

1. Digital television: an introduction

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The purpose of this chapter is to set in context the contributions which follow describing the development of digital television in a range of American, Asian and European countries, and also discussing certain general issues in the development of broadcasting in the digital era, including the provision of spectrum, protection of property rights and containment of market power.

The first section outlines the development of digital television broadcasting globally. The second section describes the value chain in digital broadcasting, identifies where market power might be exercised, and discusses possible remedies. The third section discusses some of the issues associated with providing spectrum for digital broadcasting, and the implications of digital switch-over. The final section provides a brief review of the chapters which follow.

WHAT IS DIGITAL TELEVISION AND WHO GETS IT AND HOW?

Hernan Galperin's book on digital television in the UK and the USA eloquently explains in its first paragraph what digital television does:

the transition from a world of spectrum scarcity, dumb terminals, and one-way services, to a world of on-demand programming, intelligent terminals, and abundant channels – namely, a transition from analogue to digital TV. Heralded as the most important innovation in the history of the industry, digital TV involves the reconfiguration of a sector that, beyond its economic significance, is central to the mechanisms of democratic politics and the evolution of popular culture. This is certainly not the first time that the television industry faces reorganization on a massive scale. But for the most part past technological innovations have spurred evolutionary, not revolutionary change. An old black-and-white TV set would probably be able to pick up several colour TV signals. Analogue cable branded packages of programming called channels. The transition to digital TV is different. It requires a complete retooling of the existing video production and distribution infrastructure, from studio cameras

to transmission towers. It requires new mechanisms to compensate content creators and is distributed in a world where conventional ads can be skipped and perfect copies made and distributed with the click of a button. And it requires new tools for viewers to navigate the maze of programming and new services available, much like Internet browsers help us find our way through the World Wide Web (Galperin 2004, p. 3).

The world may be going down this road, but it is doing so in different proportions and at different speeds in different countries. What we observe is the progressive addition of new services which offer viewers first more channels, made possible by the much greater compression attainable under digital rather than analogue technology;¹ then some interactivity, which can involve an enhanced electronic programme guide (EPG), for example with a search engine, content on demand, opportunities to modify a programme via display of additional information or choice of camera angle, interactive advertising, and use of the television to play games or place bets (Jensen 2005); then, in the more distant future, a more comprehensive change in the economic and social relations linking consumers, content providers, and all the intermediate steps in the processes linking providers and consumers of content.

We will begin with platforms, because these are the most visible aspect of the new digital production processes. Initially we had analogue terrestrial transmission, then (in some countries) low capacity analogue cable, then analogue satellite, offering many channels over a significant 'footprint' served by a transmitter in geo-stationary orbit. Compared with analogue terrestrial, cable and satellite broadcasting was already beginning to chip away at the limitation on access to content supported by barriers to entry arising from limited spectrum availability – or the reluctance to release what there was or the part of governments which were often in thrall to politically influential incumbents.

Transition to digital platforms both expands the capacity of each and breaks down divisions among different types of communication, such as television, voice communication or access to the internet (a process often known as convergence). Table 1.1, adapted from Chapter 6, exposes the range of possibilities – either available or in prospect.

The take up of digital TV is variable throughout the world. Table 1.2 shows take up rates in 2005 in a range of countries. The UK had reached the highest level – nearly 70 per cent. Other countries, such as the Netherlands with nearly 100 per cent cable penetration, had barely made a start. The take up rate of DTT in the United States remained very low – see Kwerel and Levy (Chapter 2) below – although satellite services were completely digital, cable increasingly so and DTT was widely avail-

Table 1.1 Characteristics of digital platforms

Platform	Services	Approximate capacity to home	Interactivity	Strengths	Weaknesses
Digital cable	TV, radio, PPV, interactive services	Equivalent to about 800 TV channels	Good scope – integrated return path	Large bandwidth Integrated return path	Limited return path capacity Fragmented networks add to costs
Digital terrestrial transmission	TV, radio, interactive services	4–6 times analogue capacity (say 40–80 channels)	Limited scope and no return path	Large bandwidth Mobile and portable indoor use (theoretically) Local differentiation possible	No integrated return path Expensive way to achieve universal coverage
Digital satellite	TV, radio, PPV, interactive services	Equivalent to 600–1000 TV channels	Good scope but lacks integrated return path	Large bandwidth National coverage from one satellite Fast roll-out of innovations is possible, for example, personal video recorders and high definition TV	No indoor reception No integrated return path Long transit time doesn't suit all interactive services
DSL based on telephone network	TV, radio, VOD, interactive services, Internet	Unlimited (video on demand)	Excellent – integrated high-speed return path	Large bandwidth Near universal coverage	Bandwidth available drops with distance from the exchange

Table 1.1 (continued)

Platform	Services	Approximate capacity to home	Interactivity	Strengths	Weaknesses
Powerline, based on electricity network	Internet	(as for DSL)	Excellent – integrated high-speed return path	Ubiquitous access extends throughout houses	Not yet rolled out Interference problems still to be resolved
Wide area wireless broadband	Internet	Up to 1 Mbps at present	Good	Extends the reach of fixed broadband platforms	Coverage varies within home
Mobile broadcasting DVB-H	TV, radio, interactive services	30–80 channels per multiplex	Good – uses 2G/3G return path	Suited to mobile TV and other multimedia services Backed by major handset vendors	Not mature yet Needs spectrum opportunities
3G mobile	Voice, Messaging, Audiovisual stream/download, interactive services,	No live TV at present Typically ~384 kbps	Good	Good for Internet access Fast roll-out within covered areas	Coverage variability

Note: DSL = digital subscriber line, PPV = pay per view; VOD = video on demand.

Table 1.2 Digital TV penetration rates (per cent) end 2005

	Total	Cable	Satellite	DTT	IPTV*
UK	68.9	10.5	32.0	25.2	0.2
France	34.7	4.3	21.6	6.9	1.9
Germany	28.9	6.7	17.8	4.2	0.1
Italy	36.0	0.0	20.2	14.9	0.9
Netherlands	11.4	5.3	3.1	2.3	0.6
Poland	17.9	0.4	17.5	0.0	0.0
Spain	27.6	5.6	15.4	5.2	1.5
Sweden	44.5	9.6	20.6	13.3	1.0
USA	50.3	25.3	24.2	0.5	0.3
Japan	59.1	7.2	33.1	17.9	0.9

Note: *Delivered by DSL or equivalent technology.

Source: Screen Digest.

able. In Japan, analogue terrestrial is firmly targeted for switch-off in 2011.

THE DIGITAL VALUE CHAIN AND MARKET POWER

As shown above, digital television can be delivered on many platforms, although at present cable, satellite, and to a lesser extent DTT, predominate. Moreover, the platform is a single element in a complex value chain which goes from the initial creation of broadcast content by actors, sportspeople, cinematographers, and so on and ends up with the reception equipment in a home or (in the future) on a mobile terminal. Some firms provide nearly all the services involved in the value chain; others participate in only one (for example, programme making or satellite distribution). The outcome for viewers in terms of choice, price and quality depends upon what happens in the chain as a whole.

From the consumer's viewpoint, a key determinant of outcomes is the exercise of market power. The owner of a bottleneck at any point in the value chain will try to appropriate the monopoly rents available throughout.

Table 1.3 Digital value chain

	Content creation	Programme making, filming sports etc
	Wholesaling of programmes	Complete channel or pay per view
	Retailing	Often as 'bouquets' of channels
Platform	{ Transmission Conditional access, and so on	Cable, satellite, DTT, ADSL
		Not relevant for 'closed channels' such as cable
		Including STB's – often subsidised.
	Customer provides equipment	

For this reason competition authorities and regulations have taken a keen interest in the exercise of market power in broadcasting.

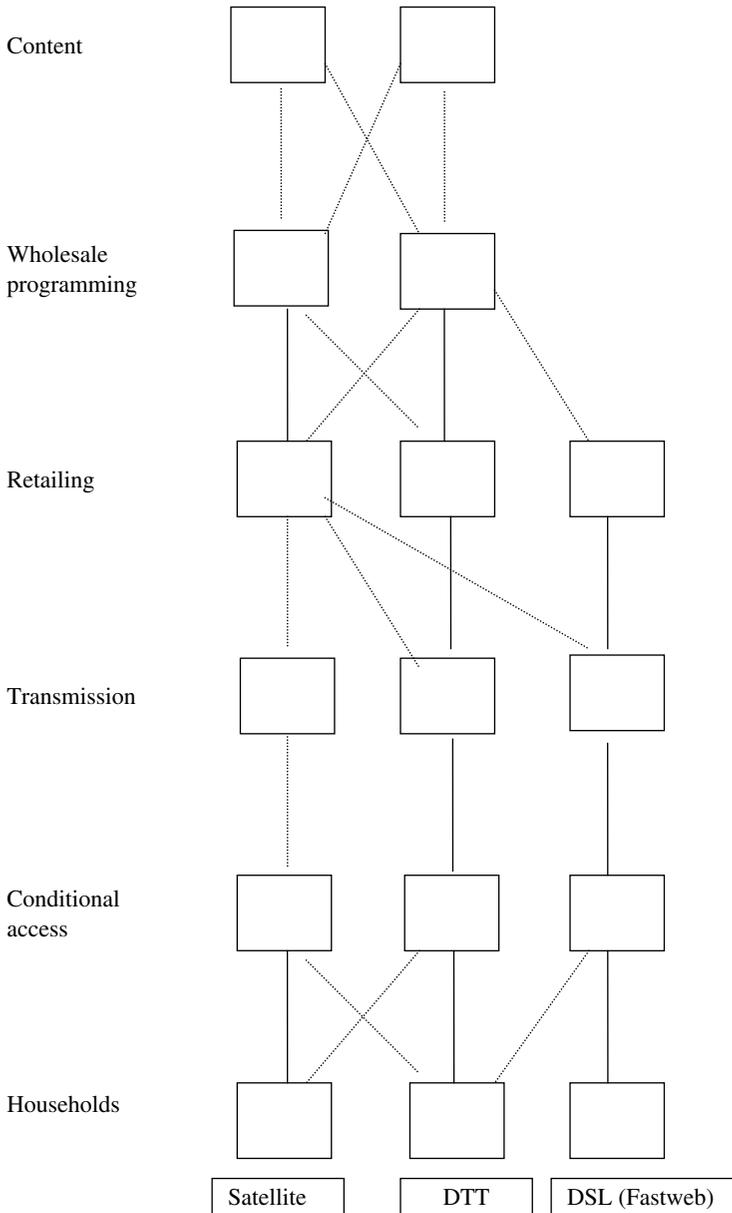
We illustrate this in terms of a simplified value chain shown in Table 1.3 (see Cave 1997). Under advertiser-supported broadcasting, instead of programmes being retailed to audiences, the audiences themselves are sold to advertisers. This activity replaces revenue capture via conditional access. Traditional analogue terrestrial broadcasting in Europe, undertaken by monolithic firms, often in public ownership, shows a high degree of vertical integration of these activities.

Throughout the value chain, competition takes place within the framework of standards adopted *de jure* or *de facto* in particular regions. An example is provided by the various versions of the digital video broadcasting (DVB) standard adopted in Europe. There has been much debate about the appropriate role of standards and the consequence of the existing multiplicity of standards across the world (Galperin 2004, Levy 1999). Most of the chapters which follow take existing standardisation arrangements as a given in their discussion, as that phase of activity has passed. But the past (and future) role of standards should not be underestimated.

A more realistic example, loosely based on the state of pay TV in Italy, is shown in Figure 1.1 (see also Chapters 5 and 11 by Del Monte and Di Mauro). This involves separation of ownership (illustrated by dotted lines) and interchange among stages.

In this representation:

- (a) content providers sell exclusively or non-exclusively to wholesalers;
- (b) the latter make their material available to multiple retailers;
- (c) one platform buys all its content at wholesale;



Notes: Dotted lines represent transaction boundaries.

Figure 1.1 Competition in the value chain: an example

Table 1.4 Broadcasting activities and likely problems

Activity	Competition problem
Content	Monopolisation
Wholesale programme market	Bundling, price squeeze, excessive pricing
Retailing of pay programmes	Bundling, price squeeze, excessive pricing
Transmission	Abuse of dominance, denial of access
Conditional access, EPG and so on	Refusal to supply, discrimination, excessive pricing

- (d) a retailer can get on to multiple platforms;
- (e) using the same or a different delivery mode (satellite, DTT, and so on), any two activities, such as transmission and conditional access, can be vertically integrated or separated; and
- (f) households can take programmes from more than one platform.

This complex structure generates an almost limitless array of opportunities for the exercise of market power. Table 1.4 contains some of the more prominent ones encountered in practice.

By way of illustration of the competition problems which have been identified:

- The issue has arisen in the United States as to whether cable operators can foreclose entry in platform markets by denying their platform rivals access to programming (Hazlett 2005).
- In Europe, the collective selling of live football rights to a single programme wholesaler has attracted intervention by competition authorities; the practice has been impugned as a joint exercise of market power which also leads to reduced competition in downstream retail markets.
- In Italy, it was made a condition for a merger between two pay-TV operators that the combined entity would give rivals access to its platform.
- In the UK the leading pay broadcaster was investigated for (and cleared of) conducting a margin squeeze by preventing purchasers of its wholesale programmes from being able to make a profit in retail markets.

The chapters which follow pick up these competition issues in various ways. They also address questions of how legitimate protection of intellectual property can be achieved. In this context a particularly interesting

development is the growth of digital rights management (DRM). Copyright on content can be justified by the need to provide incentives for its creation (Scotchmer 2004). In a digital world, making perfect copies is easy and cheap. Content owners thus have a strong incentive to protect their intellectual property and have a range of new technical options available. As Cowie and Kapur show in Chapter 9, some of these supersede functions now carried out by platform providers, thus altering the balance of market power in the value chain. In Japan the issue of improving a defective copyright regime has become increasingly important, as Chapters 10 and 12 by Domon and Joo and Oniki show.

SPECTRUM POLICY AND THE DIGITAL SWITCHOVER

Public policy in the field of spectrum allocation also exercises a powerful influence on digital TV. Traditionally, governments used their power to assign spectrum as an auxiliary instrument for controlling the number and identity of broadcasters. Traditional spectrum management techniques suited this purpose very well.

These techniques are known as ‘command and control’ and have operated in essentially the same way since the first global convention for co-ordinating spectrum use in 1906. Under the system, spectrum blocks are allocated, through international agreement, to broadly defined services. National regulatory authorities then assign licences for use of specific frequencies within these allocations within their jurisdictions (Cave 2002, 55).

This regulatory task involved an inherently complex balancing act in a range of dimensions, in each of which there are many conflicting considerations. Key factors include:

- *Interference* Transmissions interfere unless sufficiently separated in terms of frequency, geography and time. Regulators must strike a balance between reducing the extent of harmful interference, through careful planning, and enabling potentially valuable new services to enter the market.
- *International co-ordination* The effective use of radio spectrum in one country will typically require careful co-ordination with neighbouring countries, to mitigate the extent of harmful interference.
- *Investment in equipment* Most radio equipment can operate over only a limited range of frequencies, and so relies on predictable access over time to defined frequency bands. Stability in spectrum assignments to encourage investment in equipment can slow the pace of

spectrum re-use. Increasingly, technical specifications are determined internationally to reap economies of scale in production. National regulators need to balance stability and international harmonisation with responsiveness to new technologies.

The problems of co-ordinating broadcasting spectrum are particularly severe, since broadcasting is a ‘one-to-many’ communications technology which is efficiently done over a large area. This inevitably creates the risk of interference with broadcasters in neighbouring areas or countries. This problem was vividly exposed in the United States in the 1920s when a Court ruling denied the Government the power to control access to spectrum. The resulting free-for-all, in which radio stations progressively turned up their power to resist interference from others led to a ‘Tower of Babel’ and eventually to the Radio Act 1927 which gave the Secretary of Commerce power to authorise and control access to spectrum.

The resulting problems are resolved in the age of television broadcasting by international agreements, which set out in great detail which transmissions at what power are permissible from which specified sites. Thus analogue terrestrial television broadcasting in Europe is governed by agreements reached in Stockholm in 1961. A European plan for digital broadcasting is currently being developed for approval at a Regional Radio Conference in 2006.

Subject to these constraints, each national spectrum authority assigns frequencies to particular broadcasters. For example in the United Kingdom, analogue and digital terrestrial TV transmissions use 368 MHz of spectrum within the band 470–854 MHz (Cave 2002, 161). The spectrum is split into 46 frequency channels, each composed of 8 MHz of spectrum. The following bands are used:

- 470 to 590 MHz (channels 21 to 35);
- 598 to 606 MHz (channel 37);
- 614 to 854 MHz (channels 39 to 68).

(To complicate matters, channel 36 is allocated to radar for historical reasons.) Each channel can be used to broadcast either one analogue TV service, or one digital multiplex – carrying six or more separate TV services – from a given transmission site. There is a maximum of 11 channels used at a transmission site (five for analogue TV channels, and six for DTT multiplexes). At such sites there are still seemingly 35 frequencies (46 minus 11) lying idle. These empty frequencies are interleaved with the frequencies used for the analogue and digital services. Some of the empty interleaved frequencies’ channels cannot be used because they would

cause interference with the channels which are used or with adjacent transmitters; some, however, could be made available to broadcasters or other users.

Satellite broadcasting also requires spectrum for two purposes – to uplift signals to the satellites and to broadcast signals direct to home (DTH). As signal strength from the medium-powered satellites currently in use is fairly low, frequencies must be cleared of alternative services to allow signals to ‘get through’. A further feature of satellite broadcasting is that, because transponders have a multinational footprint, and because uplift and reception can be in different countries, the spectrum authority in the country where the signal is received may have no jurisdiction over the provider of transmission services.

While command and control has been used almost universally for managing broadcasting, and most other frequencies, the attention has turned in several countries to the alternative of using market mechanisms to allocate and assign spectrum. A start has been made in this process by the use of auctions to assign licences, especially for third generation mobile services, but the market agenda extends to ‘secondary trading’ – that is exchange of ownership of spectrum or spectrum licences which have already been issued, accompanied by the opportunity for the existing or new licensee to change the use of the spectrum – often known as liberalisation, subject, of course to international obligations. The US and UK spectrum management agencies have supported and to some degree introduced secondary trading and liberalisation (FCC 2002, Ofcom 2005).² The European Commission is expected shortly to endorse secondary trading.

Under a liberalised regime, spectrum can be used interchangeably, for example, for mobile communications, traditional terrestrial broadcasting, mobile broadcasting and a range of other possibilities. The chosen use would depend, as in other markets on the varying willingness to pay of potential licensees, which would itself depend, where end users are buying the services, on their willingness to pay for those services. As noted below the switchover to digital terrestrial will confront spectrum authorities with a choice between command and control and market methods of assigning released spectrum.

One consequence of the switchover to digital terrestrial is that, for a transitional period, both analogue and digital platforms have to be used at once. The length of the period is under government control, but the turnover of customer premises equipment – televisions, VCRs, and so on – of which there may be three or more per household – is a slow process, and provision may have to be made to encourage the acquisition of digital set top boxes by slow adopters. (Such policies are analysed in Adda and Ottaviani (2005).) In Italy, which has a switch-over target date (almost certainly

unrealistic) of 2006, the Government offers set top box subsidies of 40 euros per household. Cave's chapter describes how the issue is being faced in the UK. Clearly, government to pre-announce a subsidy if it will choke off investments by individual households.

None the less, the possible 'spectrum dividend' associated with analogue switch-off has encouraged most governments of richer countries to seek a digital switchover of terrestrial transmission, which both brings the other advantages of digital television noted above and releases valuable spectrum which can be assigned to other users, either by command and control or market methods.

The European Commission has proposed a target date of 2012 for the 20 member states of the EU, setting 2015 as the latest date for members. Table 1.5 shows the state of the process in each country.

Digital switchover in the USA is now scheduled for 2009 under recently passed legislation. In Japan a plan for digital terrestrial broadcasting has been implemented since 2003, starting with the three main metropolitan areas of Tokyo, Osaka and Nagoya. It is planned that analogue broadcasting will cease on 24 July 2011.

THE CHAPTERS WHICH FOLLOW

The interplay of forces which determine a country's broadcasting system tends to be much more idiosyncratic than those which govern, for example, its telecommunications sector.³ The chapters which follow therefore take up a variety of themes. First, six chapters provide a number of country or area studies; further country studies of digital terrestrial television in Europe can be found in Brown and Picard (2005). Then a group of three chapters discusses rights issues. Finally, four chapters analyses various aspects of platform competition in digital broadcasting.

Chapter 2: The DTV transition in the US (Kwerel and Levy)

This chapter discusses the transition to digital television (DTV) in the US on three platforms: terrestrial broadcasting, cable and satellite. DTV provides more and better services for consumers on all three of these platforms, and promotes inter-modal competition, as without the transition of terrestrial broadcast television from analogue to digital it is questionable whether terrestrial broadcast television could survive as a viable competitor to cable and satellite. The transition of broadcast TV to digital also has the additional benefit of freeing up spectrum for other potentially more valuable uses.

Table 1.5 European digital switchover timetables

Country	Target Date	Status	Other details
Austria	2010	Provisional	
Belgium	2012	Provisional	SO planned to start in 2010
Cyprus	no date set		
Czech Republic	2017	Provisional	
Denmark	2011	Provisional	No decision yet
Estonia	no date set		
Finland	2007	Provisional	August 2007 – all of country
France	no date set		No decision yet
Germany	2010	Provisional	Berlin switched off 2003.
Greece	2010	Provisional	
Hungary	2012	Provisional	
Ireland	no date	Provisional	No decision yet
Italy	2006	Committed	
Latvia	2006	Committed	
Lithuania	2012	Provisional	SO starting in 2012
Luxembourg	no date set		No decision yet
Netherlands	no date set		No decision yet
Malta	no date set		
Poland	no date set		
Portugal	2010	Provisional	No decision yet
Slovakia	2015	Committed	2012 target
Slovenia	2015	Committed	2012 target
Spain	2010	Provisional	May start earlier by region
Sweden	2008	Committed	February 2008 – proposed final date.
United Kingdom	2008–2012	Committed	

Source: European Union, May 2005.

In assessing the current status of the US DTV transition, a number of indicators can be considered. One of these is the number of stations actually transmitting in digital format. The authors find that terrestrial DTV signals are widely available throughout the US, and that digital programming is also widely available on cable. Note that satellite television is a completely digital service. Another factor to consider is the availability of digital content via the various distribution platforms. All the major US commercial broadcast television networks are currently producing significant amount of HDTV content, and there are roughly 17 non-broadcast HDTV services distributed by cable and satellite, representing a variety of genres. The take-up of DTV

equipment is also an indicator, and sales figures suggest that approximately 3.3 per cent of US households had the capability to receive terrestrial DTV signals off-air at the end of 2004.

Digital rights management (DRM) policy has a strong impact on DTV diffusion, as consumer demand for DTV equipment depends heavily on the content available and the willingness of content providers to make content available depends on their ability to retain control over distribution and, especially, to prevent or limit unauthorised copying. Unlike analogue material, digitally formatted data may be copied repeatedly with little or no quality degradation, diminishing the return to the creators of the content and thus diminishing the amount of content produced. This reduces the incentive for consumers to invest in DTV equipment. Policymakers must balance incentives to produce new content against the potentially substantial benefits to consumers of copying and sharing.

A target date of the end of 2006 had been set for switching off all analogue television in the US. However, the legislation permitted stations to continue analogue broadcasting in markets where penetration of DTV reception equipment is less than 85 per cent. In 2006, legislation was passed which set a hard date of 17 February 2009 for switchoff regardless of penetration rates achieved. Funding for convertor box subsidies was approved up to \$1 bn, with a provision for an increase to \$1.5 bn. The auction of spectrum recovered for commercial use must start by January 2008.

Switching to digital broadcasting would free up spectrum that could be valuably used elsewhere, but the cost of the loss of analogue service to viewers some or all of whose sets rely on analogue signals must be taken into account. However, this cost is much less than the value of the spectrum made available for other uses. Therefore, incentives should be provided to speed up the switchover.

Chapter 3: Digital broadcasting in the developing world: a Latin American perspective (Galperin)

This chapter examines the issues associated with the switch to DTV in the developing world, specifically in Latin America. While the transition to DTV has been underway for some time in most of the developed world, Latin American nations have only recently begun to set the terms for the transformation, which implies a complete retooling of the existing production and distribution systems, as well as new mechanisms to compensate creators and distributors for the increased ease of copying, which makes new demands on the existing legal apparatus.

Some of the advantages of DTV are particularly relevant to the developing world. First, it may help fuel the growth of wireless communication

infrastructure, critical in nations where no legacy of wired networks exists. Second, it can offer a unique gateway into the information society for those who are currently excluded: while few households in Latin America have computers or internet connections, most have televisions.

However, there are also challenges involved in the transition to DTV, as the experiences of developed nations have demonstrated. Galperin identifies two distinct strategies that have been adopted to overcome these obstacles: the US approach in which the existing broadcasting arrangements are extended into the digital era and the approach exemplified by the UK, where there has been a reallocation of spectrum rights and greater government involvement in managing the transition and addressing potential co-ordination problems. Countries in Latin America must consider both local and international factors in deciding which approach to adopt: the proximity of some of the nations to the US has proved an important deciding factor. Galperin goes on to focus more closely on the markets of Argentina, Brazil and Mexico, three key Latin American markets.

Chapter 4: DTT and digital convergence: a European policy perspective (Fontaine and Pogorel)

Television policy in the EU has been designed to conform to overall aims of European integration. This requires co-ordination of national legislation over an area where the specifics of the broadcasting markets of individual countries often differ significantly. In larger countries (with the exception of Germany), terrestrial transmission tends to be the largest platform. Conversely, it is marginal in almost all of the smaller European nations, such as Benelux, Switzerland and Scandinavia, which have opted for cable or satellite as it has not been feasible to develop a broad national offer on terrestrial broadcasting. Terrestrial migration to digital could alter the situation by stimulating a resurgence of interest in terrestrial broadcasting as the range of services offered expands, making it a viable alternative to cable or satellite, and possibly increasing usage, especially in countries where terrestrial broadcasting is currently secondary. However, in many of the larger European countries digital terrestrial television will not cover as much of the population as analogue (often as little as 85 per cent) so a greater number of people will have to resort to an alternative platform.

Chapter 5: The development of digital broadcasting in Italy (Del Monte)

There are a number of common justifications for regulating the broadcasting market as both economic and social. However, the policy adopted with regard to regulation differs in different countries and this has resulted in

different market structures for the analogue TV sector. These structural features constrain the transition from analogue to digital to the extent that the transformation often follows a pattern determined by the pre-existing industry structure. Therefore the amount and type of regulation needed to maximise the benefits of the introduction of digital television varies from country to country.

In theory, the relaxation of spectrum scarcity should decrease barriers to entry and increase competition in the television market, and the higher number of channels will increase product differentiation. However, it is unlikely that market forces alone will bring about these changes. For example, if the allocation of licences is not designed to favour new entrants, the incumbent operators, who benefit from key assets such as distribution infrastructure and ownership of content, will preserve and ultimately strengthen their market position as the transition to digital takes place.

The pay-TV market is much less developed in Italy than in other European countries due to features of the regulatory environment from the 1970s onwards, so DTT faces little effective competition from other platforms. This means that the Italian media laws alone are incapable of increasing competition in the digital service markets, as are other rules of conduct which might be sufficient in other national broadcasting markets. In Italy structural regulation will be necessary to achieve the goal of a genuinely competitive market.

Chapter 6: The development of digital television in the UK (Cave)

The UK has a 2005 penetration level of digital TV of 60 per cent, and plans to switch off analogue terrestrial transmission on a regional basis from 2008–2012, and immediately to achieve the same level of near-universal coverage by DTT.

Throughout the 1990s, multi-channel television, delivered by cable and satellite platforms began to take off, and in 1998 the Government licensed DTT, broadcasting to about 70 per cent of households a mixture of non-pay and pay services. However the pay-TV licence did not prosper and in 2002 a multi-channel largely free-to-air service was launched (Freeview) which quickly acquired 5 million customers. In the coming years, cable, satellite and DTT are likely to compete with DSL-based services.

A further boost to DTT is provided by digital switchover, as the Government has required that (almost) all households are provided by a DTT service. The switchover will take place progressively over a four-year period beginning in 2008.

The use of the freed analogue spectrum will be decided within the framework of the UK's spectrum management policies, which over the past

decade have sought increasingly to impose market-type disciplines on all spectrum users including broadcasters, and now propose to rely primarily on auctioning and secondary trading of spectrum (allowing change of use) to make spectrum assignments. As a result, released analogue spectrum may be deployed in a variety of users, including DTT, mobile television (known as DVB-H) or mobile communications.

Chapter 7: A perspective on digital broadcasting in Japan (Nakamura and Tajiri)

Japan is undergoing the same transition to digital television as is occurring in other countries. Three principal platforms are in play: DTT, which was inaugurated in 2003 and should supersede analogue terrestrial transmission in 2011; satellite broadcasting, using both ‘broadcasting’ and communications satellites, which are switching to digital; and cable, where digitalisation is still in its infancy. In addition, fibre to the home installed by telecommunications companies provides a fourth platform.

The chapter focuses upon relations between content providers and broadcasters. The former are subject to ‘natural oligopoly’ tendencies as a result of the superiority of particular forms of content – vertical quality differentiation. However certain content providers are subject to potential abuses from more powerful incumbent and protected broadcasters.

This latter problem finds reflection in copyright issues, which tend to be resolved in favour of broadcasters, as a result of inadequate procedures, especially for secondary rights.

A further problem exists with spectrum policy, where current assignment and charging regimes fail to either promote economic efficiency or to achieve equity between under-paying broadcasters and over-paying mobile operators.

However the authors conclude that the developing features of the communications sector – notably convergence – provide an encouraging context for the development of a new competition regime based upon competition with existing new markets and competition for innovative ones.

Chapter 8: Legal and economic issues of digital terrestrial television (DTTV) from an industrial perspective (Hayashi)

This chapter discusses the issues associated with DTTV from an industrial perspective by taking the Japanese experience of DTTV as an example. The shift to DTTV can be viewed in one of two ways. Under the substitution hypothesis DTTV is nothing more or less than broadcasting based on digital technology rather than analogue. This is the view of DTTV

subscribed to by most broadcasters and policymakers. Hayashi offers the paradigm shift hypothesis as the view of DTTV diametrically opposed to the substitution hypothesis, whereby DTTV is in fact radically different to conventional broadcasting, necessitating a rethink of the entire broadcasting industry. Namely, content and conduit, which have traditionally been vertically integrated, should now be treated separately. In addition, transmission using Internet Protocol should be implemented to respond to the diversity in conduits and receivers.

The experience of the internet revolution and the convergence of communications and computing that it entails suggests that although dependence on the substitution hypothesis as a business plan may provide a solid start, it may sometimes be overtaken by the paradigm shift hypothesis, as was the case with the choice of routing technology. However, the paradigm shift hypothesis essentially provides policymakers with unlimited scenarios, while the substitution hypothesis automatically provides limits and thus lends itself better to analysis of the issues involved in the transition to DTTV. Hayashi goes on to discuss some of these issues, but then states that the ensuing analysis highlights the inadequacy of the substitution hypothesis, again suggesting that we should look at the transition to DTTV in terms of a paradigm shift rather than in terms of evolutionary change.

Chapter 9: The management of digital rights in pay TV (Cowie and Kapur)

At present, broadcasting content is protected by a mixture of legal and technological measures. The transition to digital television poses new challenges for the protection of this content as piracy becomes easier, prompting both changes to copyright law and new technological solutions. Digital Rights Management (DRM) is one such technological response, one which the authors believe will be increasingly important for protecting digital content in the pay TV supply chain. This chapter examines the potential impact of DRM on market power in digital pay TV.

DRM is a suite of technology employing a number of discrete tools which combine to allow the content owners to monitor and control access to material from the point of creation to the end of its life. Preventing unauthorised duplication and transfer enables the owners to appropriate the full value from content, providing greater incentives to support the new digital platform, and thus welfare gains arise in the form of new products.

DRM also reduces the transactions costs associated with the transfer of digital media. This renders new business models viable and leads to a change in the economics of the supply chain at intermediate levels as content owners can threaten to use DRM to distribute content directly to

consumers, bypassing pay TV platforms. This has implications for regulation and competition policy.

DRM also improves the ability to charge discriminatory prices. This could potentially be welfare improving, but price discrimination often causes dissatisfaction in consumers, sometimes translating into calls for regulatory intervention.

Chapter 10: Copy control of digital broadcasting content: an economic perspective (Domon and Joo)

This chapter adopts an approach to controls over copying digital broadcasting material based on the economic literature. The latter has analysed in particular the pros and cons of allowing copying of printed matter, reaching ambiguous conclusions both theoretically and empirically. A key issue has been the extent of indirect appropriability – the degree to which the content provider can appropriate copiers' willingness to pay via an increase in the demand price of the direct customer.

The same phenomenon applies in respect of pay-TV products. While personal copying benefits both producer and consumer, by increasing consumption, copying by third parties increases competition in the market while creating opportunities for indirect appropriability.

The authors concluded that digital broadcasters will be forced to confront the same issues as has the music industry. Copyright infringements will not disappear, and this will force action to be taken. But those actions must take account of the effects on indirect appropriability.

Chapter 11: Regulation of digital TV in the EU: divine coherence or human inconsistency? (Di Mauro)

Regulation of content and regulation of infrastructure are treated separately within the EU regulatory framework. This article focuses solely on the regulation of infrastructure, specifically on infrastructure needed to convey digital TV broadcasting signals.

The most important aspect of the regulation of DTV infrastructure is the regulation of conditional access systems (CAS). CAS is any system or arrangement that allows a broadcasting service to be consumed only by those who are entitled to consume it, usually through subscription. The introduction of CAS represents a shift in broadcasting from a quasi-public good status to that of a standard good as CAS displays the key feature of excludability.

The basic EU regulation of CAS, dating back to 1995, states that providers must offer their services on terms that are fair, reasonable and

non-discriminatory (FRND). This was supplemented in 2003 by the new regulatory framework (NRF), based more explicitly on economic analysis than previous regulation. The chapter goes on to examine the determinants of digital broadcasting regulation in the EU, with reference to the FRND structure, especially the discriminatory aspect that is particularly relevant to CAS. The author concludes that although there are dangers associated with adopting a FRND remedy for digital television services, a reasonable interpretation of it is necessary if the needs of end users are to be put at the centre of the regulatory framework.

Chapter 12: Platforms for the development of digital television broadcasting and the internet (Oniki)

The chapter is concerned both with regimes for generating revenue from content and with competition at various points of the value chain in a world where the potential of digital television broadcasting has been realised so that it competes with the internet.

The author first notes that DTT in Japan is being developed in a highly controlled way, which maintains the position of the key network stations in the analogue world. As the dominant source of revenue from television is terrestrial television, its owners seek to maintain the *status quo*, under which revenue comes from advertising, not pay TV.

However, digital television is a technology which is capable of selling content, and the author describes a number of ways in which this could be done, by creating a series of 'windows', subject to disclosure of marketing plans.

The author then turns to problems associated with bottlenecks in the value chains of digital television and the internet. A 'layer' model is developed in which monopoly of infrastructure plays a key role – the situation in Japan in broadcasting and telecommunication markets providing examples of abuses by vertically integrated companies. A variety of antidotes for such conduct are put forward, including obligations to supply at a competitive price, accounting for ownership separation, and competitive interventions by one or more public corporations.

Chapter 13: Economies of scale, scope and vertical integration in the provision of digital broadcasting in Japan (Mitomo and Ueda)

The impending development of digital terrestrial television, which is being introduced at considerable cost with a view to switching off analogue broadcasting in 2011, focuses attention on the cost function of broadcasting firms. The chapter analyses the evidence for Japan, using a sample of analogue

broadcasting stations, and testing for economies of scale, economies of scope and the effects of vertical integration.

Economies of scale are investigated using a translog cost function. The results suggest that a broadcaster operating over a larger geographical area is more efficient and this may provide an argument against the tight merger controls at present operating in the industry.

Vertical integration and economies of scope between programme production and transmission is investigated via estimation of cost functions for both activities and for programme production alone.

The policy implications of these results are then examined. A future re-organisation might involve fewer, larger stations, without the vertical integration which has characterised the industry.

Chapter 14: Comparative analysis of the market structure of broadcasting and telecommunications in Japan (Asai)

The broadcasting and telecommunications sectors in Japan differ in the degree of vertical integration, level of competition and date of digitisation. The chapter examines these relationships, using a general description of economic activity in terms of vertical levels or 'components' and the interfaces between them. Open interfaces are often governed by standards, which in telecommunications are typically *de jure* standards, while the internet relies on a *de facto* standard, TCP/IP.

Broadcasting in Japan is done on terrestrial, cable and satellite platforms. Terrestrial broadcasting is dominant and highly regulated to achieve vertical integration of programme making and transmission and the attainment of a degree of localism within a network-affiliate structure. Satellite markets exhibit more separation and higher levels of competition. Copyright law is undeveloped, although digitalisation is likely to change this.

Japanese telecommunications have been opened up to competition and diversified firms such as KDDI and Softbank have emerged through mergers. The historic monopolist, NTT, has also been legally separated. Digitalisation was completed in 1997.

The author anticipates that when digitalisation of broadcasting is complete, new competition will emerge at the different levels and the dominance of broadcasters over production companies will be reduced. Terrestrial broadcasting will, however, be subject to little internal competition, and competitive processes are likely to come from outside, from sources such as the internet.

NOTES

1. Digital television permits the broadcasting of approximately four to six times as many channels of current definition, or the same number of channels of high definition television, as can be broadcast on analogue with a given amount of spectrum. It also permits widescreen pictures, more robust technical quality and interactive features. If a household owns an analogue set, it must acquire a set top box to convert the broadcast digital system into analogue format.
2. In this respect, they are following earlier pioneers, such as Australia, Guatemala and New Zealand. Further details of UK and USA policy are described in Chapters 2 and 6 by Kwerel and Levy and Cave.
3. It would perhaps flatter telecommunications to recall here Tolstoy's remark that 'all happy families resemble one another, but every unhappy family is unhappy in its own separate way.'

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