, and the links between the re-multiplexer and transmitter stations as the distribution network. As the difference is not germane to the discussion here, we refer to the both sets of links as the distribution network.
DVB-H	Digital Video Broadcasting – Handheld: a variant of DVB optimised for broadcasting to handheld devices.
ECM, EMM	Entitlement Control Messages, and Entitlement Management Messages. These two messages, in combination with the smart card, provide the key needed to descramble a scrambled TV channel within an MPEG2 transport stream.
Fibre	Optical fibre in a communications network carrying information in the form of optical signals.
Head-end	The point in the network where the TV and radio content is typically brought together before being carried over the distribution network to the transmitter stations.
Joint costs	In this report, costs which are ascribable to, or caused by, more than one activity in a business, but not by all of them. See also common costs.
Microwave	Radio links operating at gigahertz frequencies used to carry information in a communications network.
MPEG 2	An encoding standard developed by the Motion Picture Experts Group.
MPEG2 packet headers	The packet headers contain information about the content of the data packets
MPEG2 stream	A stream of data packets containing MPEG2 encoded video.
Multiplex (sometimes abbreviated to "mux")	Several TV and radio channels can be coded on to a single RF signal in which the combination of channels is referred to as a multiplex.
Multiplexing	The process by which a number of MPEG encoded signals are combined into a single data stream so as to minimise the bandwidth occupied by the combined signal.
Packet and packet header	In this report, elements of a television picture or a radio sound or a piece of text, sent in the form of discrete blocks (packets) of digitally encoded information. The packet header is effectively a label which identifies what is in the packet attached to it.
Rate of return	The amount of profit earned by a business in relation to the capital invested in it. Rate of return is usually expressed as a percentage.
Redundancy	In this report, the provision of equipment which may not be used except to provide back-up to other equipment.
Relay station	A station which receives signals from a TV transmitter station and rebroadcasts the signals on the same or different frequencies.
Re-multiplexing	The process by which one or more of the video streams encoded within a multiplex may be altered, for example to insert advertisements or to replace one TV channel by another.
RF (radio frequency) signal	The radio frequency signal carrying the TV or radio content from the transmitter antenna to the domestic receiver. For DTTV these are between 470 MHz and 860 MHz.



Term	Meaning
RF Transmitter	The combination of equipment needed to convert a DVB multiplex stream into the RF COFDM signal ready for radiation from an antenna system.
SI	Service Information
Significant Market Power (SMP)	A concept of regulatory economics in which a player in a defined market is deemed to have the ability to act independently, or largely independently, of reaction from competitors. Regulators normally impose special obligations on companies with SMP in order to stop them from abusing it.
Spectrum	In this report the range of wavelengths used for broadcasting radio, terrestrial television and satellite television. Usable wavelength ranges from about 100 KHz to about 400 GHz.
splicer/transcoder	Equipment which in conjunction with a re-multiplexor enables different content (such as advertisements) to be inserted into a multiplex of TV and radio channels to replace the original content.
Telco	A commonly used abbreviation for "telecommunications company" or, sometimes, "telephone company".
Transmitter station	The physical site from which the TV signals are broadcast.
UHF	Ultra High Frequencies – radio signals between 300 MHz and 3000 MHz



APPENDIX 2: OTHER METHODS OF DEPRECIATION

Declining Balance

- A2.1.1 This method is an accelerated depreciation method that takes into account the fact that depreciation can be highest in the early years of the asset's life. This is because assets may contribute more to revenue generation when they are newer. In addition, this approach can be attractive for assets in which technological change makes obsolescence more important than physical deterioration. Finally, this approach recognizes that repair and operating expenses can become higher as the asset ages. Therefore, the combined value of depreciation and repair expenses are more constant than they would be under straight line depreciation.
- A2.1.2 In the declining balance approach the normal rate of depreciation ($1/n$) is increased and applied to the remaining value of the asset. Thus the cost of the asset is never entirely written off as long as it continues in use. When the asset is retired from use, any un-depreciated cost is written off. Differences in the proceeds from the sale and the book value are recorded as a gain/loss on the disposal of the asset.

Sum-of-the years' digits

- A2.1.3 This is another accelerated depreciation method, where the depreciation rate applied is a fraction defined by

$$\text{Remaining years of useful life/sum of years of useful life}$$

- A2.1.4 For example if the asset life is 4 years, the denominator will be ($1+2+3+4=10$), and for the first year the depreciation will be $4/10$.

Production or service output method

- A2.1.5 This method calculates the depreciation charge by dividing the original cost of the asset by the estimated units of output rather than estimated number of years of useful life. This may provide a more equitable allocation of costs, but might not be suitable in situations where obsolescence is important. Also, in some industries, such as broadcasting, unit of output might not be a very applicable concept.

Constant percentage method

- A2.1.6 This accelerated depreciation method is based on a geometric progression with the terms of progression being the successive depreciated values of the asset over its useful life. The depreciation rate is calculated as

$$dr = 1 - \exp\left[\frac{1}{n} \times \log\left(\frac{S}{C}\right)\right]$$

where C is the initial cost price, S is the scrap value; and n is the years of expected life



APPENDIX 3: COST OF EQUITY – ALTERNATIVES TO CAPM

Dividend growth model

A3.1.1 The *dividend growth model* calculates the cost of capital by summing up dividend yield and expected growth in dividends. A simplified version of the equation required is:

$$r_e = \frac{D_1}{P_0} + g$$

where r_e is the return on equity, D_1 is the dividend in period 1, P_0 is the current price of the stock and g is the expected constant growth rate in dividends. In principle, this calculation looks at fundamentals that affect shareholders' perceptions of value. However, in practise the assumptions on dividend growth can be difficult since historical growth may not be representative of future growth.

Comparable earnings method

A3.1.2 The *comparable earnings method* bases the cost of equity on the return on equity for a sample of comparable companies, which is calculated as the accounting return on the each company's book value of equity. However, it is often difficult to identify comparable companies. In addition the use of book values of income and equity are problematic since the cost of capital is a market related concept.

Discounted cash flow method

A3.1.3 The *discounted cash flow method* is the most widely used method to estimate cost of equity capital in regulated firms in the US (Myers and Brucki 1994). This method defines the cost of equity as the discount rate, which equates the present value of the expected future dividends with the current share prices. A major limitation of this method is that the company's expected dividend stream needs to be forecasted for the estimation, and the company has to be listed.

Price earnings ratio method

A3.1.4 The *price earnings ratio* method derives the cost of equity from the price earnings ratios of a sample of comparable companies. However, this might be problematic if the growth opportunities for the sample companies are different from those of the firm in question.

Risk premium approach

A3.1.5 The *risk premium approach* derives an estimate of the extra return required on equity investments over and above the return required on debt investments. A long term government bond is normally used for the return on debt investments, and this, along with the risk premium (usually based on some study of long term historical rates of returns) is used to calculate the cost of equity. A subjective adjustment is then made to adjust for changes in risk between this particular company and the average company.



Arbitrage pricing theory

A3.1.6 The *arbitrage pricing theory (APT)* is based on the idea that competitive financial markets will ensure that equilibrium prices are based on risk and return. The only risk that is assumed to matter is systematic risk (as with the CAPM model), i.e. the risk that cannot be diversified away. However, in contrast to CAPM, which considers market risk as the only source of risk, the APT considers multiple risk factors. The APT can therefore be looked at as a multi-beta version of the CAPM. However, this is also the key constraint of this model as it is difficult to identify and estimate all the relevant risks.

Fama-French model

A3.1.7 Finally, the *Fama-French model* identifies three factors that determine the risk of the company: market risk, company size (measured by the market value of the company's equity), and the ratio of its book value of equity to its market value of equity. The model suggests that the cost of equity is higher for smaller firms and for those companies with higher book-to-market ratios. However, the model is still not universally accepted and is still in a relatively early stage of development. In addition, it is based on empirical estimations rather than theory. Therefore, it is possible that the extra factors identified are proxies for some other unidentified factors.