OXFORD ECONOMIC RESEARCH ASSOCIATES

EUROPEAN COMMISSION

STUDY ON INTEROPERABILITY, SERVICE DIVERSITY AND BUSINESS MODELS IN DIGITAL BROADCASTING MARKETS

VOLUME II: APPENDICES

FEBRUARY 2003

Blue Boar Court
Alfred Street
Oxford OX1 4EH
Tel: +44 (0) 1865 253000
Fax: +44 (0) 1865 251172
Email: Enquiries@oxera.co.uk

Contents

Appendix 1: Economic Theory

This appendix reviews the relevant economic theory for the study on 'Interoperability, Service Diversity and Business Models in Digital Broadcasting Markets'. Markets where the consumer requires a durable good in order to receive content—such as the DTV market, where the durable good is the STB with the appropriate software—are characterised by four main features:

- *consumers may face the costs of switching supplier*—a consumer switching between pay-TV providers has to pay for the installation of a new cable link or a satellite dish if the switch is across platforms. Regardless of whether the switch is across platforms, if the STB is not interoperable, the consumer may have to purchase a different box if the new provider charges for STBs;

- *network effects*—these arise when a first-mover with a large base of installed customers has a significant advantage in signing up new customers. Such effects constitute a barrier to entry. In DTV, network effects are likely to be small, and relate to the fact that content providers will be more willing to supply content to an operator with a large number of existing customers;

- *standards and standardisation*—the positive question here is whether firms themselves have incentives to standardise part or all of their technologies, such as APIs, or whether some firms will prefer to retain their own proprietary technology. The normative issue is whether, in the absence of agreement between firms to set up standards, there is a role for public policy in encouraging or enforcing standardisation;

- *vertical integration and control*—pay-TV operators have very close links with manufacturers of STBs, but they also have close links with consumers, whose STBs require managing and maintenance.

A1.1 Switching costs and consumer lock-in

A product has switching costs if a repeat buyer finds it costly to switch from one seller to another.[1] Switching costs also arise if a buyer makes a series of transactions in different products (such as service and repair on an initial purchase) and finds it costly to switch supplier. If this lock-in effect is strong enough, a buyer is effectively committed to buying a series of goods, and, in response, sellers sometimes offer life-cycle contracts. In this case, the standard analysis of competition may still apply; with strong relationship-

[1] For recent surveys of the literature on switching costs, see Farrell, J. and Klemperer, P. (2002), 'Coordination and Lock-in: Competition with Switching Costs and Network Effects', mimeo, and Klemperer, P. (1995), 'Competition when Consumers have Switching Costs: An Overview with Applications to Industrial Organization, Macroeconomics and International Trade', *Review of Economic Studies*, **62**, 515–39.

specific economies of scope, competition applies to bundles of goods rather than single goods.[2] The difference is that, with economies of scope at a single date, contracts tend to specify all the prices. With dynamic economies of scope (switching costs), contracts are often short-term, so consumers do not know future prices and have to form expectations about them. Short-term contracts governing a long-term relationship often create *ex post* monopoly, for which firms compete *ex ante*, as in Williamson (1985).[3] In other words, switching costs imply that competition, where it exists, is about supplying consumers' demands over time. A typical pattern of pricing in markets characterised by switching costs is 'bargain then rip off'. This is particularly likely when firms are able to set different prices for old and new consumers (for example, banks offering better interest rates to new customers). Because consumers are profitable once they are locked in, it is attractive for firms to capture as large a market share as possible by subsidising purchases early on. For example, it may be a sensible business strategy to subsidise STBs to build up a base of loyal customers who are unlikely to switch subsequently. It is important to note that this need not be a cause for regulatory concern. Consumers might not be worse off than when switching costs are absent, and firms might not have any market power over the life-cycle of the product (although they do have some *ex post* power over locked-in consumers).

In some markets with switching cost, firms set the same price to both old (locked-in) and new customers. Having some locked-in buyers encourages a firm to set relatively high prices, but a countervailing force is that firms might set low prices to build a new locked-in customer base. Thus, the overall price effects of switching costs in oligopoly are ambiguous. When firms can commit to future prices and qualities, a market with switching costs is closely related to one with economies of scope in production. With switching costs, each individual consumer can be viewed as a market with economies of scope between purchases now and purchases later. Just as a market with production economies of scope is entirely captured by the firm with the lowest total costs in the simplest price-competition model, so, in a simple model with complete contracts, each individual buyer's entire stream of needs in a market with switching costs is captured by the lowest-cost supplier of the buyer's requirements over a whole lifetime. That is, firms compete on their life-cycle prices. The market outcome is efficient provided that there are enough competitors and that switching costs confer no overall market power on firms. This simple analogue (and very often the efficiency of the outcome) breaks down if firms cannot commit to future prices or qualities. The resulting welfare losses may be substantial. Switching costs generally raise prices and create deadweight losses, and may also discourage new entry, thereby further reducing the efficiency of the market.

The preceding discussion treats switching costs as exogenous; in some cases, however, firms may choose the level of switching costs. While some switching costs (eg, transaction costs) may be unavoidable, their size is generally not immutable, and

[2] Economies of scope exist when the cost of a firm producing more than one product is less than the total cost of separate firms producing each product on a stand-alone basis.
[3] Williamson, O. E. (1985), *The Economic Institutions of Capitalism*, The Free Press, New York.

other kinds of switching costs are typically the result of deliberate actions by firms. They may have incentives to create switching costs which would not otherwise exist. The simplest way to endogenise switching costs is to have an initial stage in which firms make compatibility or other choices that determine whether or not switching costs subsequently arise. Koh (1993) analyses a model in which each firm independently chooses the cost of switching to its own product, and finds that, in order to relax price competition, the firms choose positive switching costs.[4] In contrast Matutes and Regibeau (1988) and Economides (1989) present models in which firms prefer their product lines to be compatible rather than incompatible.[5] Firms are more likely to choose compatibility if, as in the latter two models, their products are not functionally identical, both because compatibility directly increases demand when consumers value variety, and because product differentiation mitigates the anti-competitive effects of switching costs by giving consumers an incentive to use more than one supplier.

Switching costs do not only apply to repeat purchases of identical goods. In many examples, 'follow-on' goods, such as spare parts and repair services, are bought in 'after-markets', and there are switching costs if the follow-on goods are not compatible with the original purchase, as may be the case if they are not bought from the same firm.[6] The term after-market refers to a market for goods and services, such as replacement parts maintenance and upgrades, which may be needed after the consumer has purchased a durable good. A typical concern is that the durable goods producer behaves in a fashion that prevents alternative producers from offering the good or service, with the result that the original durable goods producer monopolises the after-market.

Carlton and Waldman (2001) show that, in a second-best world, if one market is subject to a distortion, such as the exercise of monopoly power, it is not necessarily efficient to have perfect competition in related markets.[7] For example, consider a monopolist selling a durable good where used units of the good require maintenance. If the monopolist prices its output above marginal cost while the maintenance market is competitive, the resulting outcome may be inefficient. A consumer with a used durable faces the choice between replacing the durable at a price that exceeds marginal cost, and maintaining the durable by purchasing maintenance services at a competitive price. The existence of market power in the new durable goods market means that consumers have too strong an incentive to maintain rather than to replace. Restrictions on competition in the after-market, in this second-best world, may enhance efficiency by discouraging consumers from maintaining

[4] Koh, D.-H. (1993), 'Competition by Endogenous Switching Time', UCLA Graduate School of Management Working Paper.

[5] Matutes, C. and Regibeau, P. (1988), 'Mix and Match: Product Compatibility Without Network Externalities', *Rand Journal of Economics*, **19**; Economides, N. (1989), 'Desirability of Compatibility in the Absence of Network Externalities', *American Economic Review*, **79**.

[6] After-markets have been much studied since a US Supreme Court decision (*ITS v. Kodak*) held that it was conceptually possible for ITS, an independent repair firm, to prove that Kodak had illegally monopolised the after-market for servicing Kodak photocopiers. See, for example, Shapiro, C. and Teece, D. (1994), 'Systems Competition and Aftermarkets: An Economic Analysis of *Kodak*', *Antitrust Bulletin*, **35**.

[7] Carlton, D.W. and Waldman, M. (2001), 'Competition, Monopoly, and Aftermarkets', NBER Working Papers 8086, National Bureau of Economic Research.

the used good for too long. The key point is that maintenance and purchasing a new durable are substitutes. The main problem in this example is market power in the market for durables, and it is this that public policy should address. Note that such a monopolist, who is unable to control the after-market, is likely to adopt a strategy of not transferring ownership of the durable to consumers, but leasing it to them instead. This immediately eliminates the competitive constraint provided by a competitive maintenance market, and has a close parallel with the standard solution to the durable goods monopoly problem of Coase.[8] Although this example may be rather contrived, it shows the importance of second-best considerations in markets for durables. Increased competition for one product will not automatically raise overall efficiency when distortions, such as market power, exist in related products.

A1.2 Network effects

Network effects arise when the value of consuming a particular product or service increases with the number of other consumers who use the same product or service.[9] Networks are socially beneficial constructs, to the extent that they allow the sharing of resources, communication and the 'mixing and matching' of component parts. Network effects may arise directly or indirectly. An example of a direct effect is the case of a telephone, fax or email network, where consumers directly benefit as more individuals use the same technology—ie, all users of the network benefit from being able to contact more people as more individuals join the network. Indirect network effects arise where incremental development occurs as a result of additional users of a product, but individual users do not gain from this increased take-up *per se*. The benefit to the users comes from the development and availability of more complementary goods.[10] An example is a video gaming system. Existing owners do not benefit directly as more people buy the same system, but the new users create an incentive for software firms to develop new games for that particular system. In DTV, the network effects are likely to be of the indirect type, and the presumption is that they are not very large.

A market with strong network effects (direct or indirect) is often described as 'tippy', since the market is likely to 'tip' one way or another, with one product becoming the industry standard. If the market tips towards a proprietary (rather than an open) standard, there may be a 'winner takes all' outcome, as the owner of the proprietary standard dominates the market. In other words, the existence of multiple incompatible standards in the presence of strong network effects tends to be unstable. The direction of tipping may well be influenced by history (ie, backwards compatibility with previous purchase

[8] The durable goods problem refers to competitive restraints on pricing, even under monopolistic conditions. Coase reasoned that a monopolist supplying a durable good would not, in fact, enjoy any market power. See Coase, R. (1972), 'Durability and Monopoly', *Journal of Law and Economics,* **15**.
[9] Economides, N. and Flyer, F. (1997), 'Compatibility and Market Structure for Network Goods', discussion paper EC-98-02, Stern School of Business, New York University.
[10] This effect is termed 'consumption spillover' by Quélin, B.V., Abdessemed, T., Bonardi, J-P. and Durand, R. (2001), 'Standardisation of Network Technologies: Market Processes or the Result of Inter-firm Co-operation?', *Journal of Economic Surveys*, **15**.

decisions) and by expectations on the part of consumers, and not necessarily by the 'quality' of the winner. The classic example of this was the rivalry to become the home video standard—VHS won, even though Betamax was arguably the 'higher-quality' system.

There may be a role for public policy when there are network effects, though the arguments here are often very sensitive to the assumptions. Katz and Shapiro (1994) discuss the case of indirect network effects.[11] Suppose that consumers purchase hardware and complementary software. Hardware is provided by a perfectly competitive market while the software market, with high fixed costs and low marginal costs, is monopolistically competitive. It may be efficient to subsidise hardware purchases because software is not priced at marginal cost. Subsidising hardware will increase the demand for software, which is socially valuable since price exceeds marginal cost in a monopolistically competitive equilibrium.

In practice, hardware is often not provided competitively. A monopoly seller of hardware may have private incentives that are aligned with the social incentives. For example, a monopolist who sells hardware but is also vertically integrated into the software market may want to encourage network expansion by selling hardware at a price below the pure monopoly price. If it has a large enough interest in the software industry, the firm may want to go as far as to subsidise hardware purchases.

A1.3 Standards

This section examines the private and social incentives to achieve compatibility—ie, to agree on a common standard. When private firms make decisions concerning compatibility, the issue is whether these firms are biased for or against compatibility, by virtue of their focus on profits rather than total surplus. Only when social and private incentives to achieve compatibility differ can intervention be justified.

Social incentives to standardise

The social benefits of standards depend on the type of system. For communication networks, where direct networks effects are important, a common standard expands the size of the total network, relative to incompatible networks. This raises the value for a consumer who subscribes to only one network. In hardware/software systems, however, where the network effects are indirect, the social benefits of compatibility are ultimately due to lower production costs in the software market, as economies of scale are realised because of the greater market size. Compatibility also enhances variety by allowing consumers to mix and match differentiated components from various systems.[12] Finally, compatibility means that consumers need not fear that the technology they have picked

[11] Katz, M. and Shapiro, C. (1994), 'Systems Competition and Network Effects', *Journal of Economic Perspectives*, **8**:2.
[12] Matutes, C. and Regibeau, P. (1988), 'Mix and Match: Product Compatibility Without Network Externalities', *Rand Journal of Economics,* **19**.

will end up being a loser, leaving them stranded or forcing them to purchase replacement equipment.

The potential social costs of compatibility depend on how it is achieved. The main cost from standardisation, when systems are designed to have interchangeable components, is that there is a loss of variety. Consumers have less choice and potential new incompatible systems might not be developed. In addition, if a standard is set before the technology is fully developed, there is a danger that an inappropriate standard is chosen (given the uncertainty that pervades such decisions) and innovation in new systems may be reduced. With adapters, which attach to a component of one system to allow it to interface with another system, the main cost is that of the adapters themselves, plus the fact that adapters may work imperfectly.

Private incentives to standardise

The literature on standards emphasises that standardisation has strategic implications for firms in terms of competition and cooperation strategies. Firms' private incentives to standardise are examined below. Several authors have addressed the issue of firms' incentives to make their products compatible when introducing a new product in a market with network externalities. Katz and Shapiro (1992)[13] show that a firm introducing a new technology with cost advantages prefers incompatibility if the market grows rapidly. This is because incompatibility enables the firm to enjoy an installed base advantage. Economides (1991, 1996) has pointed out that a stronger firm in terms of demand prefers incompatibility.[14] In particular, a private network with a large share of demand prefers incompatibility, while a smaller private network prefers compatibility. Finally, Fudenberg and Tirole (2000) show that an installed user base of an incompatible network good can hinder entry.[15] In a sense, standardisation in network markets reinforces network effects by creating larger markets.

The literature that studies the issues of standardisation in isolation considers the circumstances under which firms choose whether to make their products compatible with those of rivals.[16] For systems that are compatible, competition shifts from the overall package to the specific cost and performance characteristics of each individual component.[17] This general principle implies that if one firm has a distinctly superior overall package (including installed base, reputation, etc), it is likely to prefer incompatibility and may in fact spend resources on blocking compatibility. However, if each firm has a distinctly superior component, both firms may prefer compatibility and may spend resources to achieve it. For example, if compatibility reduces competition

[13] Katz, M.L. and Shapiro, C. (1994), 'Systems Competition and Network Effects', *Journal of Economic Perspectives,* **8**.
[14] Economides, N. (1996), 'The Economics of Networks', *International Journal of Industrial Organisation.*
[15] Fudenberg, D. and Tirole, J. (2000), 'Pricing a Network Good to Deter Entry', *Journal of Industrial Economics,* **48**.
[16] Besen, S. and Farrell, J. (1994), 'Choosing How to Compete: Strategies and Tactics in Standardisation', *Journal of Economic Perspectives*, **8**.
[17] Matutes C. and Regibeau, P. (1988), 'Mix and Match: Product Compatibility Without Network Externalities', *Rand Journal of Economics,* **19**.

among firms and allows them to appropriate more of the benefits which would otherwise accrue to consumers, firms should be biased towards standardisation. An important question thus becomes how compatibility affects the degree of competition between system suppliers.

There are two aspects, namely strategy towards:

- vertically related firms, where systems are made up of *complements*; and
- horizontal competitors.

Strategy towards vertically related firms

Firms produce complementary goods that combine to form a system, for example computers and applications software. Separately, the components have little or no value for the consumer; utility is derived from the system as a whole. It may, however, be possible to buy the components separately. Firms must decide whether to make their components compatible with those produced by a rival firm, or, in the case of a single product, the firm must decide whether to make that product compatible across the range of systems in the market.

Under compatibility, consumers can assemble a complete system by separately purchasing the necessary components from different suppliers. Incompatibility implies the need to purchase the entire system from one supplier. These issues are the focus of the 'mix and match' literature, which considers the effects of compatibility on prices, profits, product variety and consumer welfare.[18] The main conclusion from this literature is that, while total welfare (producer plus consumer surplus) may be higher under compatibility, consumers in general are not better off, since compatibility can lead to higher prices. Other work demonstrates that incompatibility can be used in a strategic manner—for example, to deter entry.[19] When compatibility is mandatory, this type of strategic behaviour becomes infeasible.

Strategy towards horizontal competitors

The issue here is that the firm may choose either to make its product compatible with its rivals, resulting in competition *within* a standard, or to make it incompatible, resulting in competition *between* standards. Incompatibility implies competition between competing, non-interoperable, systems (eg, between service providers). Compatibility implies that potential network effects will be realised; competition will be between close (ie, compatible) substitutes (eg, STBs).

[18] Matutes C. and Regibeau, P. (1988), 'Mix and Match: Product Compatibility Without Network Externalities', *Rand Journal of Economics,* **19**. Economides, N. (1989), 'Desirability of Compatibility in the Absence of Network Externalities, *American Economic Review,* **79**. Boom, A. (2001), 'On the Desirability of Compatibility with Product Selection', *Journal of Industrial Economics,* **49**.
[19] Matutes, C. and Regibeau, P. (1996) 'A Selective Review of the Economics of Standardization: Entry Deterrence, Technological Progress and International Competition', *European Journal of Political Economy,* **12**.

A firm's decision on the issue of compatibility is a crucial part of its competitive strategy, and it subsequently affects the competitive environment in which it operates. Strategies include a battle to be the winning proprietary standard, compatibility based around the firm's proprietary standard, or compatibility achieved by cooperating with a rival. An important factor is the degree to which a market exhibits network effects.

Firms base their competitive strategy on their perception of the relative rewards to be reaped, in the context of the particular competitive and market environment. Actually *becoming* the standard implies large gains, so firms may well be keen to fight for it. Such battles over standards exhibit similarities with patent races, since establishing a dominant proprietary standard confers an advantageous position on the winner and helps to keep rivals out, in much the same way as winning the patent race would.[20] Proprietary systems, rather than common standards, may thus emerge where firm investment and innovation produces a competitive edge for the firm.

However, fierce competition for the market can be detrimental. It can cause profits to dissipate, and can slow market growth as consumers wait for the market to settle down before making a purchase decision. Consumers may resist making a decision in the face of a proliferation of products and standards, being wary of investing in a 'loser'. Instead, they wait to see *which* 'standard' will finally become dominant.

Uncertainty also causes consumers to delay their decision to transfer to a new, superior technology, as they fear losing the network benefits of the old technology. This is particularly likely if new adopters are not prepared to bear the burden of the initial incompatibility costs and could delay the development of the network, potentially resulting in the new technology never being adopted. An example of this is the survival of the 'inefficient' QWERTY keyboard, despite alternative more 'efficient' versions, such as the Dvorak.[21]

It is also possible for a new technology to be adopted inefficiently in the face of uncertainty, as a result of 'excess momentum'. This will occur when enthusiastic early adopters make the new technology too attractive to others in the installed base of the old technology, even though the new network is not yet completed. Inefficiency arises as the base of early adopters of the new technology swells too fast, and as the old installed base is depleted and its network externalities diminish.

When firms choose to make their products compatible with those of rivals, competition becomes based upon more conventional features such as product price, service and attributes. Such compatibility, or common standards, may therefore emerge more naturally when:

[20] Harris, C. and Vickers, J. (1985), 'Patent Races and the Persistence of Monopoly', *Journal of Industrial Economics,* **33**.
[21] It is noted that some work has shown that the issue is not so clear-cut (see Leibowitz, S.J. and Margolis, S. (1990), 'The Fable of the Keys', *Journal of Law and Economics*, **33**); nonetheless, the principle remains.

- firms are small and are unable to attain the critical mass to assert proprietary systems; and/or
- there are significant network effects.

A further aspect of standardisation may be that manifested through effective *interface* standards between components of a larger system. This set-up specifies the properties that a product must have in order to work with other complementary products within the system. It allows for ‘open’ systems where multiple proprietary component designs may exist on either side of the interface. This means that innovation may occur as long as the open interface retains its integrity, and that substitution of more advanced technologies may occur over time, within the framework of the open standard. Where such interface standards do not exist, systems may well not fully meet user needs, and price competition between component parts may be diminished.

A1.4 Vertical relationships

In the pay-TV market, broadcasters provide the STB and the content as a bundle. Different manufactures produce the STBs, but the broadcasters maintain strict control over the specifications and capabilities of the boxes. The STB is not merely a way to ensure that those who have paid can decrypt the signal and receive the content. The box and its software present an opportunity for the provision of value-added services by the broadcaster. For example, interactivity requires the STB to have software, and associated hardware, such as a remote control, that is fully compatible with the content stream being offered by the broadcaster. Without control over its STBs, a broadcaster is likely to find itself unable to provide such enhanced services.

There are two sides to the control over STBs that a pay-TV operator is likely to want: the operator–manufacturer relationship and the operator–consumer relationship. First, the relationship between the broadcaster and the manufacturers is one of almost full vertical integration. This has several advantages. The operator has certainty about the specifications of the boxes and thus compatibility with its own content stream. From the point of view of incomplete contracts theory, the fact that the parties are almost fully integrated means that each side has the confidence to make relationship-specific investments, such as the manufacturer investing in capacity to make a specific operator’s boxes. Second, vertical integration between the supplier of a durable and the supplier of software (content) gives the firm incentives to promote the system as a whole. A vertically integrated firm may want to subsidise STBs in order to reap the benefits through subsequent content sales (at prices that exceed marginal costs). One aspect of this is that, in the early stages of establishing a network, a vertically integrated STB monopolist may want to rent rather than sell the hardware. This can help to boost consumers’ confidence in the network and increase demand for the hardware, since there will be no problem of stranded assets for consumers and the firm is effectively committing itself to not exploiting customers in the software market. Such exploitation would reduce the value of the hardware owned by the firm.

A standard concern about vertical separation is that this will generate double margins. If a horizontal market for STBs is mandated, and both this market and the content market are dominated by firms with market power, the overall margin may be set too high from an efficiency point of view. This contention has been used to argue against the structural break-up of Microsoft that was proposed in 2000 into an operating systems company and an applications company. In practice, however, double marginalisation is unlikely to be an issue for DTV. If there is keen price competition between manufacturers then one of the margins is eliminated automatically. Alternatively, even with competition at either stage, the firms at the different levels are supplying complementary goods. They have a strong incentive to design pricing systems that reduce the double-margins problem and ensure that the consumer is not exploited by two successive monopolists.

The downside of the close vertical ties between the operators and the manufacturers is that there might be a reduced incentive for innovation and efficiency on the part of the manufacturers. With markets for their boxes that are effectively guaranteed, the spur to innovation provided by direct product market competition might be absent. A counterargument in the literature is made by Armour and Teece (1978), who present a strong case for a positive relationship between vertical integration and technological innovation.[22] Specifically, they refer to the beneficial effects of a vertically integrated environment as facilitating the sharing of technological information; allowing better implementation of new technologies in the presence of strong interdependencies; and benefiting the formulation of more focused research objectives. Armour and Teece argue, however, that vertical separation is advantageous in terms of the variety of products sold.

Whether there are likely to be net benefits from requiring operators to give up vertical control over STB manufacturers—ie, mandating a horizontal market—cannot be answered by the theory. On the positive side, such vertical separation might enhance innovation and variety. On the negative side, both the operators and the manufacturers might underinvest in relationship-specific assets, and inefficient double margins may emerge unless at least one stage of the vertical chain is competitive.

Pay-TV operators currently have control over the box after it reaches the consumer. This enables an operator to control the process of upgrading software in the installed base of boxes in order to give consumers access to new services. In the longer run the operator can also provide new boxes when significant hardware upgrades are required. This will remove the complication that legacy systems create—if the operator knows that all consumers will have a new box then content will not need re-authoring if a new system is used. Vertical separation severs the tie between the consumer and the operator, and may be costly.

[22] Armour, H.O. and Teece, D.J. (1980), 'Vertical Integration and Technological Uncertainty', *Review of Economics and Statistics,* **62**.

Appendix 2: Digital Broadcasting Markets

This appendix contains more detailed information on the state of digital broadcasting in each Member State. For each Member State there is a description of the broadcasting market, and particularly the digital sector; details of the business models used by each platform operator to deliver digital pay-TV services; a table outlining the subscription procedure required, such as installation fees and minimum length of contract; and a map of the companies and operators involved in the digital market in each country.

In terms of digital service offerings, for each Member State tables are provided that show the basic, maximum and intermediate packages available (the latter shaded in dark grey), as well as any extra groupings or individual channels that can be added on to an existing package (shaded in light grey).

Satellite and cable operators usually offer a basic package, a larger package including more channels, and a series of thematic optional channels that can be added to the package deals. For this reason, the total number of channels available can often exceed the number offered in the maximum package deal. Basic packages vary across operators and can include free terrestrial channels, radio stations, and interactive services, as well as the main digital channels. Audio and free-broadcast channels are not included in the channel counts.

In these tables, 'basic' refers to the lowest-priced package offered by the operator (note that this may not necessarily have the least number of channels) and 'maximum' refers to the highest-priced package, although a subscriber can often add further extra channels at additional cost.

In addition, a summary of the digital choices available in each Member State is included, with a comparison of PPV and film channel costs, both of which are available in the majority of cases. There are qualitative differences, as not all channels are the same, but, in general, comparisons can easily be made.

Country data are taken from the following sources:

- DG Information Society (2001), 'Digital Switchover in Broadcasting. A BIPE Consulting Study for the European Commission. Annexe: Country Profiles', December;
- Strategy Analytics (2001), 'Interactive Digital Television. February 2001 Market Forecast', in Annexes to the European Commission's seventh report on the implementation of telecom regulatory package, November.

Company-specific information is sourced from annual reports and company websites. All costs in this appendix are in euros, and the information is correct as at October 2002.

Austria

Cable and satellite delivery dominate in the Austrian market, with a combined household penetration of over 70%. Indeed, Austria has one of the highest satellite dish penetration rates in Europe—40%. It is unclear, however, how many of these are capable of receiving digital services. Many households use a combination of reception modes in order to be able to receive international, national and local channels, as well as all the main free German channels. Much programming is broadcast over more than one network, and in analogue and digital format. Austrians are therefore accustomed to a free multi-channel analogue environment. As in other European countries (particularly German-speaking ones and the Netherlands), this factor has inhibited the development of the pay-TV market. Ten digital free-to-air (FTA) Austrian channels are also broadcast.

This environment of free-television and the fragmented nature of the Austrian television network (particularly the cable network) mean that digital penetration is low. By the end of 2001 Austria had a digital household penetration level of only 5%, mostly satellite; it is unclear how far the cable networks have been upgraded to be able to carry digital. Digital satellite content is provided by the public service broadcaster (PSB), ORF, and via German FTA broadcasters. Given the low rate of digital penetration overall, the digital pay-TV market is very small—estimated at less than 2% of the market in 2000. Kirch's Premiere World service (the same as is offered in Germany) is currently the only available digital satellite pay-TV service. There are plans to introduce digital terrestrial television (DTT) in 2003.

The cable-TV market in Austria, as already noted, is extremely fragmented. At the end of 2000 there were 261 (analogue) cable operators, although of these, just ten were responsible for 66% of all subscribers. By far the largest is Vienna-based Telekabel, which is 95% owned by Dutch media company, UPC, and the second-largest is Liwest, based in Linz.

While UPC and Premiere World have used a similar marketing system to their offers in other countries, Liwest encourages its subscribers to pay a one-off price and purchase the STB, thereby gaining access to a large number of extra channels without any additional monthly costs.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. sub	Installation	Deposit	Monthly rental	Purchase
UPC Telekabel	Cable	None	Not Available	50	70	Free	Not Applicable
Liwest	Cable	None	Not Available	Not Applicable	Not Applicable	Not Applicable	345
Premiere World	Satellite	None	12 months	Free	75	Free	350–410

Austrian DTV packages

Satellite

Premiere World

	Basic package	Additional options	Maximum package
STB rental €7.50		Premiere Film 8 channels €20*	
	Premiere Start	Premiere Sport 2 channels €20*	Premiere Super (Start + Film + Sport)
STB purchase €350–€410			
		Premiere Plus 14 channels €10	
Cost	*€5*		*€30**
Channels	*2*		*16*

Note: * Price drops by €2 if taking out a 24-month subscription, as opposed to the standard 12 months.

Cable

UPC Telekabel

	Basic package	Additional options	Maximum package
		Any 3 premium channels €3	
STB rental €23.90	Free channels	Any 6 premium channels €5	All premium channels
		Any 9 premium channels €7	
Cost	*€0*		*€23.90 +€ 10*
Channels	–		*31*

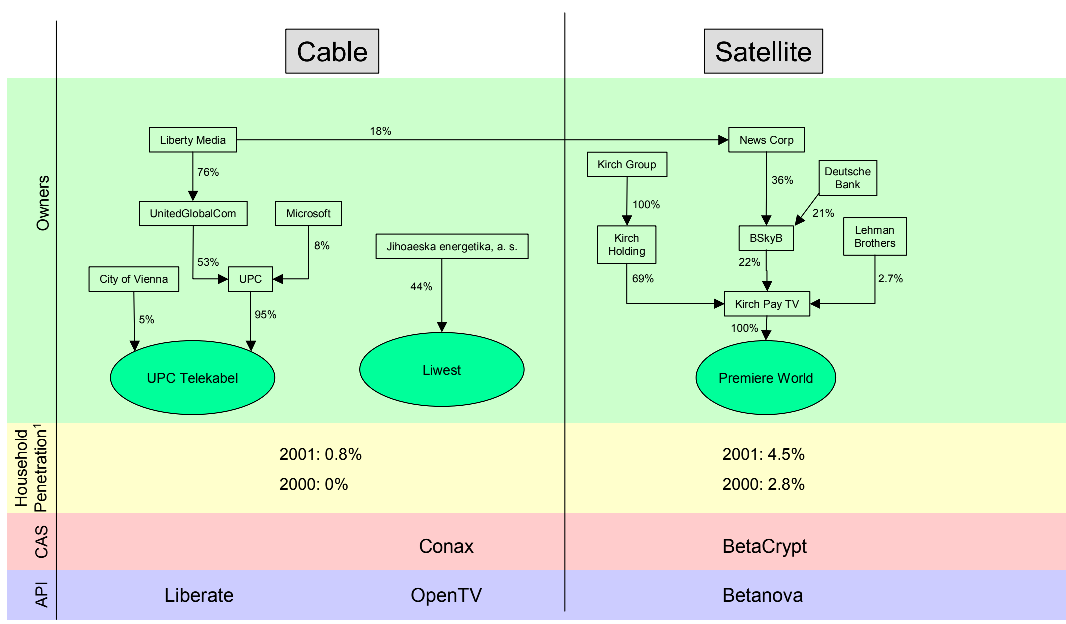
Liwest

	Basic package	Additional options	Maximum package
STB purchase €345	Free channels	Lifestyle Package 5 channels €6.90 Music Package 4 channels €5.90 Sport Package 4 channels €6.90 Adult Package 2 channels €14.90	All 4 packages
Cost	*€0*		*€34.60*
Channels	*–*		*15*

Operator	No. of channels		Cost per month		Options	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
UPC Telekabel	Free only	31	23.90	33.90	Not Applicable	3
Liwest	Free only	15	0	34.60	Not Applicable	Not Applicable
Premiere World[1]	2	16	5	30	8 channels for 20	3

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free-broadcast channels. [1] All prices given are per month, based on a 24-month subscription; the cost is €5 more per month for 12 months only.

Ownership structure of Austrian DTV providers



[1] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. 2001 figures are forecasts only.

Belgium

Television delivery in Belgium is dominated by analogue cable. The percentage of television households in Belgium connected to a cable system was over 90% in 2000. In addition to a number of commercial broadcasters, there are two PSBs: RTBF (broadcasting in French); and VRT.(in Dutch). These are also broadcast terrestrially (this is mandatory under universal service obligations) via an analogue signal. Six digital FTA Belgian channels are also broadcast.

The high cable penetration and resulting proliferation of service offerings may explain why pay-TV penetration has always been low in Belgium. Canal Plus is the only active pay-TV operator, and its penetration is less than 10%.

By the end of 2001, Belgium had approximately 100,000 digital households, one of the lowest penetration levels in Europe (less than 3%). All digital delivery is over cable and is a pay service, helping to fund the considerable investment required to upgrade the cable networks. A further complication has been commercial difficulties in relaying digital cable services; Belgium's cable market is highly fragmented and pay-TV operators cannot access the consumer directly, but have to negotiate access with local cable access providers, which do not have the resources to upgrade their networks to digital standards. As a result, less than half of Belgian households have the potential to access digital cable services. However, the main cable operators have recently taken control of some of these cable networks, making pay-TV a more viable option in the future.

Belgium's main digital operator is the cable company, UPC Belgium. Telenet (controlled by Callahan Associates) plans to launch digital services in the near future. Canal Plus offers two digital pay-TV packages over the compatible cable systems: Canal+ Numerique in French and Canal Digitaal in Dutch. Canal Plus has varying prices but centres around two main options: a subscription to its exclusive region-specific channels or to a 'bouquet' option of more general popular channels (such as the Discovery channel).

Satellite has only a marginal presence as a form of Television reception in Belgium due to strict building permission laws on satellite dishes, and, as yet, no digital satellite option exists. DTT tests involving RTBF and, VRT have started, and licences are due to be awarded in late 2002, although no launch date has been announced.

The digital pay-TV market faces strong competition from the local free-to-view (FTV) channels available to all cable subscribers, as well as French and Dutch language channels in the appropriate areas of the country.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	STB installation	Deposit	Rental	Purchase
UPC Belgium	Cable	Free	Not available	Free	Free	Free	Not Applicable
Canal+ Numerique	Cable	49.58	12 months	Price not available	24.79	Free	Price not available
Canal Digitaal	Cable	49.58	12 months	Price not available	Price not available	Free	Price not available

Cable

UPC Belgium

	Basic package	**Maximum package**
Free STB rental	Starter package	All 15 channels
Cost	*€11.50*	*€21.50*
Channels	*2 + 3*	*2 + 15*

In addition to two standard channels, French -language UPC Belgium offers the subscriber a choice of 15 channels. For €11.50, the subscriber picks any three, and any additional channel thereafter costs €1 each, although if the subscriber takes all 15 channels, the last three are provided free of charge. Ethnic channels are included as standard, regardless of the level of subscription.

Dutch-language UPC Belgium also costs €11.50, but offers a choice of 14 channels. A fifteenth channel, Cinenova, is available, but its inclusion (the ‘FilmPack’) raises the monthly subscription price to €20.50.

Both language groups require a six-month minimum contract, with 12 months for the price of 11 as an incentive to take a longer contract.

Canal Plus

Canal Plus in Belgium operates two companies: Canal+ Numerique for French speakers and Canal Digitaal for Dutch.

Canal Digitaal

	Basic package	Additional options	Maximum package
		Canal+ package 3 channels €34.68	Canal+ package
Free STB rental	HET BOEKET	Cinema World 3 channels €7.44	
		Music World 4 channels €4.96	HET BOEKET
		X-Zone 1 channel €12.39	
Cost	*€19.81*		*€34.68 + €19.81*
Channels	*17*		*3 + 17*

Some interactive features are available, such as ‘Piloot’ which provides additional information about individual programmes of interest.

Canal+ Numerique

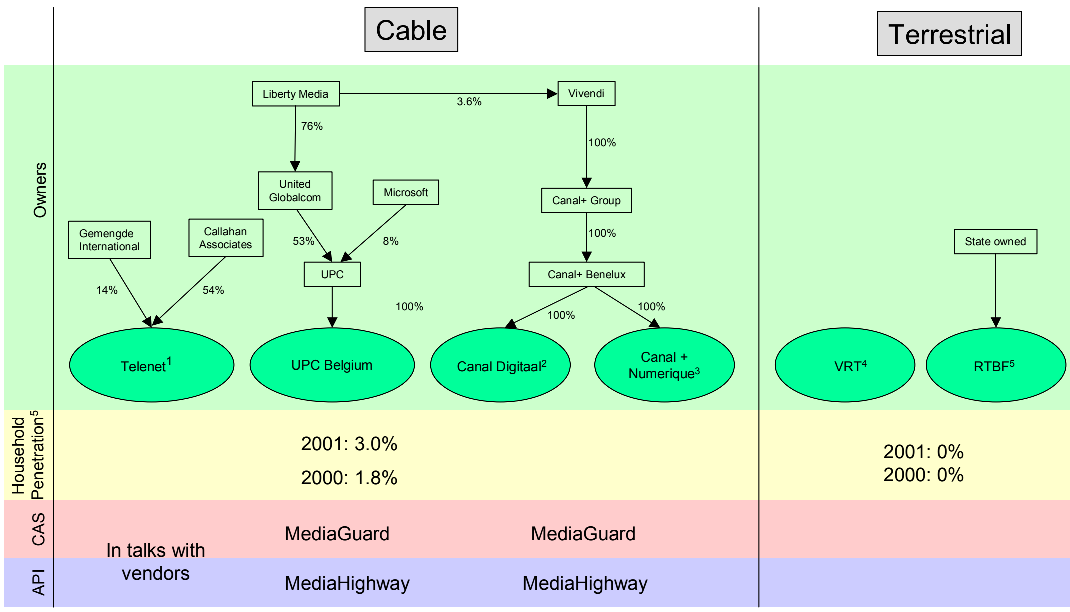
	Basic package	Additional options	Maximum package
		Canal+ Numerique 2 channels €37.16	Canal+ Numerique
Free STB rental	Le Bouquet		
		Option Cinema* 3 channels €9.92	Le Bouquet and Option Cinema
Cost	*€32.20*		*€64.43*
Channels	*25*		*2 + 25 + 3*

*Only available if also subscribing to ‘Le Bouquet’.

Operator	No. of channels		Cost per month		Options	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
UPC Belgium	5	17	11.50	21.50	Price not available	Not applicable
Canal+ Numerique	25	30	32.20	64.43	3 channels for 9.92	Not applicable
Canal Digitaal	17	21	19.81	54.49	3 channels for 7.44	3.72

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free-broadcast channels.

Ownership structure of Belgian DTV providers



[1] Launch due at the end of 2002.
[2] Dutch language broadcasting.
[3] French language broadcasting.
[4] FTA service being tested around Antwerp.
[5] FTA service being tested around Brussels.
[5] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Denmark

Television delivery in Denmark is dominated by cable (over 60% penetration), with the remainder split fairly evenly between satellite and terrestrial delivery. Therefore, multi-channel offerings are already available to most of the population. There is one digital FTA Danish channel.

There are quite significant differences in the level of estimated digital penetration. Sources estimate penetration from 8%[23] to 25%.[24] The digital pay-TV market is small, with about 150,000 digital satellite subscribers, which equates to around 6% of households.

Digital satellite operators, Canal Digital and Viasat, broadcast to all four Scandinavian countries. Both companies have actively supported digital transmission since 2000, with Canal Digital broadcasting its main premium channels in digital format only and Viasat no longer offering analogue packages to new customers. Both companies have provided STBs free of charge for short promotional periods in the past, although the standard method of obtaining an STB is now through monthly rental.

In addition to these two satellite broadcasters, there are two other digital operators in Denmark: the main cable operators, Telia Stofa and Tele Danmark (recently renamed TDC Kabel TV). TDC Kabel TV is controlled by SBC Communications, the US telecoms company, while Telia Stofa is the Danish subsidiary of Telia, the Swedish state-controlled operator.

Licences for DTT have yet to be awarded, although tests have been ongoing since 1999.

[23] Gallup (2001), 'Annual Survey', week 31–48, as quoted in DG Information Society (2001), op. cit.
[24] Strategy Analytics (2001), op. cit.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	Installation	Deposit	Monthly rental	Purchase
Stofa[1]	Cable	39	–	–	–	–	–
TDC Kabel TV	Cable	16.10/yr	12 months	61	Not applicable	Not applicable	214.90
Canal Digital	Satellite	52.50/133/yr	12 months	52	Not applicable	7.95	107
Viasat	Satellite	134.50/yr	6 months	Price not available	Price not available	Not specified	Price varies

Notes: [1] Stofa does not have a uniform price or programme structure. The network comprises many local systems, and the company therefore refrains from providing information about the specific channels and prices.

Satellite

Canal Digital

	Basic package	Additional options	Maximum package
		Family 7 + 24 channels €22.75	
STB rental €7.95		Canal+ 7 + 3 channels €29.50	
	Local		Entertain
STB purchase €107		2 Theme packages 3–4 channels €9.30/10.60	
		4 Individual premium channels €6.60–12.80	
Cost	*€0*		*€42*
Channels	*7*		*7 + 24 + 3*

Notes: The digital smartcard has an annual subscription fee of €52.50, unless the subscriber has the local package only, in which case the price is €133 per year.

Viasat

	Basic package	Additional options	Maximum package
STB purchase	Viasat Basis	Viasat A la Carte 8 channels €9.30 each 2 individual premium channels €20 each	Viasat Guld
Cost	*€8.50*		*€27*
Channels	8		*8 + 22*

Note: The annual smart card fee is €134.50.

Cable

Stofa

	Basic package	Additional options	Maximum package
STB rental €8	VisionFamily	Canal+ Package 3 channels €29.50	Kombi (VisionFamily Plus Canal+)
Cost	*€10.60*		*€36.20*
Channels	*12*		*12 +3*

Note: The smartcard costs €39 per year.

TDC Kabel TV

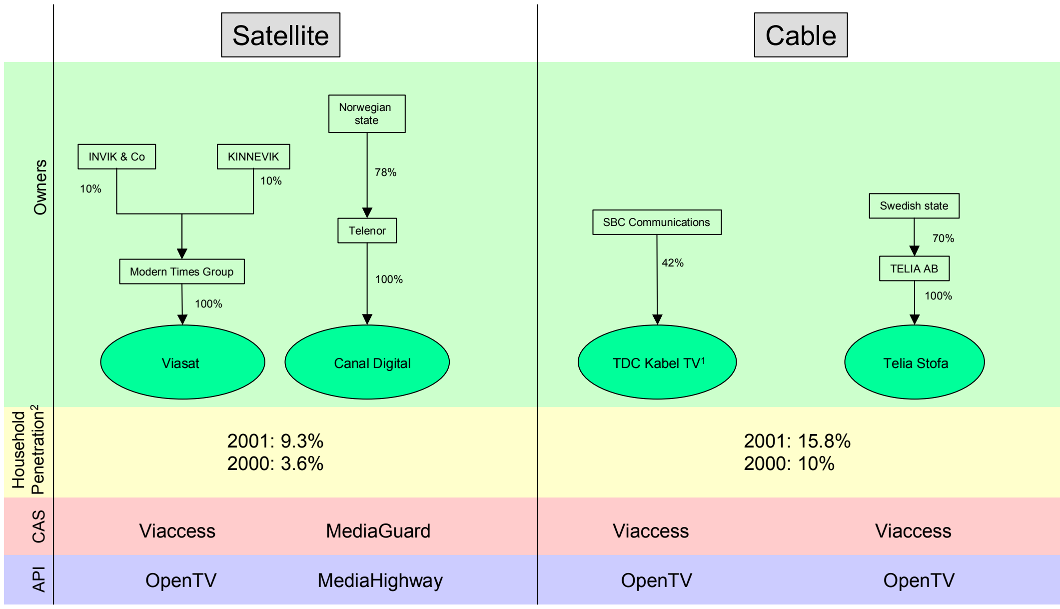
	Basic package	Additional options	Maximum package
STB purchase €214.90	12 Specialpakker	TV1000 4 channels €24.10 Canal+ Package 3 channels €29.50 Entertain and The Studio* 13+1 channels €17.30 The Studio and Canal+ 1+3 channels €34.20 Entertain and Canal+ 13+3 channels €37.50 4 Premium channels €3.90–€10.60	Canal+, Entertain and The Studio
Cost	*€3.90–€13.30 each*		*€42.95*
Channels	*3–13 per package*		*3+13+1*

Notes: * TDC kabel TV operates under the brand name OnCable Entertain costs €10.60 through the Specialpakker option. The Studio costs €7.70 individually. The smartcard annual fee is €16.10. The STB costs €134 if purchased with a subscription.

Operator	No. of channels		Cost per month		Options	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
Stofa	12	15	10.60	36.20	–	–
TDC Kabel TV	3–13	15	3.90–13.30	42.95	–	5.25
Canal Digital	7	34	0	42	9.30 for 3 channels	5
Viasat	8	30	8.50	27	3 channels in max. package	5.25

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free-broadcast channels.

Ownership structure of Danish DTV providers



[1] Previously known as Tele Danmark.
[2] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Finland

In Finland, low population density makes cable installation unfeasible in many areas, while satellite reception is technically difficult in northern areas. As a result, terrestrial (analogue) television reception accounts for just over 50% of households, and cable (analogue) for approximately 40%, with satellite reception (analogue and digital) only used by around 10%.

The market is dominated by FTV offerings, with the pay-TV market reaching under 5% of the market. The state broadcaster, YLE, and the largest commercial operator, MTV3, share the majority of the television-viewing market, with a further small commercial broadcaster, Channel4, achieving a minority share of less than 10%. One digital FTA Finnish channel is also broadcast.

Digitisation is in the early stages of development, and was originally driven by satellite, although take-up of services is low, with penetration below 1%. In the future, digital penetration is likely to be driven by DTT as it rolls out. There is as yet negligible cable digital coverage, largely due to the cost of upgrading the networks—this issue is compounded by the small scale of some of the networks. The digital future in Finland is likely to be terrestrial, given the problems of satellite reception in the north of the country. The Finnish government has consequently moved swiftly to introduce DTT, which has been available since August 2001 and is due for a full launch in October 2002. Finland is the first country to choose the multi-media home platform (MHP) applications programming interface (API) for interactive services.

Finland has three digital pay-TV operators: Digita is the terrestrial transmission network operator (partly owned by the PSB, YLE, and partly owned by France's TDF),[25] and Canal Digital and Viasat, which broadcast across Scandinavia, are both satellite operators. The main cable operator, Sonera (formally Telecom Finland), does not offer a digital service at this time.

The terrestrial offering includes 12 channels and at present all channels are broadcast for free. In the future, a package costing around €22.5 a month will be introduced. This will comprise two Canal Plus channels plus a sports channel. The basic Finnish decoder costs FM 2,900 (€450), but MHP-compliant boxes are expected to cost 25% more.

[25] Digita Oy owns and operates the digital network; the multiplex operator is Platco, jointly owned by the PSB YLE and the commercial channels, Nelonen and MTV.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	Installation	Deposit	Monthly rental	Purchase
Digita	Terrestrial	–	–	–	–	–	450
Canal Digital	Satellite	33.47/yr	Not available	Price not available	Price not available	9.92	Price not available
Viasat	Satellite	17/yr	12 months	Price not available	Not applicable	Not applicable	100–450

Satellite

Canal Digital

	Basic package	Additional options	Maximum package
STB rental €9.92	Local	Family 4 + 21 channels €20 Canal+ 4 + 4 channels €26.74 2 Theme packages* 3/4 channels €8.41/9.92 4 Individual Premium channels* €5.89–15.14	Entertain
Cost	*€0*		*€40.20*
Channels	*4*		*4+ 21 + 4 + 1*

Notes: Annual smartcard renewal is €33.47. * Not available solely in conjunction with the local package.

Viasat

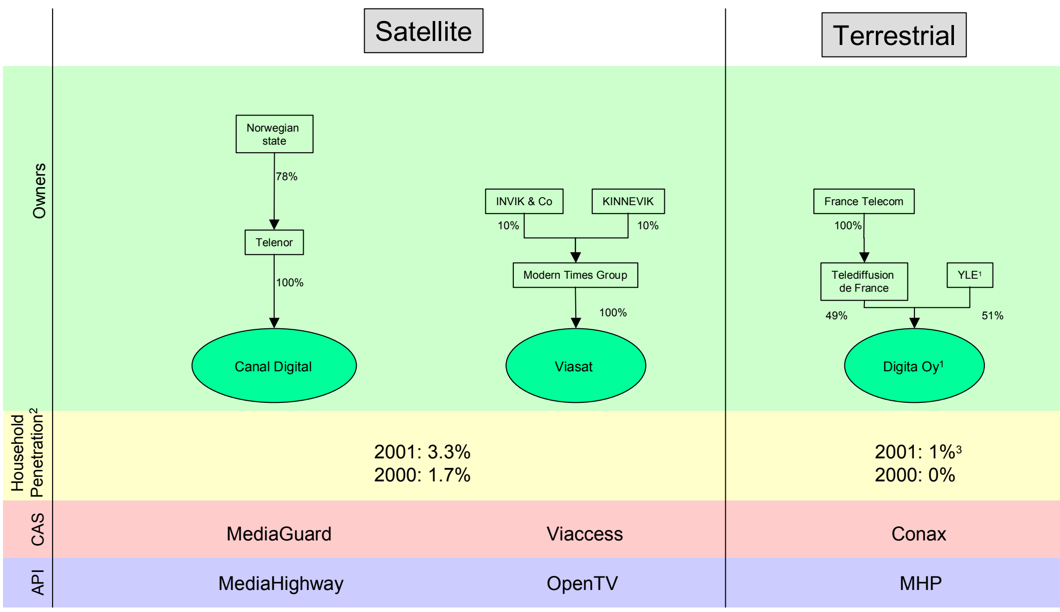
	Basic package	Additional options	Maximum package
STB purchase €100–€450*	Viasat A la Carte peruspaketti	3 Themed packages 8 channels €7 each 2 Individual premium channels €16/17	Viasat Kulta
Cost	*€8*		*€28.50*
Channels	5		*5 + 24*

Notes: Annual smartcard renewal is €17. * Subsidised price on a variety of STB models, but only available if subscribing to Viasat Kulta.

Operator	No. of channels		Cost per month		Options	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
Digita	12[1]	–	–	–	–	–
Canal Digital	4	30	0	40.20	9.92 for 3 channels	5.5
Viasat	5	29	8	28.50	3 channels[2]	6

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free-broadcast channels. [1] All channels currently FTA. [2] Part of the maximum package, not available separately.

Ownership structure of Finnish DTV providers



[1] Started broadcasting Aug 2001. Digita Oy owns and operates the digital network; the multiplex operator is Platco, jointly owned by YLE and two commercial channels.
[2] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.
[3] Based on Digita Oy's own figures.

France

Historically, the French market has been based around analogue terrestrial television. The supply of FTV programming is low compared with other Member States, with four national PSB channels (France2, France3, Arte and France5) and two commercial national channels (M6 and TF1). Thirty-eight digital FTA French channels are also broadcast.

Pay-TV was launched in 1984, initially in analogue terrestrial format, and then analogue direct to home (DTH). Digital satellite was first launched in 1996. By mid-2001, pay-TV penetration had reached 34%, split approximately equally between analogue delivery (over cable and terrestrial) and digital delivery. Digital pay-TV is dominated by satellite; cable coverage has not developed very fast in France and just over 10% of French households access television through cable. Digital cable pay-TV penetration is therefore very low. DTT is due to be launched in 2003 and licences have been granted to several public channels.

There are currently six digital pay-TV operators: Canal Satellite, TPS, Noos, NC Numéricable, UPC France, and France Telecom Cable. Canal Satellite and TPS are satellite broadcasters, while the remaining four are cable companies. Consumers acquire STBs through rental agreements, plus a deposit. The costs of STB rental and deposit do not vary greatly across the platform operators; monthly rental charges vary between €5 and €7, and deposits are quite consistent at €75–€77. None of the operators offers the possibility of buying the decoder. Installation fees vary considerably across platforms, from free to over €100. There is generally a minimum subscription requirement (six or 12 months, where specified).

Operators make available a wide diversity of promotional 'special offers', aimed at attracting new subscribers. These offers are constantly changing, as they are valid for only a limited time. Promotions include free satellite dishes for the first four months of subscription, cheaper rates for the first few months of subscription with no commitment, free installation, and a free three-month basic package.

Summary of costs of DTV access

Operator	Transmission	Connection fee	Min. subscription	STB installation	Deposit	Rental	Purchase
Canal Satellite	Satellite	None	6 months	40	75	8	Not applicable
TPS	Satellite	None	Not Available	Price not available	76.22	10	Not applicable
Noos	Cable	None	12 months	110	75	8	Not applicable
NC Numéricable	Cable	53	Not Available	Free	75	8	Not applicable
UPC France	Cable	50	12 months	Free	75	4.88	Not applicable
France Telecom Cable	Cable	None	12 months	82.32	76.22	6.50	Not applicable

Satellite

TPS

	Basic package	Additional options	Maximum package
STB rental €10	TPS Thema	TPS Premium 5 + 18 channels €21 TPS Premium + Superstades 6 + 18 channels €31 TPS Optima 31 + 18 channels €25 Superstades channel €10 10 Additional themes 1–5 channels €2.50–€15	TPS Maxima
Cost *Channels*	*€17.50* *26 + 18*		*€33* *31 + 1 + 18*

In addition to its 26 exclusive channels, TPS gives access to a further 18 standard French channels (including six national ones) as well as interactive services. The main attractions are the five film-based TPS channels and the football channel, Superstades. The packages are carefully priced to encourage take-up of the maximum package, which costs a little less (€33) than adding the Superstades channel to the next option down (TPS Optima), which would come to €35.

Canal Satellite

	Basic package	Additional options	Maximum package
STB rental €8	Canal Satellite Thematiques	Canal Satellite Famille 55 + 5 channels €23.90 Canal Satellite Cinema 55 + 7 channels €25.90 4 Additional themes 3–8 channels €7.40–€12 4 Individual premium channels €4.50–€5.30	Canal Satellite Grand Spectacle
Cost *Channels*	*€17.99* 55		*€27.90* *55 + 11*

In addition, there are 12 exclusively interactive channels. While there are only three of the national channels, as opposed to six on TPS, and no particular sport (football) offer, a strong mix of channels is available in all the packages, with seven movie channels and four Disney channels (+ Discovery) being the key additional features.

Cable

Noos

	Basic package	Additional options	Maximum package
		25 étoiles €11 + 4	
		75 étoiles €11 + 12	
STB rental €8	Le Pass NoosTV	110 étoiles €11 + 16	Infinity étoiles
		150 étoiles €11 + 20	
		225 étoiles €11 + 27	
		300 étoiles €11 + 34	
Cost *Channels*	*€11* *35**		*€11 + €59* *35* + 68**

Note: *Some extra channels are available, depending on location.

The Noos cable network covers 18 regions in France, of which half also have Internet capability. The Noos subscription system operates around the number of 'stars' (étoiles) that the subscriber purchases. Each individual channel has its own star rating, ranging from 0 for a national channel such as TF1, to 95 for the movie channel, Cinestar2. Most channels 'cost' five stars. Subscriber can then pick their personal selection based on their package limit, or have them all if they take 'Infinity étoiles', the maximum package. They can change their choice of channels each month, provided they stay within their limit.

NC Numéricable

	Basic package	Additional options	Maximum package
		Grand Ecran Numérique 39 + 9 channels €21.90	
		Canal+ offer 4 channels €27.29	Grand Ecran Numérique
STB rental €8	Découverte Numérique	Les Chaines Passion 3, 6, 9 or 12 channels €6.90–€16.90	
		Les Chaines Prestige 4 themes 12 channels €5–€11	Integral*
		Integral: Passion + Prestige 24 channels €60–€68*	
Cost *Channels*	*€13.90* 39		*€21.90 + €60* *48 + 24*

Notes: * Integral: all the Passion channels + Prestige channels. €68 extra for subscribers to the basic package (Découverte Numérique) and €60 for subscribers to the maximum package (Grand Ecran Numérique), making the final price identical. The 'Passion' option allows the subscriber to choose 3 (€6.90), 6 (€10.90), 9 (€13.90), or 12 channels (€16.90) from a selection of 38.

The NC Numericable network covers 29 areas within France, a third of which also have Internet capability. Joint television/Internet packages are also available.

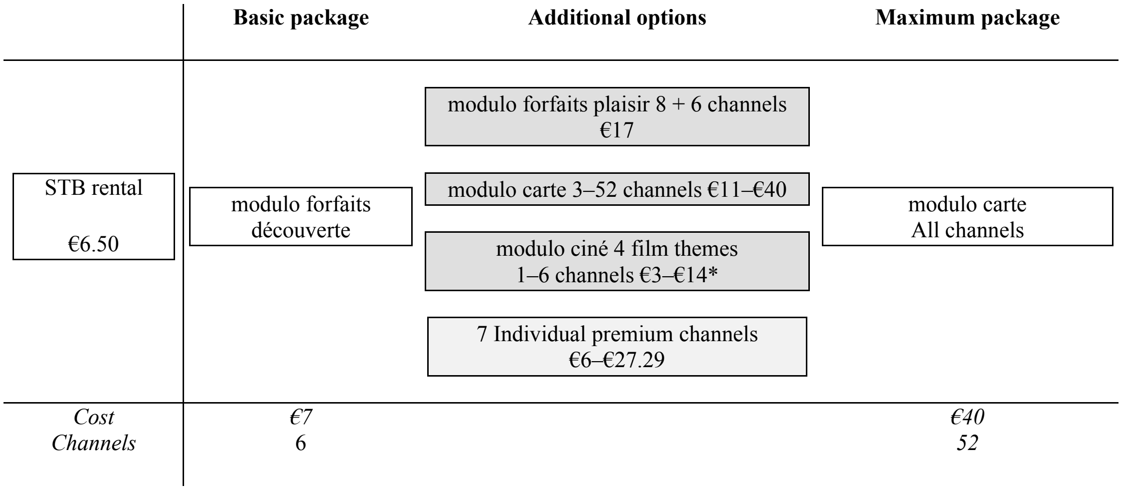
UPC France

	Basic package	Additional options	Maximum package
		2 Bouquets 16 + 8* channels €12	
		3 Bouquets 24 + 8* channels €15	4 Bouquets
STB rental €4.88	1 Bouquet	4 Bouquets 32 + 8* channels €17	
		3 Additional Themes# Film 4 channels €10.37 Disney 3 channels €10.37 Sport 3 channels €7.32	Film + Disney + Sport Theme
		Combinations of Film/Disney/Sport Themes 6–10 channels €15.55–€24.54	
Cost	€8		€17 + €24.54
Channels	8 + 8*		32 + 10 +8*

Notes: * The 'Bouquet Basique' of seven national French channels (+ 1 local channel) is free with any paid-for bouquet, but is also available independently for €36.39 per year. # Only available if subscribing to at least two of the standard bouquets.

The four standard bouquets offer a wide selection of channels (CNN, Eurosport, etc) and can be exchanged every month, but the high-demand film, sport and Disney channels are only available through the higher subscription rates; the customer needs to be paying for at least two standard bouquets (€12). The combinations of these high-demand themes are competitively priced compared with the price of the individual themes in order to encourage take-up. For instance, the price of the three themes individually would be over €28, but the combination of all three is offered for €24.54 (this is a pricing practice known as 'deep discounting'). Internet access is available, but no joint packages with television are marketed.

France Telecom Cable

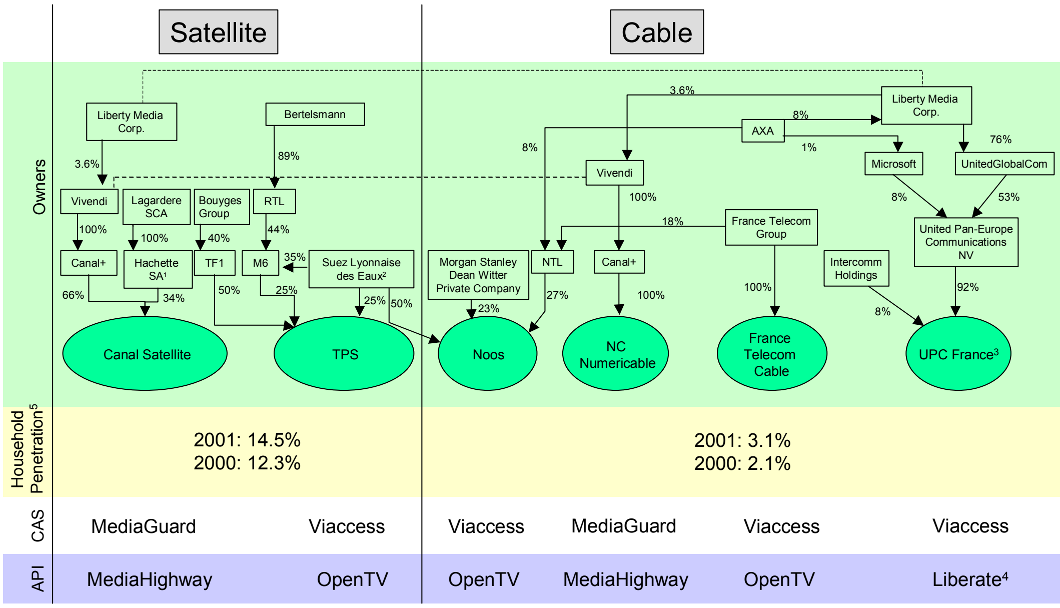


Notes: * All four themes are also available as one total package for €35. With modulo carte, five levels of subscription are available: any three channels, €11; any six channels, €15; any nine channels, €18; any 12 channels, €19; all channels, €40.

Operator	No. of channels		Cost per month		Options	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
Canal Satellite	55	66	17.99	27.90	7.91 for 5 channels	Not applicable
TPS	44	50	17.50	33	Price not available	4.5
Noos	35	103	11	70	Not applicable	Not applicable
NC Numéricable	39	72	13.90	71.90	Price not available	Not applicable
UPC France	16	50	8	41.54	10.37 for 4 channels	Available
France Telecom Cable	6	52	7	40	14 for 6 channels	Available

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free-broadcast channels.

Ownership structure of French DTV providers



1 Known publicly as Lagadere Media; 2Suez has now sold its stake in TPS to TF1 & M6 (FT: 19/06/02); 3 Known also as Mediareseaux SA; 4Being introduced 20/03/02.
5 Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Germany

Germany, with well over 30m households, is the largest television market in Europe. Within this market, 56% of German households receive their television via cable and 36% via satellite.

The vast majority of cable subscribers are connected to Deutsche Telekom's network, although division of control within the German cable market is somewhat unique: Deutsche Telecom owns 'Level 3' (cablehead to street), and regional companies ranging from housing associations to corporations, such as TeleColumbus, own 'Level 4' (distribution from street to home). Deutsche Telekom is in the process of selling off its nine regional networks: Callahan Associates International and the Iesy consortium have purchased three, and intend to launch digital services in the future. The expected sale of the remaining six networks to Liberty Media recently collapsed over regulatory issues.

Historically, German households have been able to access a wide variety of FTV channels. The large majority of households (87%) receive at least 30 FTV services delivered by the two PSBs, ARD and ZDF, and the two commercial operators, RTL Group and Kirch. Programming may be national, regional, generalist or thematic, and is delivered on all platforms. However, national terrestrial coverage is only achieved by ZDF and ARD, terrestrial broadcasting being mainly reserved for local stations. Most of the major FTV channels are simulcast analogue and digital. As a consequence of this high level of competition from FTV channels, pay-TV has a low level of penetration in Germany. Sixty-five digital FTA German channels are also broadcast.

Digital penetration reached 12% in 2001, with just over 4m households, split approximately equally between cable and satellite. All cable households can technically receive digital modulation, owing to recent work to upgrade the network. It is not known how many satellite households can technically receive digital services. Digital terrestrial trials are ongoing and a small number of licences are likely to be awarded initially, probably to the PSBs, ARD and ZDF, which have been heavily involved in the frequency planning.

The numbers of terrestrial viewers is quite small in Germany; nevertheless, legislation has recently been put in place for DTT and there are plans to launch a trial service in Berlin in 2003.

There are currently only two commercial digital broadcasting operators in Germany: PrimaCom (owned by UPC) and Premiere World (owned by Kirch Pay-TV[26]). Deutsche Telekom-controlled MediaVision stopped digital broadcasting in June 2002. MediaVision and PrimaCom are Level 4 cable operators, while Premiere World is both a satellite and cable operator. As a result of the wide availability of free programming, the digital pay-TV market is much less developed than in other European markets. In cable, only about

[26] With Kirch Group in financial difficulties as of September 2002, the future of this platform remains in doubt.

5% of subscribing households (1m) pay more than their basic subscription (which allows access to all free channels) in order to access the premium pay-TV services offered by PrimaCom and Premiere World. This amounts to less than 3% of total households. In the year 2000, the number of subscribers to digital satellite pay-TV (services offered by Premiere World) was of approximately the same order of magnitude (3%). Pay-TV penetration is therefore probably only around 6–8% of total households.

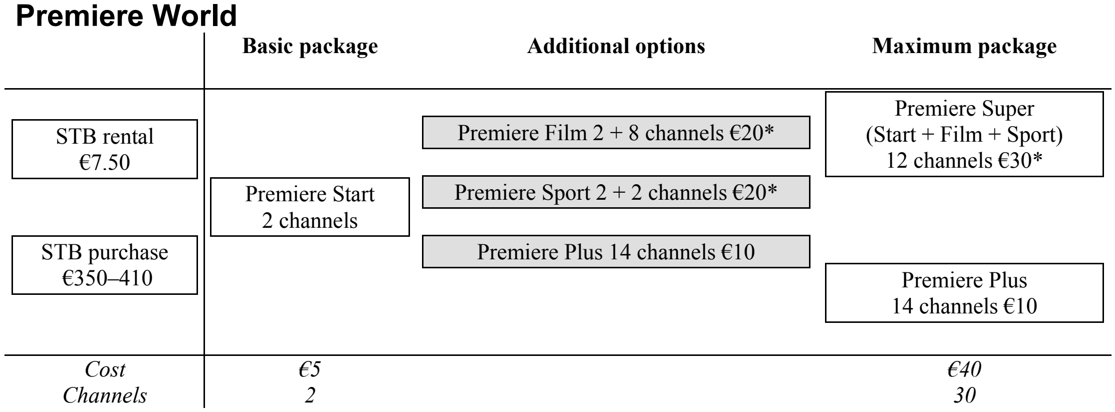
There are three mechanisms for acquiring an STB, dependent on the operator: for 'free', through purchase, or through monthly rental payments. MediaVision allowed for either a monthly STB rental fee of €7.62 and a deposit of €79.69, refunded on return of the decoder, or subscribers could purchase the STB for €408.01. PrimaCom offers a uniform installation fee of €20 for all its programme packages, but offers only STB rental. Premiere World requires a deposit of €75, but does not charge a monthly rental fee.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	Installation	Deposit	Monthly rental	Purchase
Premiere World	Satellite and cable	—	—	Free	75	Free	350–410
MediaVision	Cable	—	—	Free	76.69	7.62	408.01
PrimaCom	Cable	—	—	20	Free	5.95	Price not available

Satellite and cable

Premiere World



Note: * There is a discount of €2 on the price if a 24-month subscription is taken out, as opposed to the standard 12 months.

Given the large number of free digital channels available on satellite, Premier World has concentrated on content, specifically movies, football and Formula 1. This strategy has had limited success, given the significant amount of money that was required in order to obtain exclusive broadcasting rights, and Premiere World's owner, Kirch, is currently undergoing restructuring.

Cable

PrimaCom

	Basic package	Additional options	Maximum package
		4 Themed Packages 4 channels €2.70 each	
STB rental €5.95	*prima*TV BASIS	Adult Channel €5.95	*prima*TV MAXI*
		2 Individual Premium channels €14.95/€15.95	
Cost	*€0*		*€6.95*
Channels	*15*		*14 + 15*

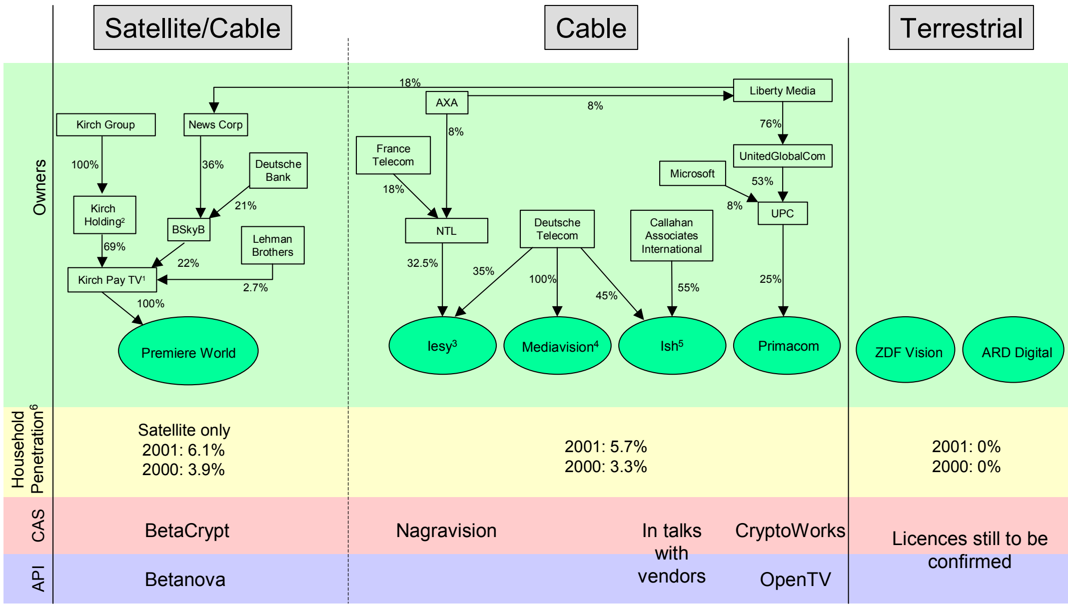
Note: * Combination of three of the theme packages, the Adult channel and the Single channel.

Interactive features are being introduced through a new theme package called *prima*FUN, which lets the user play games. PrimaCom also provides a telephone and high-speed Internet service, though there are currently no combined offers.

Operator	No. of channels		Cost per month		Options	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
Premiere World	2	30	5	40	20 for 8 channels	3
MediaVision	18	18	Free	Free	—	—
PrimaCom	15	29	0	6.95	—	Price not available

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free-broadcast channels.

Ownership structure of German DTV providers



[1] Insolvent as of November 2002 ; [2] Also known asTaurus Holiday; [3] Not yet launched; [4] As of 19/06/02, Mediavision has stopped broadcasting; [5] Due to launch in 2003; [6] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Greece

Television coverage in Greece is mainly terrestrial (analogue). Cable is non-existent because, until recently, the law forbade private operators from laying cable for broadcasting services. Infrastructure is limited to experimental networks, and there are no service offerings, either analogue or digital. The terrestrial offering is reasonably varied, with ten nationwide FTV networks, one PSB (ERT), and many small, local commercial channels. Television is therefore traditionally multi-channel FTV. Eleven digital FTA Greek channels are also broadcast.

The pay-TV market is based around satellite and terrestrial analogue delivery, with penetration at around 11%. The digital penetration rate is around 4%, and is driven by satellite services. It is the smallest market in the EU after Luxembourg, and, together with Belgium, has the lowest level of digital penetration. A move to DTT is some way off.

Until September 2002, there were two satellite operators in the country: Nova and Alpha Digital. Despite discussions of a merger, Alpha Digital went into liquidation and its subscribers were transferred to Nova. Both operated a subscription plan based around purchase of the STB, as opposed to rental. This is virtually unique among the European countries—where rental or give-away options are common—and may be hindering satellite take-up. Nova offers documentary, news, cartoons, FTA, movies and sports channels. There are two packages: the first offers the digital decoder, a satellite dish, free installation, and pre-paid subscription for €575; the second offers the same items but does not include the satellite dish and costs €457. Pre-paid cards can be bought for two, six, and 12 months and these give access to all programmes. For the first package, Nova offers a financial scheme whereby the customer pays €146 for the technical equipment as down-payment and then €14.30 per month for 30 interest-free instalments. Alpha Digital offered 23 channels and charge €48.42 per month. Like Nova, Alpha Digital did not offer the option of renting the STB. Instead, the digital decoder could be bought for €455. Both companies offered only one package in terms of the channels that can be viewed.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	STB installation	Deposit	Rental	Purchase (decoder only/ decoder + dish)
Nova	Satellite	Not applicable	2 months	Price not available	Not applicable	Not applicable	457/575[1]
Alpha Digital	Satellite	Not applicable	4 months	Price not available	Not applicable	Not applicable	317/455

Note:[1] Can be purchased with a deposit of €146 followed by 30 interest-free payments of €14.30 per month, totalling €575.

Satellite

Nova

	Basic package
STB purchase €575 or €457*	Nova Basic package
Cost	*€48.40*
Channels	*26*

Notes: * Known as the Nova Alternative Package, this includes the Nova digital satellite decoder and the Nova smartcard but not the necessary satellite dish.

The Nova smartcard costs €140 with a pre-paid subscription for the first two months (€70/month); €305 with a pre-paid subscription for the first six months (€50.83/month); or €584 with a prepaid subscription for one year and free television viewing for the 13th month (€48.66/month). Once the subscription period runs out, the card, and access to Nova channels, costs €48.40 per month. The pricing is set so that most subscribers are likely to buy the €140 initial access; however, this works out as the most expensive per month, costing €70 for each of the two months that come with it. The cost per month falls to €50.83 over the six-month option and to €48.66 for the 12-month period (with an extra free month further reducing the actual price per month to €44.92). The package includes nine Greek channels and a combination of movie, sports, kids, news and documentary channels.

Nova has recently introduced an interactive service, NOVA Search, which allows subscribers to find programmes using various search criteria, for example by filling in the type of programme (movie, documentary, series) and the subtype (action, adventure, cartoon).

Alpha Digital

	Basic package
STB purchase €455 or €317*	Alpha Digital package
Cost	*€48.42*
Channels	*23*

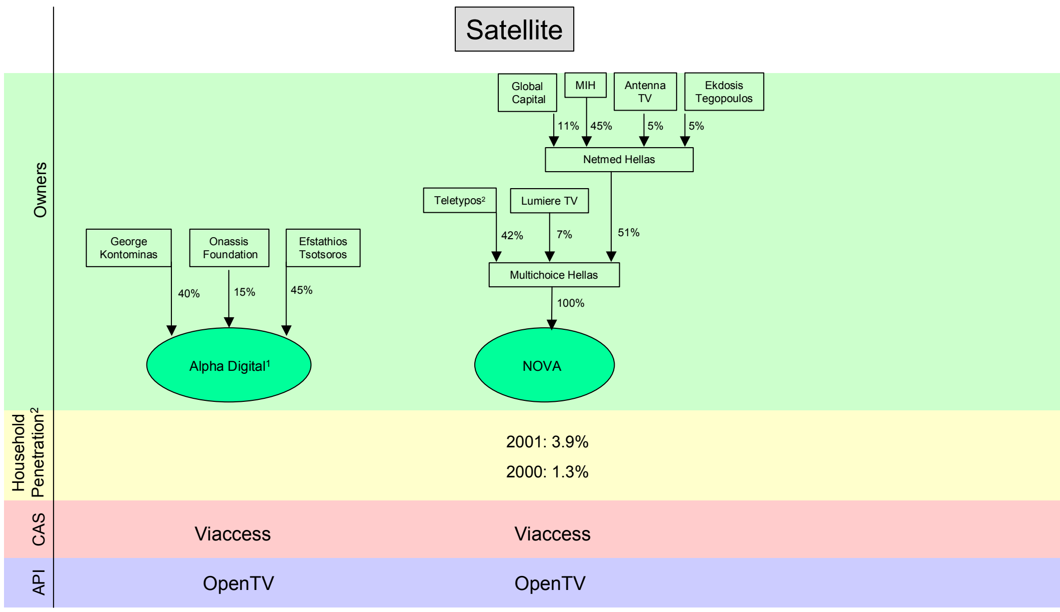
Note: * Decoder only, does not include antenna and installation. The prices include a 25% discount on the equipment.

The Alpha Digital card costs €211, with a pre-paid subscription for the first four months; or €516, with a pre-paid subscription for one year and free television viewing for the 13th month. Once the subscription period has expired, the subscriber can either pay a monthly subscription, or renew for a 12-month period for €480. There are 23 special channels in the package, covering themes such as sport and current affairs.

Operator	No. of channels		Cost per month		Options	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
Nova	26	–	48.40	–	–	–
Alpha Digital	23	–	43.50	–	–	–

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free-broadcast channels.

Ownership structure of Greek DTV providers



[1] Launched October 29th 2001.
[2] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Ireland

Television reception in Ireland is dominated by cable (52% of households have access). Terrestrial accounts for 39% of households, and satellite for 9%. FTV broadcasts are dominated by the PSB, RTE. There are no digital FTA Irish channels.

Like the UK market, the relatively small number of channels broadcast terrestrially means that the Irish market readily accepted subscription pay-TV offerings and access to multiple channels, particularly through cable. Ireland also has a small penetration of multi-channel multipoint distribution service (MMDS) subscribers in areas that cannot be covered by cable, although broadband cable and DTT may make MMDS redundant.

Digitisation is developing, with an overall penetration of 12% (8% satellite and the rest via cable). Ireland had 378,000 digital subscribers by the end of 2001, and this is expected to rise to 1.1m by 2006. Currently, there are three digital broadcasters: Chorus and NTL Ireland are cable operators, while Sky Digital is the only satellite operator. DTT services are planned; in 2000, the Irish government announced its intention to allow a private DTT operation and a separate transmission company. The it'sTV consortium was the only bidder for the DTT licence but has since withdrawn from the market.

NTL Ireland offers a single package of 35 channels for €12.81 per month. Decoder equipment is provided for free and there are no installation costs. Chorus offers 20 channels for €24. In contrast to NTL, Chorus requires an STB fee of €63 and installation fees of €90.30. The base package for Sky Digital offers four channels, plus a number of FTV channels, for €19. Sky Digital offers receiver equipment for free, although this requires a subscription of at least one year; there is an installation fee that varies between €75 and €100, depending on the subscription package. Maximum packages offer between 37 and 50 channels.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	Installation	Deposit	Monthly rental	Purchase
NTL Ireland	Cable	Not applicable	12 months	Not applicable	Not applicable	Free	Not applicable
Chorus	Cable	€63.50[1]	Not Available	90.30	Not applicable	Free	Not applicable
Sky Digital	Satellite	Not applicable	12 months	75–100	Price not available	Free	499

Notes: [1] STBs will be provided free to existing Chorus analogue customers. Other customers pay €63.50.

Satellite

Sky Digital

	Basic package	Additional options	Maximum package
		4 themed packages 8–15 channels €18.11 each	
		Family package 54 channels €27	Family package
Free STB	Value package	Sky Sports World 4 Channels €45	
		Sky Movies World 4 Channels €45	Sports and movies combination package
		Disney 4 channels €6.35	
		5 Additional premium channels €6.35–€8	
Cost	*€19*		*€27+53*
Channels	12		*54 + 8*

Cable

NTL

	Basic package	Additional options	Maximum package
		Sports package 3 channels €20.50	Sports + Movie Package
Free STB rental	Go Digital	Movie package 4 channels €25.59	
		4 Individual premium channels €6.40–€10.23	Go Digital
Cost	*€12.81*		*€33.28 + €12.81*
Channels	*37*		*7 + 37*

NTL's basic analogue package of 15 channels costs €15.63, while the maximum package costs just under €40, making digital an attractive option by comparison. Interactive channels are due to be added shortly, covering travel, sports, news, shopping and games.

Chorus

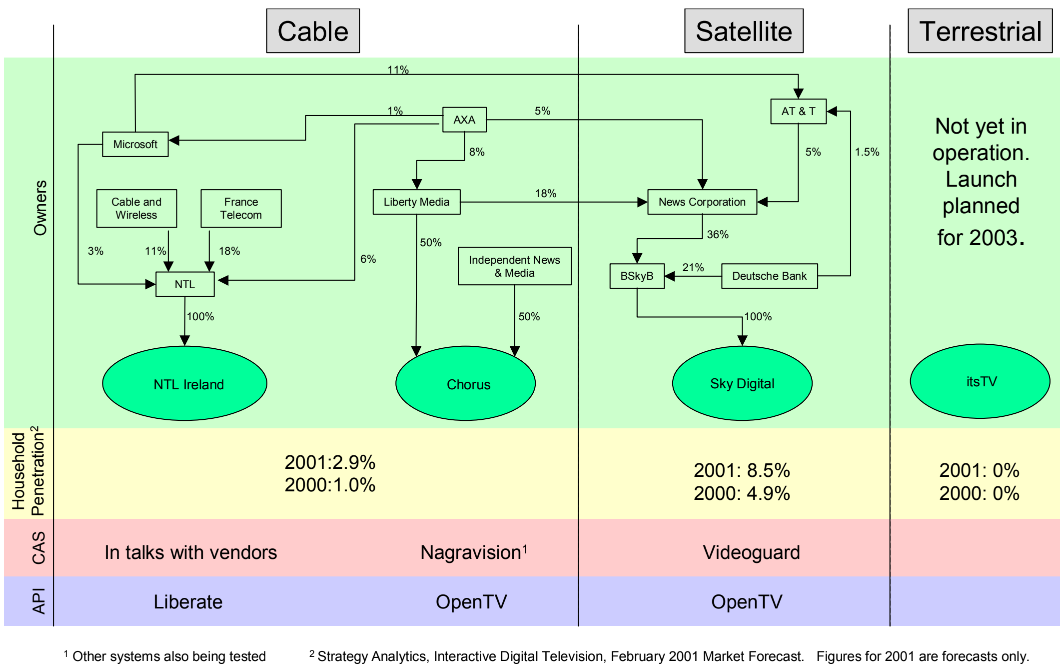
	Basic package	Additional options	Maximum package
		3 television Packages 4 + 5 + 5 channels €6.33 each/€12.68 the lot	
Free STB rental	Chorus TV	Sports collection 3 channels €21	the lot + all stand-alone
		Movies collection 4 channels €28	
		2 stand-alone premium channels €6.33/7.60	
Cost	*€24*		*€69.82*
Channels	*21*		*42 + 2*

Notes: *Free to existing Chorus Intro customers. Stand-alone channels: Racing Channel and Playboy channel.

Operator	No. of channels		Cost per month		Options	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
NTL Ireland	37	44	12.81	46.09	4 channels for 25.59	3.84
Chorus	21	44	24	69.82	4 channels for 28	4.44
Sky Digital	12	62	19	80	4 channels for 45	Not applicable

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free broadcast channels.

Ownership structure of Irish DTV providers



Italy

Historically, television in Italy has been dominated by analogue terrestrial delivery (almost 90% of households in 2001). Two FTV broadcasters, RAI (the PSB) and Mediaset, broadcast six terrestrial channels (RAI also broadcasts thematic satellite channels). Other terrestrial broadcasters have more regional coverage. Italy is unique in that it has introduced single digital decoder legislation on all operators. Sixty-four digital FTA Italian channels are also broadcast.

The pay-TV market has been slow to develop in Italy for two reasons: a large number of terrestrial FTV channels are available; and a lack of clear legislation until 1997 has limited the development of the cable industry. Cable penetration is therefore very low, with less than 1% of households passed, and actual penetration is even lower. Digital cable penetration is therefore likely to be negligible. Cable access is operated by Stream. However, satellite penetration is higher, at 12% (nearly 3m households), and satellite delivery is all broadcast in digital format. DTT trials began in November 2000 and will run to the end of 2002, with the likelihood of up to four licences being granted. The pay-TV market in Italy is currently solely DTH digital delivery.

There are two satellite digital operators: Stream and Telepiu. Both heavily promote their exclusive football channels, with a significant increase in price in order to subscribe to them. The operators have split Serie A between them, with each owning the viewing rights to home games of exactly half the teams (9 each). Serie B is less evenly split, with Stream owning the viewing rights to 15 of the 20 clubs. The STB can either be rented for €6 per month, or purchased for €257 from Stream. Stream requires an installation fee but no deposit; Telepiu requires a deposit of €49 and charges €7.30 per month in rental charges (although there is no installation fee). Special offers from Stream include free STB rental for 12 months, free installation and a free satellite dish.

There is considerable uncertainty surrounding the future corporate structure of the pay-TV operators in Italy. News reports indicate that News Corporation is finalising a deal with Vivendi to acquire Telepiu. News Corporation then intends (subject to regulatory approval) to merge Telepiu with Stream, its existing Italian pay-TV joint venture with Telecom Italia.[27]

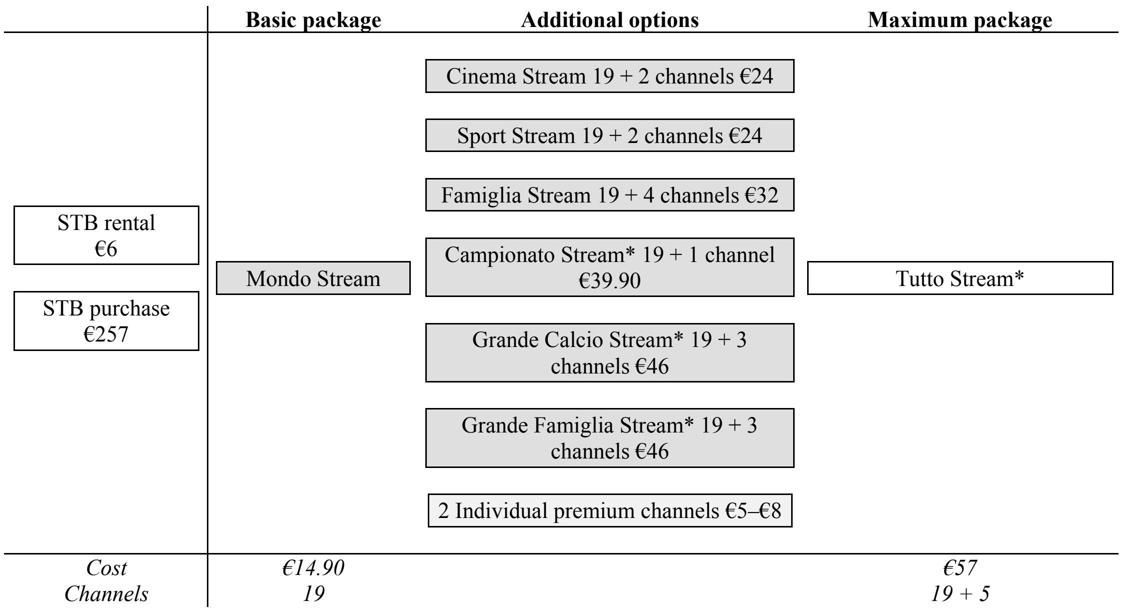
[27] *Financial Times*, September 18th 2002.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	STB installation	Deposit	Rental	Purchase
Stream	Cable/Satellite	None	Not Available	119	None	6	257
Telepiu	Satellite	49	Not Available	None	49	7.30	Varies

Satellite/cable

Stream



Note: *Includes the Campionato channel.

All Stream packages come with an additional 14 interactive channels, which have features such as portfolio tracking, home shopping and games. The packages contain the same 19 basic channels (Discovery, etc) and various combinations of Stream's five exclusive channels: two sports-related, two film-related and one channel, Campionato, covering the Italian football league. This channel is only available through the more expensive packages. Although it is possible to watch football matches PPV, they cost €17.90 each, making the higher-priced package subscriptions more tempting if the subscriber wants to watch several games.

Satellite

Telepiu

	Basic package	Additional options	Maximum package
STB rental €7.30		Premium Plus 16 channels €32	
		Family 17 channels €39	
	Super	Superpremium 33 channels €39	Superpremium Gold
STB purchase + dish*		Football channel €24	
		7 Individual premium channels €5.20–13	
Cost	*€19*		*€45*
Channels	*27*		*34*

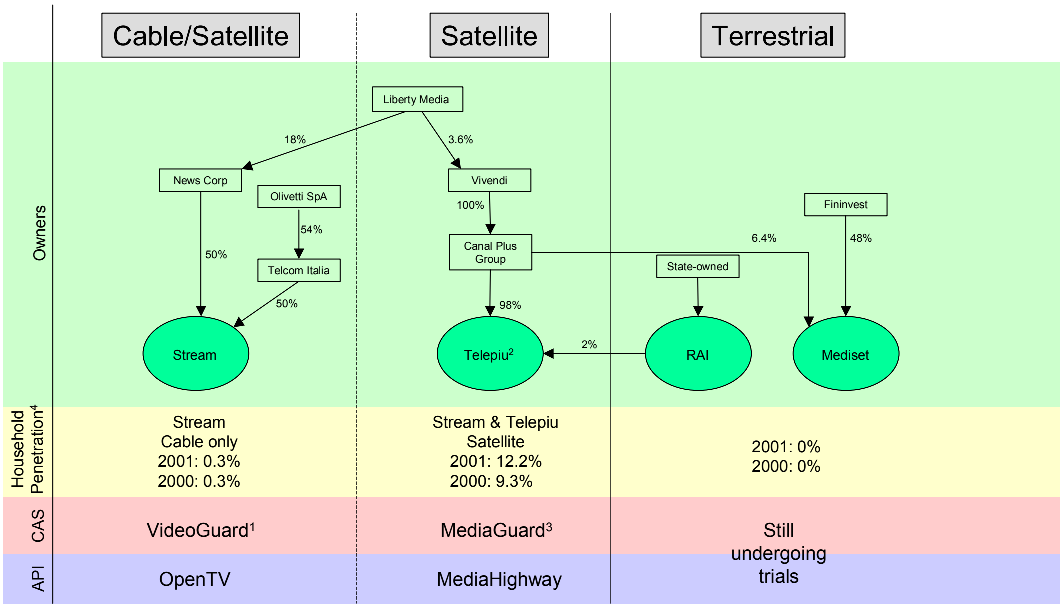
Note: * Prices vary according to retailer.

The exclusive channels offered by Telepiu are its own set of five Tele+ channels and the football channel 'Calico Gold'. Although the cheapest package (Super) contains more channels than some of the other packages, it does not include any of these key channels. The football channel is used to encourage upgrades to higher-priced packages, as it can be added at a low price to the Premium Plus and Superpremium packages, for €7 and €6 respectively, which are then re-titled as the Family or Superpremium Gold packages.

	No. of channels		Cost per month		Options	
Operator	**Base package**	**Max. package**	**Base package**	**Max. package**	**Movies**	**PPV cost per film**
Stream	19	24	14.90	57	Part of package	Available
Telepiu	27	34	19	45	Part of package	Available

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free-broadcast channels.

Ownership structure of Italian DTV providers



[1] Small number use SimulCrypt. [2] Also known as Digitale+ (D+) [3] Small number use ComCrypt.

[4] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Luxembourg

Over 80% of households in Luxembourg receive broadcast signals over a cable network. Belgian, French and German free channels may also be received. Residents are therefore used to multi-channel free offerings. Six digital FTA Luxembourg channels are also broadcast.

As in neighbouring countries, this proliferation of free channels in Luxembourg poses an obstacle to the development of the pay-TV market. Cable (analogue) pay-TV probably has less than 3% of the market. Digital services are generally underdeveloped, as Luxembourg's small population, combined with the lack of pay-TV penetration, means that there is little commercial motivation to upgrade the cable network.

Luxembourg had 23,000 digital subscribers in 2001 (15% penetration). SelecTV, which has been broadcasting since November 2000, has a monopoly position in the country, with the only digital platform integrated into Luxembourg's cable network. The company currently offers just one subscription package, with 55 channels, including a number of free channels, spit over eight themed packages (children, news, adult, etc). The decoder is provided free of charge to all its customers and there are no deposit or connection fees. A premium service is promised, which will include an additional 10 CD-quality music channels. The cost of the premium-service subscription has not yet been disclosed. SelecTV has recently hit financial difficulties and the future of the platform remains uncertain.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	STB Installation	Deposit	Rental	Purchase
SelecTV	Cable	Free	Price not available	–	Free	Not applicable	Free[1]

Notes: According to SelecTV's owner, Aurora, its 'SelecTV Media Center decoder' would retail for €2,750.

Cable

SelecTV

	Single package
STB provided free	8 packages
Cost	*€36*
Channels	*55*

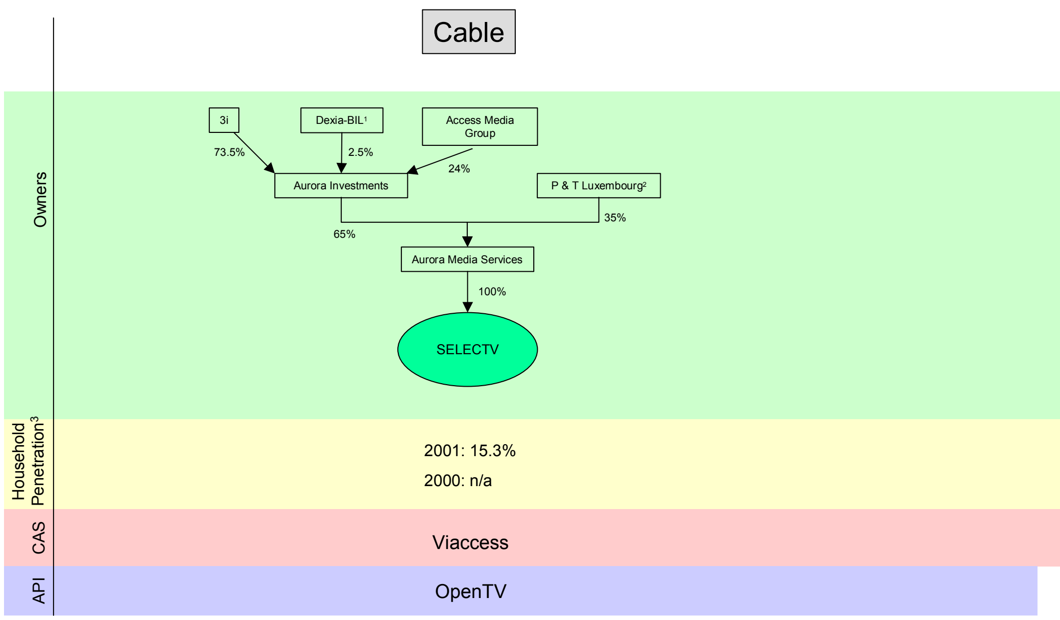
In the near future, the SelecTV digital platform will be upgraded to combine DTV, Internet access, email and on-line shopping. Another addition will be SelecTV Mediathèque. This service will provide a near-video-on-demand service, offering more than 5,000 titles and rotating through a multiplex of channels to provide about 15 different programming choices starting every 15 minutes. There will be an added feature to allow viewers to select the language of their choice.

SelecTV's owner, Aurora, plans to introduce a range of interactive services, including Internet access. To do so, Aurora intends to upgrade the SelecTV digital platform into a convergence system for cable TV networks and ADSL-equipped PSTN. This addition could be crucial in allowing DTV to catch on in Luxembourg. The wide range of free channels means that the current basic package adds little to the viewer's choice. In parallel to this, Aurora hopes to capture a share of the German market, and it has obtained a licence for distribution in the German state of Hesse.

Operator	Channels Base package	Max package	Cost Base package	Max package	Options Movies	PPV
SelecTV	55	Not applicable	36	Not applicable	3 channels in package	Not applicable

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free broadcast channels.

Ownership structure of Luxembourg DTV providers



[1] Banque Internationale à Luxembourg. [2] State Telecoms Operator. [3] Jupiter MMXI DTV Forecasts.

Netherlands

The Netherlands has approximately 6.5m television households, mostly cable users. Satellite broadcasting has been introduced relatively recently, and only about 4.5% of households access television broadcasting via a terrestrial signal. Historic multi-channel access through basic cable means that both pay-TV and digital are difficult propositions.

The Dutch market has four digital operators. Canal Digitaal, run by Canal+ Nederland, is the only satellite operator, launched as a fully digital service in April 2000. The bouquet of channels from Canal+ is also available over several of the main cable operators networks. The Dutch cable market is highly developed and featured over 100 operators until only a couple of years ago. There are only a few large players, however, of which only Casema and UPC provide a digital cable service, which currently accounts for only a small percentage of their customer base. The consortium, Digitenne, is the only terrestrial contender at this time. It was awarded a licence in January 2002 and will begin operating in October. The network has five multiplexes each with capacity for five channels. Coverage will stand at 40% of the population at launch, rising to 80% by the middle of 2003 and 98% at the beginning of 2004. Eight digital FTA Dutch channels are also broadcast.

A variety of packages is offered, with pressure on Canal Digitaal and Digitenne to take customers away from the large established analogue cable market. As a consequence, both have competitive offers. Canal Digitaal offers its STB for a minimal amount with any subscription (€15 per year). Digitenne is likely to retail at €9 per month, with a 25-channel service. It will include the free and commercial channels, as well as a selection of pay-TV channels. In a bid to compete with cable, it will also include an adult entertainment service as a free bonus channel.[28] UPC only offers a one-price package (which differs slightly, depending on geographical location). This contains a mixture of individual channels, four themed groups of channels and a premium channel (movie or ethnic). Casema offers four separate themes, each with five channels and several premium channels at additional cost.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	STB installation	Deposit	Rental	Purchase
Canal Digitaal	Satellite	Free	12 months	Free	None	15 per yr	Not applicable
Casema	Cable	Price not available	12 months	Price not available	Price not available	Free	Not applicable
UPC Digital	Cable	Price not available	6 months	90.30	45.38	Free	Not applicable
Digitenne[1]	Terrestrial	–	–	–	–	9	–

Note:[1] Due to be launched in October 2002.

[28] *New Media Markets*, June 21st 2002.

Satellite

Canal Digitaal Satelliet

	Basic package	Additional options	Maximum package
		canal+pakket 3 channels €26.80	
STB rental €15/year	BASIS-pakket	combi-pakket 12 + 3 channels €32.50	TOP-pakket
		2 Individual premium channels €6.99/€12.50	
Cost	*€6.25*		*€46.50*
Channels	*12*		*12+3+2*

Cable

Casema

	Basic package	Additional options	Maximum package
Free STB rental	4 theme packets	5 premium channels €13.75–€30.75	All theme packets
Cost	*€2.75 each*		*€7.50*
Channels	*5, 5, 5, 6*		*21 + 3*

Interactive features include TV mail, computer games and interaction with a live Dutch game show.

UPC Digital

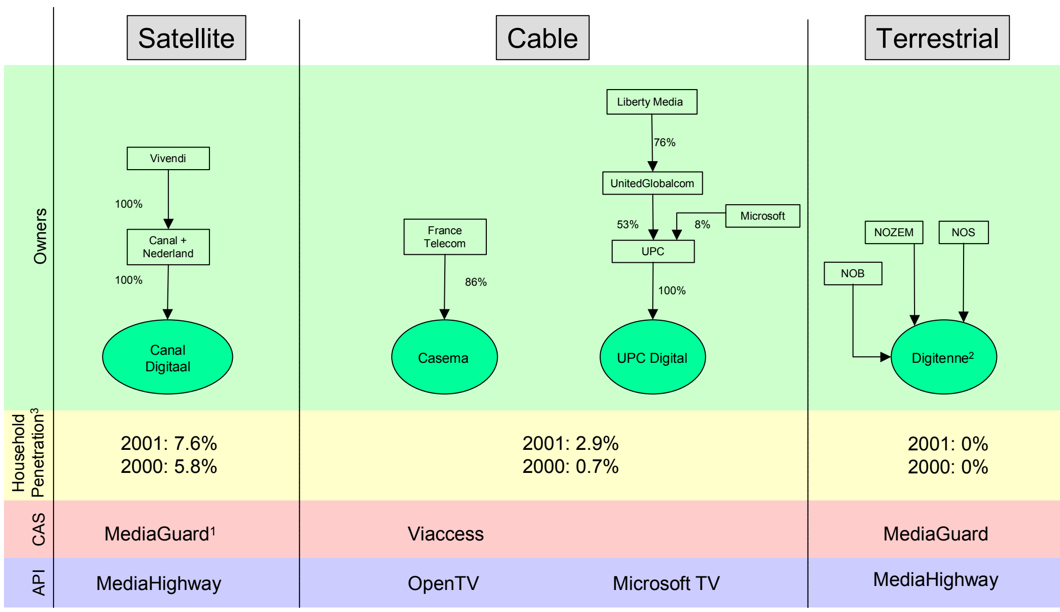
	Basic package
	UPC Startpakket 12 channels
Free STB rental	4 theme packets 17 channels
	1 extra premium channel[1]
Cost	*€24.95/€27.95**
Channels	*30*

Notes: *Depending on location [1] Choice of CineNova or one of the ethnic channels (SET, ZeeTV or MBC), or TVBS (which costs an extra €14.95).

Operator	No. of channels		Cost per month		Options	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
Canal Digitaal	12	17	6.25	46.50	1 for 6.99	Not applicable
Casema	5	24	2.75	7.50	1 for 13.75	Not applicable
UPC Digital	30	–	24.95	–	1[1]	3.61
Digitenne	–	–	–	–	–	–

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free-broadcast channels. [1] Included in the price of the main package.

Ownership structure of Dutch DTV providers



[1] Small number use Simulcrypt.
[2] Not yet deployed.
[3] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Portugal

Historically, television in Portugal has been delivered by terrestrial means. The shift of football rights to pay-TV channels was an important trigger in cable penetration. Currently, all three delivery mechanisms are in use, with just under 50% of households receiving terrestrial coverage, 31% cable coverage and the remainder satellite coverage. Five digital FTA Portuguese channels are also broadcast.

Digital penetration, almost entirely through satellite subscription, is at 6%, well below the European average (18%). The country has one single digital operator, TV Cabo, which is fully owned by PT Multimedia and supplies digital services via satellite and cable. It is the largest cable operator in Portugal, with approximately 1.8m subscribers and 2.2m homes passed. The company has only recently started to promote digital services through cable (some upgrading of cable networks has had to be carried out), hence the low penetration. There are other, much smaller, cable companies.

In 2001, the consortium Plataforma de Televisao Digital Portuguesa (PTDP) was awarded the country's sole DTT licence, valid for 15 years. The five-multiplex network, which is due to be launched in late 2002, will carry FTA simulcasts of the existing analogue national networks, plus new programme and interactive services.

TV Cabo offers a single pricing structure with a basic package of 15 channels for €6.53 and a maximum package of 35 channels for €15.90. A premium movie channel costs an additional €9.45. Installation costs €76.10 and the decoder can either be rented or bought. STB rental is €6.70 per month, while the purchase price of the decoder has recently been reduced to €253.26.

TV Cabo has also recently introduced digital interactive television over cable. The STB costs €147.12 (or €152 if spread over several payments), and there is a monthly subscription of €7.60, with a single package of 38 channels offered.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	STB installation	Deposit	Ren tal	Purchase
TV Cabo	Satellite and cable	None	12 months	76.10	Not applicable	6.70	253.26

Satellite

TV Cabo

	Basic package	Additional options	Maximum package
STB rental €6.70 STB purchase €253.26	Parabólica Mágica Iniciação	Parabólica Mágica Sport TV 10 channels €19.83 Parabólica Mágica Família 22 channels €12.64 5 Additional Premium Channels €6.39–€17.29	Família
Cost	*€6.53*		*€15.90*
Channels	15		*35*

TV Cabo also offers a special interactive service. In addition to the STB purchase/rental, a monthly fee of €7.60 gives access to ‘TV Cabo interactiva’, which offers 38 channels with different interactive services.

	Single package
STB rental €7.60 STB purchase €147.12*	TV Cabo interactiva
Cost	*€7.60*
Channels	*38*

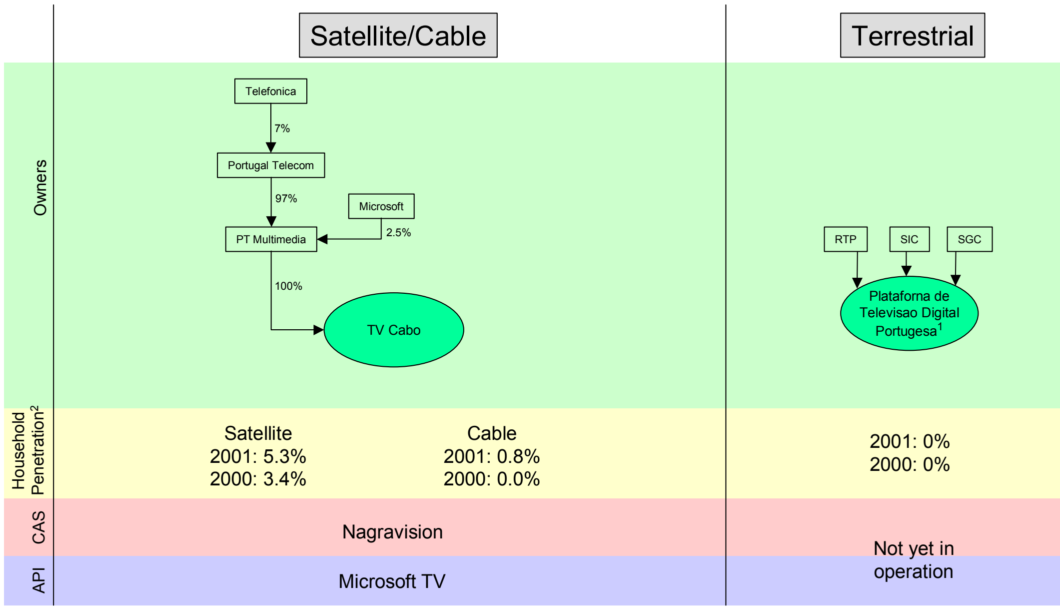
Note: *€152.20 when paying in two instalments.

Approximately 20 of the channels feature an interactive ‘toolbar’ of options, called ‘barra iTV’. This allows the viewer to carry out various activities, such as accessing programme summaries, entering channel competitions and voting. Some of the channels have an extra interactive level ‘Site TV’, which acts as an exclusive website for the channel, with features such as voting and games. Certain programmes also contain interactive content. Examples of interactive features in current use include allowing the viewer to: participate in competitions; choose alternative angles of vision during a football game; consult programme summaries; and find out more about the characters and actors in a soap opera. Similarly, interactive advertising is also being experimented with, providing the viewers with additional product information, promotions and methods of purchasing.

	No. of channels		Cost per month		Options	
Operator	**Base package**	**Max. package**	**Base package**	**Max. package**	**Movies**	**PPV cost per film**
TV Cabo	15	35	6.53	15.90	1 channel for 9.45	Not applicable

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free broadcast channels.

Ownership structure of Portuguese DTV providers



[1] Due to launch late 2002
[2] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Spain

The Spanish TV market has traditionally been dominated by analogue terrestrial broadcasting, with currently over 75% of households receiving their transmissions in this way. There are five national channels, and a large supply of regional channels, both public and private. Thirty-three digital FTA Spanish channels are also broadcast.

Analogue (cable and terrestrial) also dominates the pay-TV market; in 1999, the DTV market amounted to only 15% of the total pay-TV market in terms of revenue. However, the largely subscription-based digital market is growing. Increasing numbers of digital satellite consumers and the switch of Canal+ subscribers from its (now closed) analogue terrestrial pay-TV channel, Canal+ España, to the CanalSatélite Digital package drive its growth from analogue terrestrial to digital satellite reception. Digital households in 2001 reached 2.6m, or a penetration rate of 22%. DTH dominates digital delivery; cable digital delivery is negligible, and DTT had a penetration of approximately 3%. This is likely to be an overestimate of the current DTT penetration since Quiero, a terrestrial digital broadcaster, ceased to operate in April 2002. There are currently three other digital operators: two satellite operators, Canal Satelite Digital and Via Digital, and one cable operator, the consortium Aunacable.

In the Spanish market, all operators require payment of a 'sign-up' fee of about €30. STBs are acquired through monthly rental payments, ranging from €6.30 to €8. No deposit is required, and operators may or may not charge for installation. There is no purchase option available to Spanish consumers.

Basic packages vary widely in terms of the number of channels offered and may include interactive services. All the current operators offer a cinema option. Interactive services include shopping, chatting, messaging, games, sports, and banking services; other options include thematic channels and PPV.

There is a wide diversity of special offers aimed at attracting new subscribers. These include free installation, wireless keyboards and antennae.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	STB installation	Deposit	Rental	Purchase
Canal Satelite Digital	Satellite	30.00	12 months	Free	0	7.99	Not applicable
Via Digital	Satellite	30.02	Not available	139.43	0	7.20	Not applicable
Quiero[1]	Terrestrial	29.75	Not available	Free	0	7.20	Not applicable
Aunacable	Cable	60.10	Not available	60.10	0	6.30	Not applicable

Note: [1] Quiero's business model is shown for illustrative purposes.

Satellite

Via Digital

	Basic package	Additional options	Maximum package
		Vía Familiar* 47 channels €20.75	
		Gran Vía Max* 47 + 3 channels €33.20	
		Supervía Cine* 47 + 7 channels €37	
STB rental €7.20	Acceso Vía	Supervía Deportes* 47 + 4 channels €37	Vía Total* 47 + 8 channels
		8 Themed groups of 1–9 channels €3.65–€20.75	
		6 Individual premium channels €4–€9	
Cost	*€5.98*		*€39.50*
Channels	*9*		*55*

Note: *Includes Acceso Vía channels.

Via Digital offers two forms of subscription: the basic 'Acceso Vía' package, with various small groups of channels; or one of the more expensive packages, which include all the Acceso Vía channels, a large number of extra channels, and several, or all, of the themed channels, depending on the exact package chosen.

Canal Satellite Digital

	Basic package	Additional options	Maximum package
		Premium+ 63 + 5 channels €40.60	
		Canal+ Digital 5 channels €30.77	
STB rental €7.99	Fórmula Digital	Fórmula Cine 63 + 5 channels €37.47	Premium+ familiar 63 + 10 channels
		8 Individual premium channels* €4.70–€6	
Cost	*€31.22*		*€47.44*
Channels	*63*		*73*

Note: *Only available if also subscribing to the Premium+ or Premium+ familiar packages.

Canal channels are very much in demand and are available for €30.77. However, for an extra €10 (the Premium+ package), they can be obtained, with over 60 more digital channels additional. The individual premium channels include the football channel for Real Madrid, but subscribers can only sign up for this if they have subscribed to one of the top two packages.

Cable

Aunacable

	Basic package	Additional options	Maximum package
STB rental €6.30	Stand-alone television package	Télévisión + teléfono 40–€45* channels €19.50 Some optional channels. Availability and price varies according to location	Teléfono + televisión + Internet banda ancha 128
Cost	*€15*		*€39+ €9 for cable modem*
Channels	40–45*		*40–45**

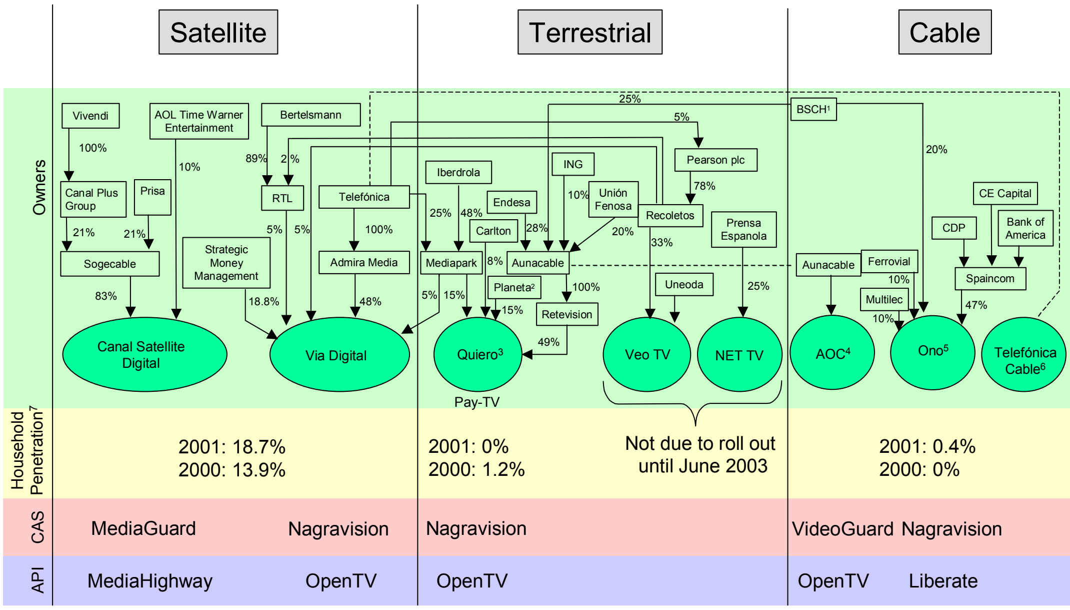
Note: *Varies slightly according to location.

Internet dial-up access over a standard telephone line is also available. The subscriber either pays a fixed tariff of €15/month for evenings and weekend use, or there is a pay-as-you-go option. These options are not available as part of the combination package. There is a strong push by Auncable to its combination packages, and the pricing encourages this. The télévisión + teléfono package is only a small increase on the television-only option, but adding Internet access to this separately (€19.50 + €15) takes it close to the price for the full triple-combination package, which has the advantage of featuring 128-kilobytes/second Internet access. Special offers are frequently run, offering free installation of the triple-combination package, to encourage further take-up of the maximum package.

	No. of channels		Cost per month		Options	
Operator	**Base package**	**Max. package**	**Base package**	**Max. package**	**Movies**	**PPV cost per film**
Canal Satellite	63	73	31.22	47.44	Part of a package	Not applicable
Via Digital	9	55	5.98	39.50	9.65 for seven channels	Not applicable
Quiero	14	–	22.55	–	–	Not applicable
Aunacable	40–45	–	15	–	7 channels as part of package	2.55

Note: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free broadcast channels.

Ownership structure of Spanish DTV providers



[1] Banco Santander Central HispanoAmericano. [2] Banco Santander Sofisclave. [3] Now shut down. [4] Agrupacion de Operadores de Cable.
[5] Also known as Cableeuropa. Managed by Callahan Association International (CAI). Launching a digital service in late 2002. [6] Has a licence but not DTV plans.
[7] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Sweden

Historically, more than 50% of Swedish households have received television broadcast by either satellite or cable. The analogue terrestrial offering is three channels (SVT1, SVT2, TV4), and Swedes have been used to buying analogue decoders and paying a nominal fee in order to access the full range of Swedish FTV channels. Five digital FTA Swedish channels are also broadcast.

Sweden has a digital penetration rate of 23%, the third highest in the EU after the UK and Denmark. Sweden had over 0.5m digital satellite subscribers by the end of 2001, and the market is expected to grow to over 3.5m by 2006. There are two cable operators, Com Hem and UPC Sweden, two satellite broadcasters, Canal Digital and Viasat, and Senda, a terrestrial operator, in the market.

Sweden has a strong mix of available technologies in the digital pay-TV market, with competition in both satellite and cable markets, and a 1999 launch of the DTT service, Senda. Within the satellite market, Canal Digital was a digital broadcaster right from its inception, while Modern Times Group's (MTG) Viasat undertook a subsidised switchover in eight months and turned off analogue feeds in May 2001. MTG also provides its channels to cable subscribers through third-party networks. Within the cable market, digitisation is under way but at a much slower pace, with many more operators involved. Since the cable industry was deregulated in 1992, the industry has developed rapidly, with over 70 companies operating more than 450 networks by 2000. However, five companies control 97% of the market, of which, only the state-owned Com Hem and, more recently, UPC, have upgraded part of their network to digital capacity.

Canal+ is represented in all the packages because its programme channels feature as part of the premium channel options for each operator. The cable operators have very similar offers, both geared towards the 'maximum user'; however, their basic packages are not as attractive. Senda, which operates commercially under the name Boxer, has a single package offer that falls between the basic and maximum packages of the others, and a very low STB rental cost. Unlike the other operators, which offer an array of specialist channels, Senda only has a movie channel add-on package. Canal Digital offers the lowest prices for its channels, including seven that are available at no extra cost.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	STB installation	Deposit	Monthly rental	Purchase
Com Hem	Cable	Price not available	12 months	Price not available	Price not available	7.50	Price not available
UPC Sweden	Cable	Price not available	12 months	77	Price not available	Free	Price not available
Canal Digital	Satellite	Price not available	Not Available	Price not available	Price not available	Annual charge	Price not available
Viasat	Satellite	Price not available	12 months	Not applicable	Price not available	Not applicable	108
Senda	Terrestrial	11	12 months	43	Not applicable	Not applicable	268.60

Satellite

Canal Digital

	Basic package	Additional options	Maximum package
		Familjepaketet 7 + 21 channels €18.20	
		Canal+ 7 + 4 channels €23.60	
STB Annual Rental	Local	Discovery theme package 4 channels €7.54	Familjepaketet med Canal+
		8 Individual premium channels €5.30–€15	
Cost	*€0**		*€37.60*
Channels	*7*		*7 + 21 + 4 + 1*

Notes: There is no fixed monthly fee for Local; all channels in Local are included in the annual subscription fee (€32.10 with the Familjepaketet, and €53.65 with the Canal+ package).

Viasat

	Basic package	Additional options	Maximum package
		3 Additional themes 3 channels each €7.40 each	
STB purchase €108*	Viasat à la Carte		Viasat Guld
		2 Individual premium channels €16	
Cost	*€8.50*		*€27*
Channels	*5*		*5 + 22*

Note: * Full price: €543.

Cable

UPC Sweden

	Basic package	Additional options	Maximum package
		TV1000-paketet 28 + 6 channels €48	
		Various choices from 16 channels* €5.30–€26	
Free STB rental	Mixpaketet	Canal+ package 4 channels €23.50	Canal+ paketet
		TV1000 package 6 channels €21.40	
		International package 9 channels €8.80	
		Adult package 1 channel €10.60	
Cost	*€32.50*		*€50.30*
Channels	*28 + 3***		*28 + 4*

Notes: *From a choice of 16. **3 channels, €5.30; 5 channels, €8; 8 channels, €13.40; 3+8 channels, €18.80; 5+8 channels, €21.50; 16 channels, €26.

Com Hem

	Basic package	Additional options	Maximum package
		8 Favoriter and TV1000 8 + 2 channels €34.40	
		Stora com hem 30 channels €32.20	
		Canal+ package 3 channels €23.60	
STB rental €7.50	8 Favoriter		8 Favoriter and Canal+
		TV1000 package 2 channels €21.40	
		3 Premium channels €16–€21.40	
		A la carte-kanaler 29 channels €4.20 each 7 channels €6.35 each	
Cost	*€13.90*		*€34.40*
Channels	8		*8+3*

Terrestrial

Senda/Boxer

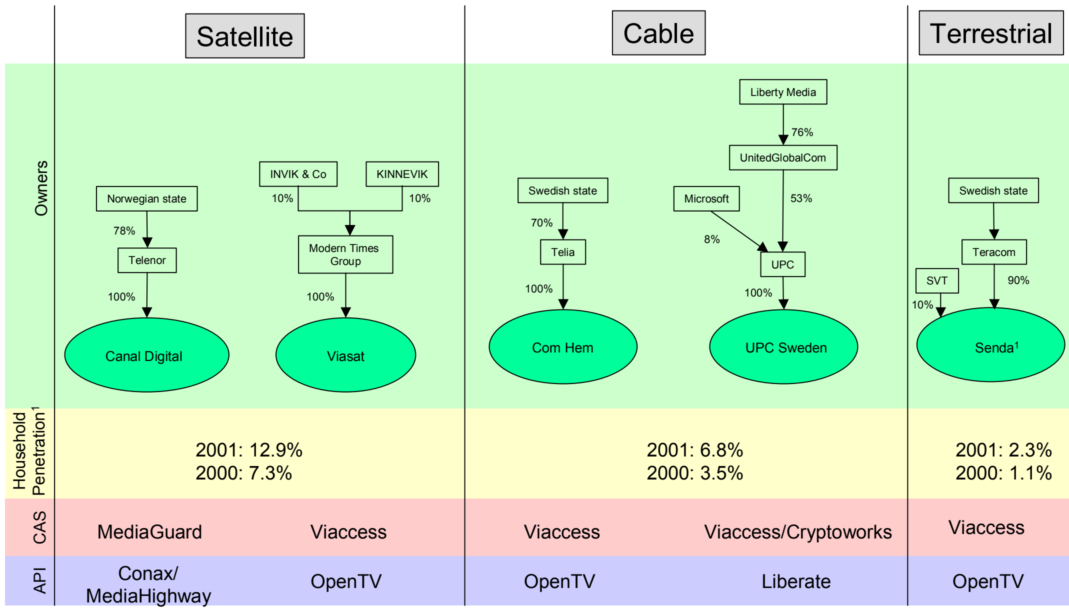
	Single package	Additional options
STB purchase €268.60	Boxerpaketet	Tillvalskanaler* 4 channels €23.60
Cost	*€15*	
Channels	15	

Note: *Tillvalskanaler = Canal+ channels.

Operator	No. of channels		Cost per month		Options	
	Base package	**Max. package**	**Base package**	**Max. package**	**Movies**	**PPV cost per film**
Com Hem	8	11	13.90	34.40	Part of package	4.75
UPC Sweden	31	32	32.50	50.30	Part of package	Not applicable
Canal Digital	7	33	0	37.60	Part of package	4.75–5
Viasat	5	27	8.50	27	Part of max. package	Not applicable
Senda	15	–	15	–	4 channels for 23.60	Not applicable

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free broadcast channels.

Ownership structure of Swedish DTV providers



[1] Operates under the brand name Boxer; [2] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

UK

The UK television market has a history of analogue terrestrial delivery, and analogue terrestrial FTV continues to be the most widely used reception mechanism. At the same time, the UK is now the leading European country in terms of digital penetration, at over 40% of households. There are five FTV channels, provided by the BBC and ITV, a network of regional commercial franchises, Channel 4 and Channel 5. With the exception of Channel 5, these channels are also digitally broadcast on all available platforms. Seventy-three digital FTA British channels are also broadcast.

Digital penetration is largely subscription-based. The high price of STBs has limited the market for FTV digital homes; however this is changing with the advent of cheaper FTV decoders. Digital consumers make up the majority of the UK's pay-TV subscribers; with over 50% subscribing to digital satellite (Sky Satellite is the only service provider). The remaining digital consumers were split almost equally between cable providers (NTL and Telewest) and the, now defunct, digital terrestrial broadcaster, ITV Digital. Backed by the BBC, a new digital terrestrial FTA platform freeview, has been rolled out since the end of October 2002. It comprises an extended offering of over 20 channels, 12 of which are new to DTT.

Subscription packages comprise in general an installation charge, a minimum subscription period, and a monthly charge based on the content taken as part of the subscription. No STB deposit is required, nor is there an explicit STB rental charge, and, in the case of Sky, the customer now owns the STB. The installation fee may vary according to the package to which the customer subscribes. Thus, Sky Digital charges €75 for installation for subscribers to Sky World and Family Package, and €100 for any other subscription package. Likewise, Telewest offers a one-off installation fee of €75 for the Starter package, €60 for the other packages when combined with telephone services and €37.50 if a customer combines DTV, telephone services, and broadband Internet. ITV Digital charged a uniform connection fee of €37.50, while NTL has a €112.50 connection fee for new homes, and €75 for pre-wired homes or for upgrades from analogue to digital.

Operators offer a series of additional services when a customer subscribes to their digital packages. Sky Digital offers an on-screen TV guide, access to email, banking and shopping through Sky Active, as well as a collection of prizes to Sky customers through its Sky Rewards programme. Telewest offers a phone line, email, games, PPV, and free access to over 150 television shops and banking services. NTL offers walled-garden Internet, interactive games and email.

Summary of costs of DTV access

Operator	Transmission	Sign-up cost	Min. subscription	STB installation	Deposit	Monthly rental	Purchase
Sky Digital	Satellite	None	12 months	75 or 100	Free	Free	Not applicable
Telewest	Cable	None	Not Available	75, 60, 37.50	Free	Free	Not applicable
ITV Digital[1]	Terrestrial	37.50	12 months	Free	Free	Free	Not applicable
NTL	Cable	None	12 months	75 or 112.5	Free	Free	Not applicable

Note: [1] ITV Digital included for comparative purposes only.

Satellite

Sky Digital

	Basic package	Additional options	Maximum package
		Lifestyle package 8 channels €20	
		Kids/Music package 11 channels €20	Family package 61 channels €25
Free STB	Value Package	Knowledge package 11 channels €20	
		Popular Mix package 14 channels €20	8 Premium channels €32.80
		1–8 Premium channels €15.60–€39	
Cost	*€15.60*		*€57.80*
Channels	*15*		*84**

Note: *Includes basic package channels.

Cable

NTL

	Basic package	Additional options	Maximum package
		Family package 62 channels €40	
		Variety package 11 channels €36	
		News and documentary package 13 channels €36	
Free rental	Base Package	Kids Music package 12 channels €36	Family, Sky Movies and Sky Sports Package 62 + €19 channels
		General entertainment package 12 channels €36	
		25 Individual premium channels €8–€20	
Cost	*€31*		*€73*
Channels	*23*		*103**

Note: *Includes basic package channels.

Telewest

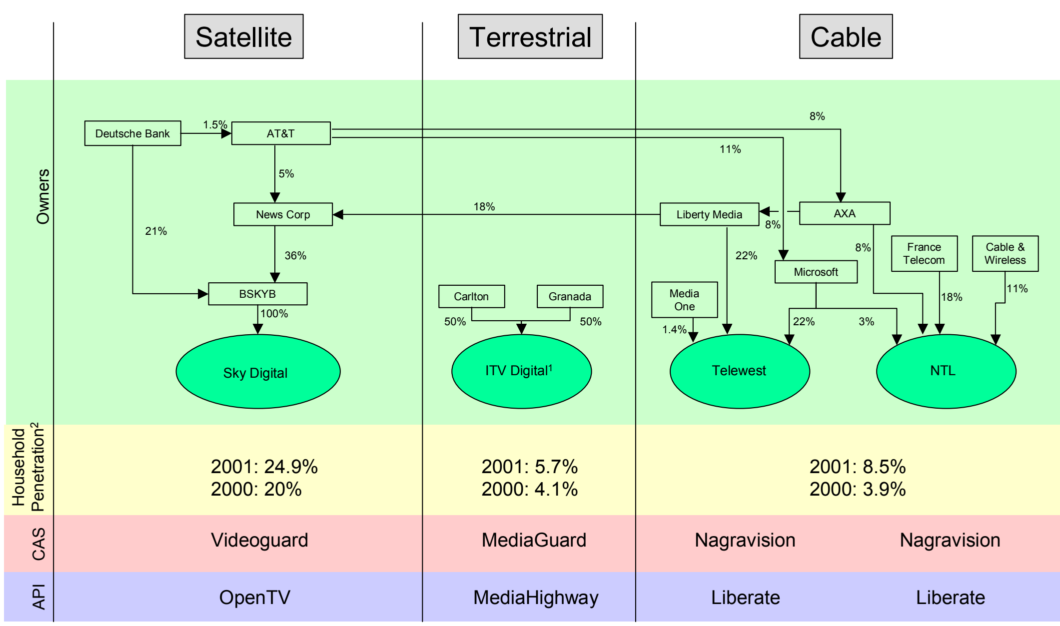
	Basic package	Additional options	Maximum package
		Essential package 18 channels €29	
Free rental	Entry package	Essential Plus package 18 + 5 channels €33.60	Supreme package 18 + 5 + 36 channels
		18 Individual premium channels €8–€23	
Cost	*€23*		*€40*
Channels	*23*		*82**

Note: *Includes basic package channels

	No. of channels		Cost per month		Options	
Operator	**Base package**	**Max. package**	**Base package**	**Max. package**	**Movies**	**PPV cost per film**
Sky Digital	15	84	15.60	57.80	Part of packages	Not applicable
Telewest	23	82	23	40	Part of package	5.50
ITV Digital	25	42	19.50	57	Price not available	Available
NTL	23	103	31	73	12 channels as part of max package	5.50

Notes: All prices quoted are per month, unless otherwise indicated. Channel numbers quoted do not include audio and free broadcast channels.

Ownership structure of UK DTV providers



[1] Ceased transmission May 2002. [2] Strategy Analytics, Interactive Digital Television, February 2001 Market Forecast. Figures for 2001 are forecasts only.

Appendix 3: Experience in Other Network Industries

This appendix examines other network industry sectors that appear to exhibit similar economic and structural characteristics to those found in the digital broadcasting industry, and which have, in one way or another, arrived at networks with a high degree of standardisation. The objective is to establish which of their characteristics has led to this standardisation. To the extent that digital broadcasting shares these characteristics, similar pressures (and problems) can be expected to arise, and it may be possible to learn from the experience of these industries to inform policy formulation in the broadcasting sphere. The standardisation cases analysed are:

- operating systems for PCs in the early 1980s and 1990s—the de facto standardisation of PCs to a proprietary operating system standard (Microsoft Windows) in a market where competing operating systems were (and are) available;
- standardisation of mobile telephony supply in much of the world—to a non-proprietary standard (GSM telephony), which grew out of a consensual, interoperable European standard established by the market participants in direct response to governmental policy; and
- standardisation of communications over the Internet to a non-proprietary standard.

All three cases are complex, and this appendix does not purport to explain each exhaustively. Rather, the focus is on the *specific* and *fundamental* characteristics that affected the outcome (ie, standardisation), and how the economic incentives in each case can be compared with those present in the digital broadcasting industry.

To be most useful, the analysis is centred on answering two specific questions:

- what are the economic characteristics that lead to standardisation; and
- are these characteristics exhibited in digital broadcasting, and, if so, what are the implications for policy in relation to standardisation (or otherwise) in these markets?

Each of the case studies is discussed in more detail in the following sub-sections. The aim is to present a higher-level discussion of the important results. To this end, the most critical elements of each of the three cases under analysis are presented below, with particular emphasis on the nature of the network. A matrix is then developed that allows each case to be compared against common criteria. This is then applied to the case of digital broadcasting.

A3.1 Summary of the pressures to standardise operating systems, mobile telephony and the Internet

A3.1.1 Operating systems

The pressure to standardise operating systems emanated mostly from network effects, which were largely indirect, in the sense that direct communication between users is not the main aim of an operating system.[29] The major effect was that consumers benefited from the proliferation of applications written for the same operating system. Path dependency developed among consumers as they became accustomed to applications written for a particular operating system and/or they had an installed base of software (eg, Word) and/or applications in that software (eg, a Word document) that required the same (or backward-compatible) operating system to be available through time.

Such indirect network effects are often sufficient to lead to standardisation within a defined user group, meaning that several standards could co-exist. A more universal standard arose in the case of operating systems for other reasons:

- the economic characteristics of software—high fixed costs, very low copy costs—combined with a significant expense of converting software written in one operating system to work with another, meant that it was in the economic interests of application developers to write applications that could address the largest installed base; and
- in the absence of detailed knowledge of the characteristics of the installed base, applications developers were largely unable to target specific groups of demand known to be using a specific operating system.[30]

The interaction between generalised consumer demand—access to a larger pool of software will generally have more value for a consumer than access to a smaller one—and software economics produces a virtuous circle: the unit costs of software fall as the use of a single operating system increases, thereby making the value of the operating system greater to the end-user, and increasing the pressure to have one operating system in *all* computers.

The emergence of a dominant operating system within an undifferentiated consumer market in the face of strong indirect network effects was therefore very likely. The fact that it turned out to be Windows is likely to be more idiosyncratic—more effective commercial exploitation of the indirect network effects, luck (in terms of the relationship with IBM, together with the ability to license original equipment manufacturers (OEMs)

[29] Exchange of information is eased by use of the same standard, and the importance of this has developed with the Internet and interconnectivity.

[30] There has been one major exception to this—Apple users exploiting the (historically) higher-quality graphic artwork capability of Apple computers using the Apple operating system. A specific demand group emerged—graphic designers and desk-top publishers—identified with a specific operating system, and application developers could address these groups successfully by writing specialised applications for the Apple computer.

to produce clones), and, possibly, anti-competitive behaviour have resulted in Windows being the dominant operating system.[31]

A3.1.2 Mobile telephony

Consumers place a high value on any-to-any connectivity across telecoms networks (including mobile networks). Technology within each mobile network tends to be standardised to enable an operator to provide as much network coverage as possible within which the consumer can make calls. However, standardisation of networks (including mobile networks) is not *necessary* to achieve this objective: interconnection between networks for the delivery of end-to-end transmission paths is tightly managed, and, in the absence of standardisation of network technology and operation, translations at the point of interconnection can largely overcome any interoperability problems.[32]

However, in addition, a *mobile* network's customers will also benefit if they can make and receive calls when they are outside the area covered by their own operator's network. Roaming is therefore a valuable consumer service and increases the direct network effects by an order of magnitude. To deliver roaming efficiently, different networks need to be able to interoperate with *handsets* originally provided for use on another network operator's network. Standardisation of handsets (which implies standardisation of the handset/network base-station interface) is the most efficient way of doing this. In addition, the complexity of the infrastructure required to produce cellular networks produces significant economies of scale at levels above that required to satisfy one network in one country. GSM standardisation relates to both these issues by standardising the way in which handsets and base stations interact, thereby enabling roaming and the development of a European (and wider) market for equipment.

Finally, the ability of the service provider (usually a network provider) to bar roaming on a network-by-network basis means that standardisation does not automatically result in functioning interoperability between a handset and all mobile networks. As a result, the commercial extent of roaming is generally one where customers can roam on networks not in direct competition with the customer's service provider, but cannot roam on directly competing networks (ie, international roaming is possible, but national roaming is not).

In summary, the pressure to standardise mobile telephony was derived from the important goals of delivering international roaming and achieving economies of scale in manufacture of network hardware.

[31] The US competition enforcement bodies have been investigating Microsoft's practices since 1990. Microsoft signed a consent decree in 1994 that settled four years of anti-trust investigation. In 1997, the Department of Justice filed a complaint that Microsoft had violated its consent decree with regard to practices concerning Internet Explorer.

[32] In practice, interconnection of networks is largely standardised, as this simplifies the provision of end-to-end services. This standardisation occurs across many different types of network, including both fixed and mobile, but at any time is not necessarily complete. Some services may only operate within one (operator's) network, or within one type of network.

A3.1.3 Internet communication

The Internet is a giant network of interconnected computers. Unlike telephone networks (including GSM networks), the Internet does not achieve end-to-end communication by creating a dedicated transmission path through predefined points of interconnection, but by packet switching individual packets of data which may travel across the Internet in different paths. As paths are not defined in advance, every packet of data must be read by every router that a packet encounters. As any packet can encounter any router in any attempt to get from the point of origination to the point of destination, all routers must be able to read all packets. This method of communication provides a much higher degree of security in communication, since no single part of the network is critical. Standardisation of the addressing and routing systems is therefore a fundamental feature of the way the Internet is designed. The result of this is a very large network to which an even larger number of users are connected and individually addressable. The core Internet service is the ability to send data between any pair of Internet addresses.

However, notwithstanding that the method of transporting data from one place to another is standardised across the Internet, the way in which services are provided *over* the Internet is not necessarily standardised. Content suppliers on the Internet can supply more or less any type of content, or application, via the Internet, and this material or application may, or may not, be understandable by the receiver depending on whether the receiver has the appropriate software available on their computer. Most Internet services tend to run on browsers, typically Netscape or Microsoft's Internet Explorer. There is considerable interoperability between these browsers, so that, even though service suppliers may optimise their content for one particular browser, the service will run on the other.

Where service providers wish to address the entire population of the Internet, or cannot identify easily the sub-set of the Internet they wish to address, end-users (ie, consumers) tend to be supplied with the means of interpreting the service for free, over the Internet. For example, service providers wishing to supply long documents may well prepare those documents in Acrobat, with the software to enable these to be read available for free over the Internet. Web pages which require specific versions of browsers to operate fully will tend to indicate which version is required, and contain the means for the consumer to access immediately the required update (or additional plug-in). Although the economic incentives for interoperability are very high under these circumstances, interoperability is not guaranteed, and, in practice, failures of one sort or another are common. They are, however, usually not critical (ie, the consumer experiences some service, although not the best quality that is theoretically available), and can be remedied by end-users.

However, at the edges of the Internet, especially where specific user groups can be identified by service providers, other economic pressures can push operation away from full interoperability. As at mid-2002, a number of 'instant message' services were available which did not necessarily interoperate, thereby producing a set of isolated networks of this service. Given the underlying characteristics of this type of service, this may well be a battle *for* the market, such that, once a dominant service emerges, the network effects will ensure that all instant message services have to interoperate *on that standard*. There is a clear economic advantage for the owner of the intellectual property rights (IPRs) in such an outcome.

In addition, the *means* of access to the Internet, especially for domestic users, is not standardised. Internet service providers (ISPs) provide their specific customers with the means of using their gateway, which is different from the way in which other ISPs operate. However, these differences are, generally, not hardware-specific; the ISP provides the necessary software, using the Internet if necessary, for end-users to configure their computers so that all the proprietary protocols and APIs are installed on their specific machines. Access control (where necessary) is achieved through passwords.[33]

The Internet, as experienced by end-users, is therefore a combination of highly standardised transportation protocols leading to universal any-to-any communications. The desire for secure, any-to-any communication—ie, direct network effects—was the main pressure for standardisation.

In addition, fairly standardised protocols are used to provide most of the any-to-any services, with most, if not all, of these protocols available to end-users over the Internet for free. At the other extreme, service provision (ie, the ability to access the Internet at all) is not standardised, but individual service providers have proprietary means of supplying access to their own customers (often with a related service contract). The proprietary means of access is not hardware-specific, so consumers can freely choose their service provider.

A3.2 A matrix of key criteria to predict standardisation

The foregoing discussion allows key criteria to be derived that characterise the incentive to standardise—ie, the incentive to standardise in each of the three cases under discussion may be explained in terms of these criteria only. In this section these criteria are derived and discussed as they pertain to each of the three cases. In all cases, it turns out that, on the basis of these criteria, there was a very strong incentive to standardise.

Given a judgement that the incentive to standardise is high, an important question is what type of standardisation process will result. Brief consideration is given to the process by which standardisation developed.

This framework is then extended to include digital broadcasting, and the incentive to standardise. Possible standardisation mechanisms are discussed.

A3.2.1 Key criteria

The criteria that characterise incentives to standardise are as follows.

Importance of the standard for user-to-user communication (direct network effects). Strong direct network effects tend to push a market towards a single standard. However, such effects alone, may not result in a single *universal* standard where the communication issue between different standards (ie, interoperability) can be efficiently and effectively

[33] A protocol is a set of rules and conventions used to impose a standardised, structured language for communication between multiple parties. For example, a protocol might define the order in which information is exchanged between two parties. In fact, a data exchange can *only* take place between two computers using the same protocol.

overcome in other ways—for example, by defining interconnection interfaces. This is how telephony networks interoperate. Different standards in different networks may therefore co-exist when user groups are well-defined and effectively bounded, so that translations of operating protocols at interconnection boundaries are manageable and reasonably economically efficient.

Network effects may, however, create pressure for a single universal standard when interoperability between networks cannot be achieved in any other way, or when consumers are undifferentiated, making the identification of bounded markets more difficult.

Importance of economies of scale in applications writing (indirect network effects). Strong indirect network effects will also push a market towards a single standard. Again, however, this is unlikely to be sufficient, on its own, for the establishment of a *universal* single standard. If user groups can be differentiated then several standards are more likely to be able to co-exist. For example, it may be possible to differentiate user groups by specialism or language. If so, applications developers may themselves choose to write applications for specific groups, and not the consumer body as a whole. Thus, the indirect network effects are bounded by the group, and different groups may well choose different standards. An example of this is the Apple computer, which has long been the system of choice for graphic designers.

Where users are not easily differentiated, however, strong indirect network effects may cause the whole market to tip to a dominant universal system.

Importance of controlling customer equipment directly (network management issues). Network management involves ensuring that all the services work on a network, and that consumers receive an appropriate level of service and care. In some cases, network management issues are eased by a common standard, which may be local to a particular network, or may apply universally across different networks. In other cases, network management issues are eased not by imposing a standard, but by controlling tightly the make-up of the equipment on the network.

There are therefore circumstances under which some network management issues *may* be best served by a universal common standard; equally, there are other situations in which the approach to network management issues is solved independently by individual network operators.

Importance of end-user mobility (ie, geographic) and portability. Here, mobility is used in the sense of physically moving equipment between countries and being able to use it (abstracting from issues relating to plugs and sockets). Such mobility may not necessarily require a common standard. Certain issues of interoperability will have to be solved, although this may be done in other ways.

Portability is used in the sense of being able to access the same services on different networks. This may be a strong enough incentive to require standardisation if defining interfaces are not sufficient to achieve interoperability.

Ability to deliver further economies of scale in hardware manufacture (ie, extra economies, associated *purely* with standardisation). Economies of scale refer to the existence of fixed costs of production so that the average cost per unit falls as output increases. This criterion refers to further effects on per-unit costs that arise *because* of standardisation. Such economies of scale may be hard to identify, but if there are substantial benefits of this nature to be gained from standardising, this may be a strong incentive for a standard outcome. It may not, however, be a sufficient incentive, since smaller manufacturing interests may fight any standard, as it may compromise their survival. A coordinated approach may be the only way to achieve these benefits.

Table A3.1 lists these criteria. Each criterion is then applied to each of the three cases under discussion, and is assigned a qualitative ranking. The application of the criteria to each case is then discussed. It is important to bear in mind the key question when interpreting this table: *in each case, does the criterion under examination push towards a single standard or not?*

Table A3.1: Criteria describing pressure to standardise in the three industries

	Operating systems	Mobile telephony	Internet
Standard:	**Windows**	**GSM**	**TCP/IP**
Criteria			
Importance of the standard for user-to-user communication (direct network effects)	Medium	Low	V. high
Importance of economies of scale in applications writing (indirect network effects)	V. high	Medium	Medium
Importance of controlling customer equipment directly (network management issues)	Low	High	Low
Importance of end-user mobility (geographic)	Low	V. high	Low
Importance of end-user portability	Low	V. high	Low
Ability to deliver further economies of scale in hardware manufacture (ie, extra economies, associated purely with standardisation)	Low	V. high	Medium

Note: Low means that the criterion does not create incentives to standardise; high means that it creates significant incentives to standardise.

Importance of the standard for user-to-user communication (direct network effects). Telephony and the Internet are both examples of large direct network effects since it is this feature that defines them both. In the GSM case, however, the GSM standard does not affect user-to-user interconnection. GSM is about interoperability between handsets and base stations. Thus, while the direct network effects associated with mobile telephony are significant, in this case they are not contingent on standardisation as implemented by GSM, but on the limited standards required for network interconnection.

However, the large direct network effects in the Internet are contingent on a standardised communications layer. There may well be interoperability problems at higher levels, but basic standardisation at the transport layer ensures communication between any pair of machines connected by the Internet. Standardisation is of critical importance because of the packet switching process used to communicate; communication based on packet switching could not be as efficiently achieved if several protocols were in use.

For operating systems, user-to-user communication is facilitated by applications written for the same operating system. However, at the time of the operating system standards battle (ie, before the Internet), this feature was not of the same relevance as it is today, and therefore not a major factor in determining an emerging single standard.

Importance of economies of scale in applications writing (indirect network effects). In all three cases, there are indirect network effects. The impact on the development of a single standard was most acute in the case of operating systems—the indirect network effects were probably *the* factor that ensured that one operating system would assert itself. Consumers benefited from the proliferation of applications written for a single operating system; applications developers had few ways of differentiating between consumers, thus the response was to write applications for the operating system with the largest installed base.[34] The result was that, in the presence of undifferentiated consumers, strong indirect network effects were sufficient to tip the market to a dominant standard. This was further cemented by the development of direct network effects, and the breakdown of clear boundaries defining user groups (such as nationality or language), as opportunities for exchange of data and information increased with the growth of the Internet.

In the other two cases, such indirect network effects are 'nice to have' and can be exploited now, but were not critical to the issue of whether one standard would emerge. Rather, the indirect network effects have developed on the back of a standard. An example might be multi-media services that are GSM-compatible.

Importance of controlling customer equipment directly (network management issues). The only case where network management issues are very important, and facilitation by a standard is relevant, is mobile telephony. The networks require active management to ensure that each consumer receives services appropriately, and that the system's security and integrity are not compromised. As noted, networks could achieve this independently, but it is the feature of portability across networks in mobile telephony (ie, roaming) that emphasises the importance of the handset/base-station standardisation that GSM ensures. In the absence of this feature, the ability to manage the network would be no less important, but it may be possible to solve the problem efficiently without requiring the use of a common standard.

The degree to which such active management is important to standardisation in the cases of operating systems and the Internet protocol (IP) is much lower. In the case of Internet communication, network management issues are solved by the robustness of the protocol.

Importance of end-user mobility and portability. Mobility *and* portability are highly relevant to mobile telephony: together, they constitute roaming. The fact that subscribers move between networks means that interconnectivity could not be achieved by writing interfaces, as had been the case in fixed-line telephony. The possibility of roaming was probably the major factor dictating a single standard outcome in mobile telephony.

[34] This was further influenced by the high re-authoring costs involved in developing an application for more than one system.

In the case of operating systems, such mobility is not really relevant since use of operating systems tends to be an independent, static process. Individuals may, however, want to use different applications on different operating systems—ie, portability may be important. This is assigned a 'low' in Table A3.1 because there was little incentive to achieve this at the time of the standards battle.

Mobility and portability with reference to TCP/IP are both defined as 'low', despite the fact that consumers expect to be able to use their computer on the Internet from anywhere (subject to payment and access). Mobility is more defined by the provision of access, which may well be through a proprietary system. Assuming access, the standard communication protocol ensures that communication is possible. Portability is less relevant since there is only one Internet.

Ability to deliver further economies of scale in hardware manufacture (ie, extra economies, associated purely with standardisation). The ability to deliver extra economies of scale in manufacturing due to the existence of standardisation is most obvious in mobile telephony. In particular, a single standard allowed economies of scale to be achieved in the manufacture of pieces of large network infrastructure, such as base stations. Standardisation prevented market fragmentation and allowed cost savings. This was an important motivation in the achievement of a single standard.

In the cases of operating systems and the Internet, there are probably few, if any, economies of scale in hardware manufacture that depend on the existence of a single standard. Manufacturers of routers for the Internet may have benefited from the one standard, but this was not a motivating factor.

In summary, the fundamental drivers of standardisation in each case were as follows.

- In operating systems, the value of indirect network effects to the consumer were, in the presence of undifferentiated consumers, important to standardisation. The difficulty that applications developers experienced in differentiating user groups was critical, since their strategy was simply to develop applications for the largest installed base. In turn, consumers chose hardware with the most software written for it. Ultimately, consumers benefited from the proliferation of applications written to, as it turned out, Microsoft Windows, and a positive spiral ensued. The presence of IBM and the clones in the hardware market were also important in the development and diffusion of indirect network effects.

- In mobile telephony, the main criteria in driving for a single standard were those defined as objectives by the GSM working group: roaming and economies of scale in production. A single standard was the only effective way to deliver these service objectives.

- With respect to TCP/IP and the Internet, the direct network effects turn out to drive the need for a standardised interconnectivity protocol. The benefits to standardising this layer at the time of inception outweighed any costs associated with imposing a standard, especially within the design framework of achieving connectionless communication for security reasons. Since then, the benefits of maintaining this fundamental communication protocol have largely outweighed the costs associated with standardisation (such as slowed innovation). The possibility of building on top of the transport layer has allowed development of the Internet independent of this layer.

Given high incentives to standardise in all three cases, it is worth considering briefly the various ways in which standardisation came about.

The actual process of introducing standardisation depends on the level of vested interests (ie, the degree of agreement over the choice of standard. A high level of vested interest in the standard indicates conflict; a low level indicates coordination.[35]

In the operating system case, there were strong incentives to standardise, but little agreement on the choice of standard. This is a classic case of 'conflict' standardisation, where each participant seeks to maximise private gains, even though it is recognised that some kind of standardisation would best serve the market *anyway*. The standards battle is enacted through competition for the market place, and the dominant firm attempts to establish a de facto standard. Other firms may then be forced to adopt the technology preferred by the dominant firm. Trying to establish a single standard among many and varied vested interests can serve to fracture a standardisation process, and emphasise the differences rather than the shared features. Microsoft essentially won the race to become the market standard.

In the case of GSM, the standardisation process was more a coordination case, where a high degree of consensus existed on the need for a common standard alongside 'low' preference over the choice of standard. Preferences were low due to the involvement of national governments as well as the European Commission, and there were well-defined goals.

The case of the Internet and communication also reflects a more consensual mode of choosing a standard, but the motivations and process were quite different, compared with the GSM case. In the case of the Internet, a standardised protocol was the only way of achieving connectionless communication, and was, in any case, more or less imposed by the US Department of Defense on early participants.

The foregoing is summarised below.

[35] Besen, S.M. and Saloner, G. (1989) 'The Economics of Telecommunications Standards', in R.W. Crandall (ed), *Changing the Rules: Technological Change, International Competition and Regulation in Communications,* The Brookings Institute, Washington DC.

Table A3.2: Summary of standards setting in the three industries

Criteria	Operating systems	Mobile telephony	Internet
Incentive to standardise	High	High	High
Vested interested in standard choice	High	Low	Low
Standards process	Competition to determine the standard	Coordination	Imposition
Outcome	Dominant standard	Single standard[1]	Single standard

Note: [1] This refers specifically to standardisation between base stations and handsets.

A3.3 Application to digital broadcasting

The structure and nature of the market for digital broadcasting mean that the network effects are slightly different, and probably weaker than in the cases discussed above.

In general, two points can be made:

- there are (as yet) few direct network effects—ie, user-to-user communication is not critical to the service offering. While such communication may be held to be an important part of the various business models, it remains unclear how this will develop and whether consumers will turn to their television set (rather than their PC or mobile phone) for communication purposes. Furthermore, a single API may be neither necessary nor sufficient to achieving user-to-user communication. A single middleware standard is therefore unlikely to be motivated by the power of direct network effects; and

- the indirect network effects are important, but it is still unclear how significant re-authoring costs are. Applications are being developed, such as electronic programme guides (EPGs) and enhanced television, but the proliferation of meaningful applications to the benefit of consumers and applications developers alike is still nascent. In addition, consumer groups are easier to define in the case of digital broadcasting.

Furthermore, the separation into non-subscription and subscription digital broadcasting sectors means that the criteria defined above may look different in each of these, leading to different incentives to standardise (or not). In particular, the subscription sector is characterised by a well-defined user group (ie, access is limited, and all consumers have an individual, ongoing, contract with the service supplier), and strong incentives on the service supplier to manage the level of service that this group receives. This means that network management issues can be very important. In non-subscription broadcasting, there is almost no concept of a 'bounded network' since the broadcaster does not aim to differentiate between potential users, and has little ongoing responsibility for the continued operation of the installed base of consumer equipment.

A3.3.1 The matrix of key criteria including the case of digital broadcasting

Table A3.3 repeats Table A3.1 above, but includes the application of the identified criteria to the case of digital broadcasting. The application of the criteria is discussed below.

Table A3.3: Table of criteria describing pressures to standardise in the three industries and digital broadcasting

Criteria	Operating systems	Mobile telephony	Internet	Broadcasting	
				Pay	FTA/PSB
Standard:	Windows	GSM	TCP/IP	'an API'	'an API'
Importance of the standard for user-to-user communication (direct network effects)	Medium	Low	V. high	Low	Low
Importance of economies of scale in applications writing (indirect network effects)	V. high	Medium	Medium	Medium	Medium
Importance of centre controlling customer equipment directly (network management issues)	Low	High	Low	V. high	High
Importance of end-user mobility (geographic)	Low	V. high	Low	Low	Low
Importance of end-user portability	Low	V. high	Low	Low	Medium
Ability to deliver further economies of scale in hardware manufacture (ie, extra economies, associated purely with standardisation)	Low	V. high	Medium	Low	High

In digital broadcasting, neither direct nor indirect network effects are asserting strong pressure towards a single standard in either sector. In the case of operating systems and Internet communication, at least one of these was very important to the value to users of the product or service.

Even if there were strong indirect network effects and undifferentiated consumers, the pressure to tip would in any case be rather different than for Windows. Pressures to tip result from access to a greater pool of complementary products—ie, tipping pressure emanates crucially from the demand side. However, in digital broadcasting, the extra applications made possible by the interactive capabilities of APIs are not yet the primary characteristic of service delivery, in contrast to the importance of software in computing. The primary linear broadcasting features of digital broadcasting are already largely standardised.

There may be greater tipping pressure in broadcasting from the supply side, related to the advantages from putting a specific API into a decoder. Platform operators and FTA broadcasters will select the API that:

- minimises costs (for example, considering re-authoring and legacy equipment); and
- maximises potential revenues (for example, through more application development).

In the case of pay-TV, where the platform operator has an ongoing relationship with its customers for the supply of content, this operator will know the configuration of decoders on its network and will probably have a commercial relationship with an API provider. Such operators will therefore choose the API to best suit their (private) business goals (with reference to the two objectives above).

In the FTA/PSB sector, on the other hand, such knowledge of the customer device does not exist. There is also no incentive *not* to use the same API as the rest of the industry. The choice of API rests more upon the manufacturers themselves in consultation with the industry, as well as any decisions reached by standards bodies such as the Digital Video Broadcasting. There may therefore be more pressure in this sector to coordinate, or at least less incentive to perpetuate with individual middleware systems.[36]

In summary, the limited nature of network effects implies that the case for market-driven tipping in middleware in digital broadcasting across both sectors is less convincing than in the case of operating systems.

Geographic mobility is of little influence here (unlike mobile telephony) since it would only apply to those people moving countries. However, in the case of portability (ie, the ability of one STB to receive services from different platforms), incentives to standardise may differ between the pay and FTA subscribers. In the subscription sector, there is little incentive for this to happen, for commercial reasons (this is akin to the GSM national roaming case)—it implies loss of control of the installed base, and such portability could complicate network management problems and compromise the integrity of the network. In the non-subscription sector, broadcasters are likely to be mildly positive to the possibility of a receiver that moves between platforms, if only because there may be economies of scale in production. However, the price of achieving that mobility, even with any concomitant economies of scale, needs to be balanced with the perceived value of the mobility to ensure that the market develops. In most countries there is not yet enough variety of content to make consumers want to change platform and/or provider, and, if re-authoring costs are low, this provides a way of ensuring that all material can be transmitted on different platforms in any case. In terms of portability achieved through re-authoring, the non-subscription sector would like to benefit from the reduced costs of a more standard authoring environment, resulting in more content. In the subscription sector, on the other hand, platform operators appear less concerned about re-authoring costs in the context of managing the network effectively.

Pressures to standardise differ between the two sectors in terms of the solutions to network management issues and the achievement of economies of scale in hardware manufacture as a result of standardisation of middleware. These economies of scale arise due to the reduction of testing and diversity costs that manufacturers face. It turns out that

[36] Any pressures to deviate would relate to whether a particular PSB's target audience had very different tastes and thus formed an identifiable group for which content could be specifically authored.

these two factors interact in different ways in subscription and non-subscription digital broadcasting, to produce quite different incentives to standardise.

In the subscription sector, the 'network' is well-defined—it exists from the operator's infrastructure (the 'centre') to, and often including, the STB. The relationship between consumer and operator is defined and maintained by an ongoing contract, hence access is exclusive and controlled. The operator is the body responsible for the delivery of consistent, secure and functioning services to the customer over the network—this is 'network management', and is an ongoing, active task. Operators want to engage in this task while they perceive that the network is fragile enough that they cannot ensure its integrity in any other (as) cost-effective way. The subscription sector is also characterised by not putting much weight on 'portability', in the sense of being able to access services *other* than the pay-TV operator's from the same STB. Since the pay-TV operator has often financed the STB, there is little commercial incentive for the operator to allow it to be used for other services (again, this is the situation of national roaming under GSM, which is barred for commercial reasons).

For subscription operators, network management is therefore an important, but high-cost task, but portability is not. Operators naturally want to achieve network management in the lowest-cost way. The solution to this problem that has emerged over time is a combination of a closely controlled network, together with a limited number of well-known, highly specified (ie, non-portable), consumer STBs. The cost of active management is explicit, and an activity that is clearly undertaken by the operators. With respect to STB costs, operators would like to take advantage of further economies of scale, but the potential for achieving cheaper boxes through a standardised API and greater volumes may result in increased network management costs or a degraded service.

In the non-subscription sector, the 'network' is much less clearly defined, although broadcasters still want to ensure the delivery of consistent, secure and high-quality services—ie, network management is still relevant to an extent. The broadcaster often has an interest in securing the widest audience possible (ie, there is, in general, no interest in circumscribing access to content, as there is in the subscription sector), but has little interest in managing the receiving equipment. Hence the 'network' is more amorphous and has no defined boundary. This has several implications:

- the STB may be a shared facility;
- there is often no well-defined ongoing contract between the broadcaster and the consumer—in fact, the broadcaster may not always know exactly who is receiving its services; and
- any individual broadcaster has only a limited interest in ensuring that the STB works as it should, since it is a shared facility that may be used to receive diverse broadcast services (the 'free-rider' problem). In reality, broadcasters are likely to be indifferent as to whether portability is feasible or not—ie, they have no overwhelming incentive to block it.

As a result, there is no clear responsibility for managing consumer equipment, as there is little economic incentive to do so (manufacturers will probably not want to assume total responsibility, beyond, say, an initial time period). This means that the end-user must take responsibility (as in the computer model).

In the non-subscription sector, therefore, the broadcaster must solve the issue of network management with as little reference to any specific STB as possible. It is therefore much more important that the box is 'robust'. In the context of APIs, this means a middleware that is very robust. This may not necessarily be the lowest-cost middleware, but obviates the need to manage the network actively. As there is no incentive to limit access and standardising may result in economies of scale, it appears that the lowest-cost solution to the network management problem in FTA may be a single, robust standard. This puts more of the cost of the solution to the network management issue on the consumer, via a robust STB that is likely to be more expensive than a non-robust one.

STB costs are expected to fall somewhat with a standard API, as this would allow a simplified testing environment for manufacturers—ie, economies of scale would exist with a standardised box. Cheaper consumer equipment implies more rapid diffusion into homes.

In summary, in the case of the subscription sector, the importance of the network management issue combined with the less relevant issue of economies of scale attained through standardisation result in little incentive to standardise. The lowest-cost solution to network management is tight specification and control of the precise equipment deployed. In the non-subscription sector, on the other hand, the two factors combine in such a way as to motivate pressures to standardise to a *robust* middleware—this is the lowest-cost solution to ensuring integrity of the network without requiring some organisation to have a continuing role in actively managing the network of consumers' STBs.[37]

There are useful similarities between the GSM case and digital broadcasting. In both cases, issues of network management are extremely important. However, in the GSM case, the very fact of roaming means that network/handset management is a shared function, and it is therefore greatly facilitated by standardisation (indeed, it is only really achievable through standardisation using a very robust specification). This is paralleled in the non-subscription sector, where there is no clear incentive to limit roaming/portability, and broadcasters need some way of obviating the need to manage actively. STBs. The solution is a robust standard. Furthermore, in the GSM case, there is a limit on roaming nationally for competitive reasons. This is paralleled in the subscription sector of digital broadcasting, where there is no incentive to allow portability between platforms.[38]

The issues of network management combined with portability or roaming can be presented in the form of a table. Table A3.4 illustrates the main points for both sectors of broadcasting and for GSM, to highlight the similarities and the differences.

[37] However, this latter solution would result in the consumer paying for a higher-cost device, which may inhibit digital penetration.

[38] Because there is an ongoing commercial relationship with the mobile customer, up-front handset costs can be reduced through subsidies, followed by higher call charges.

Table A3.4: The interaction of network management issues and portability on pressures to standardise

	Is active network management part of the business model?	Is portability an important customer feature?	Outcome
GSM	Yes	Yes	A robust, single standard is the only way of achieving this outcome
Subscription television	Yes	No	The lowest-cost solution to the network is decided independently through a business model. This includes solutions using non-standard APIs, which are relatively unstable
Non-subscription television	No	Yes	The lowest-cost solution is a robust API. In the presence of economies of scale and indifference to roaming, this points to a *single*, robust API

Turning now to the issue of the standards process, Table A3.5 is a repeat of Table A3.1, but includes digital broadcasting split into two sectors.

Table A3.5: Summary of standards setting in the three industries plus digital broadcasting

				Digital broadcasting	
Criteria	**Operating systems**	**Mobile telephony**	**Internet**	**Pay**	**FTA/PSB**
Incentive to standardise	High	High	High	Low	High
Interest in standard choice	High	Low	Low	Medium	Low
Standards process	Competition to determine the standard	Coordination	Imposition	'Private good' case: standard may not arise	Coordination
Outcome	Dominant standard	Single standard	Single standard	Co-existence of incompatible technologies	?

In the subscription sector, the combination of a low incentive to standardise and a high level of interest in the choice of standard has been denoted the 'private goods' case.[39] In this case, there *may* still be benefits to standardisation, but the distribution of those benefits will depend on the particular choice of standard. This means that firms will be sensitive to the choice of standard. Absent a dominant firm, a standard is therefore

[39] Besen and Saloner (1989), op cit.

unlikely to come about voluntarily, and participants may not welcome the intervention of an external standards body to coordinate the process.

Possible scenarios in trying to set an open standard include the following.

- If coordination is attempted, the process can be hindered as each party tries to promote its favourite technology, or prevent a different choice being made. This can result in stalemate, with no choice of standard. As a result, the market is characterised by the use of incompatible technologies simultaneously.

- A standard may arise eventually through the market, asserted by a dominant firm. However, the dominant firm may be opposed to its standard becoming an open standard if it fears that its rivals will be able to make profits at its expense by making products that are compatible with the standard. It may prefer its dominant technology to remain proprietary.

- Government intervention may be able to break the stalemate and 'force' standardisation, but this may itself be a controversial move.

- There may be no or reduced technological advance, due to the absence of a standard.

This private-good characterisation seems to describe the situation in subscription digital broadcasting reasonably well. There is low incentive to standardise on middleware, although there may be some benefits, ultimately, in doing so (eg, reduced re-authoring costs). There are industry-driven attempts to create a standard, but the process does not appear to have delivered a solution the subscription sector can implement. The subscription market is therefore characterised by the co-existence of several incompatible APIs.

In the FTA/PSB sector, on the other hand, the incentive to standardise is high, driven by the desire to minimise STB costs through the attainment of economies of scale in the management and testing of a 'standard' box (and so to aid penetration), and by the desire to ensure a secure and integral network without the need for active management. Other advantages of standardising the middleware would be the desire to reduce re-authoring costs and to reach as large a target audience as possible (particularly relevant to advertising-funded broadcasters).

This high incentive to standardise combines with a low level of interest in the chosen standard based on the economic incentives facing broadcasters. The economic analysis suggests that there will be a quite strong incentive to coordinate around one of the already available open standards, such as MHP or MHEG5; However, non-economic factors may influence the standard-setting process.

A3.4 Summary of analysis

This analysis has illuminated the pressures to standardise or not in digital broadcasting, by reference to other network industry sectors that appear to exhibit similar economic and structural characteristics.

In all of the three industry cases discussed initially, standardisation was overwhelmingly driven by at least one of the identified criteria. In the cases of operating systems and IP, indirect or direct network effects were sufficient to result in a single standard, regardless of the process used to get there. In the case of GSM, the objectives of portability and economies of scale were the pressures resulting in the single standard outcome.

No such strong effects are present in the subscription sector of digital broadcasting. Of the criteria identified as important to the emergence of a standard, only the issue of network management emerges as of importance. However, since there is low importance attached by the sector to portability across pay-TV platforms, the network management issue does not result in pressure for a single standard because each network is able to cope with these issues in an independent way. This usually involves control over the STB configuration, and thus economies of scale are achieved to the extent possible in this framework. Incentives to standardise are therefore low, and it is likely that different, incompatible middleware technologies will continue to co-exist until there is an advance that makes the choice of middleware irrelevant (without degrading the service opportunities), *or* until a economic incentive to standardise emerges.

In the non-subscription sector, the criteria identified as important were the issue of attaining economies of scale in STB management and production, and the importance of solving network management issues (ie, secure and high-quality service) *passively*. Currently, this is assumed to be possible through a robust, standard, API. Together, these two factors exert pressure for standardisation within the non-subscription sector. Incentives to standardise may therefore be high, and the attainment of the standard will depend on the level of vested interest in the choice of standard and ability to coordinate the process.

A3.5 Industry evidence

A3.5.1 Microsoft

Approximately 90% of PCs use Microsoft operating systems (Windows); the Windows family of operating systems has become a de facto market standard. They are, however, propriety, and those using Windows pay Microsoft for permission to do so.

For many consumers, this standardisation has provided a degree of confidence in the compatibility and interconnection between products.[40] Even where computers run other operating systems, it is highly likely that the other operating system is bundled with Windows (for example, the BeOS, marketed by Be, is an alternative operating system that is generally bundled with Windows).

This case is interesting because Microsoft achieved a virtual monopoly in an initially competitive technology network market without external intervention or regulation at the policy level. Effectively, Microsoft became the standard, and interoperability has either

[40] This analysis abstracts from any competition/abuse of dominance issues that have been associated with Microsoft.

become a moot issue because, in general, consumers only use Microsoft, or because interoperability has been developed between applications written for other operating systems (eg, Apple), or more specialist consumers require a completely different operating system environment where Windows does not compete. Indeed, the most crucial interoperability issue is probably now between different generations of Windows products and the incentives that Microsoft faces to write (or not) forward and backward compatibility into its products. This issue, however, is beyond the scope of the current analysis.

This sub-section considers how Microsoft achieved such a dominant position and the factors that enabled the establishment of a market standard without explicit coordination or cooperation. First, the role of an operating system is discussed; second, the economic characteristics are developed; and third, the Windows operating system is set into historical context and the development of the market. Last, the major factors that led to standardisation are considered.

The role of an operating system

A PC is composed of hardware and software: the former is made up of the physical components of the computer, such as the central processing unit (CPU) or microprocessor chip that performs numerical calculations, memory, disk drives and input/output devices; the software is machine-readable code that directs the processing unit in performing tasks, and is broadly either systems software (ie, operating systems) or applications software (although there is often an overlap between them).[41] The CPU and operating system are usually combined in fixed proportions, and are separated by the BIOS (basic instruction operating system) software that is burnt into the machine's ROM (read-only memory) chip.[42]

The operating system performs two critical roles:

- it controls the allocation and use of the main hardware computer resources;
- it supports the functions of applications software programs. Such applications are developed with a specific user task in mind. The operating system exposes APIs to the application software program. The application software has been developed with these interfaces in mind; the interfaces of APIs allow the application to access pre-written code in the operating system that performs critical tasks. It is this pre-written code that extends the potential functionality of the APIs and therefore of the operating system.

[41] Elzinga, K. and Mills, D.E. (1998), 'PC Software', Department of Economics, University of Virginia, mimeo, September.
[42] Baseman, K.C., Warren-Boulton, F.R. and Woroch, G.G. (1995), 'Microsoft plays Hardball: The Use of Exclusionary Pricing and Technical Incompatibility to Maintain Monopoly Power in Markets for Operating System Software', *Antitrust Bulletin*, **XL**:2.

APIs can also be ‘non-operating system’ and, as such, are termed ‘middleware’. Such middleware may or may not rely on the interfaces with its own operating system.[43] However, in either case, its role is to expose its own APIs to applications developers. Netscape and Java are examples of middleware in computing; OpenTV and Liberate are examples of middleware found in digital receiver equipment in broadcasting. These are examples of competing APIs in digital broadcasting, for which specific and (generally) non-interchangeable sets of applications are developed. There is little compatibility between such APIs, if any at all.

The economic characteristic of operating systems

PC software exhibits two specific characteristics that make its production and distribution costs quite different to other more ‘traditional’ product markets. These characteristics are important to understanding the development of the industry, and can help predict how other industries, with similar characteristics, may develop.

First, there are increasing returns to scale at all output levels. Most of the costs of producing software are the fixed development costs or ‘first-copy’ costs. This means that the cost of producing software decreases with volume; the marginal cost of production is thus very small (ignoring costs such as installation on the PC and any software support costs). As a result, fixed costs can be high and are generally sunk; marginal costs are negligible.

Second, there are strong network effects. A network externality exists when the value of consuming a particular product or service increases in the number of consumers that use compatible products or services.[44] All software, but particularly operating system software, exhibits such network externalities. These can be either direct or indirect.

If the network externality is direct, the value of the software to the user increases with the size of the installed user base—ie, its value is a function of the installed base. Indirect or complementary network externalities arise when the value of the software to the user increases as demand-side economies of scale or ‘consumption spillovers’ develop, whereby more applications are developed the more users there are. This is essentially a type of positive feedback effect between numbers of users of the same operating system and incentives to develop new software for that operating system.

The effects of network externalities in technology markets can be argued both positively and negatively for consumers, depending on the trade-off between network effects, relative advantages of a given standard and the costs of switching. On the positive side, technology markets tend to be very dynamic, hence any technological, market-defined standard will continually face potential technological competition to usurp it. There are

[43] An operating system is probably still necessary in order to control, for example, memory management and peripheral devices.
[44] Gandal, N. (1995), ‘Competing Compatibility Standards and Network Externalities in the PC Software Market’, *Review of Economics and Statistics*, **77**.

no special legal barriers to creating new technological solutions if one or more innovators are prepared to take the economic risk of developing a new solution. On the negative side, it can be argued that network effects reinforce one path of innovation over any other, or create 'dependency effects', since new buyers want compatibility with consumers who made the consumption decision earlier in time. Transitions based on innovation may then take on a 'step-wise' pattern, as any working standard may be difficult to overcome unless the gains are obvious and large. In operating systems, path dependency may make it hard for competitors to introduce a new (and better) operating system, since the challenge is not only to create a better product, but also to overcome the network effects created by the cumulative buying decisions and all the applications written for that system.

In general, network effects combined with rising returns to scale can increase the probability that a market will tip to one product; the co-existence of incompatible standards is unstable. A single winning standard comes to dominate the market, and displacing it, even with a much better standard, becomes extremely difficult.[45] Where there are significant vested interests in the choice of standard, competition is often fierce to become the standard, since the gains tend to be large—the outcomes are often classified as 'winner takes all' or 'winner takes most'.[46]

In network markets, *expectations* about the ultimate size of the market can prove as crucial in influencing tipping as the actual size, as consumer decisions are made on a forward-looking basis and their perception of how they expect to derive the most from the network good. This means that, even before a market has tipped, the best or cheapest product available on the market may not win the standards race, based on solely on being the best or cheapest. Because consumer expectations of which way the market will tip influence current purchasing decisions, the standard that wins may be the one that most consumers think will win—ie, a self-fulfilling outcome. From an economic point of view, the outcome of standards races is not necessarily efficient, even if they are market-driven.

It is worth noting, however, that markets do not necessarily tip completely; consumer diversity and user switching costs can create enough inertia that multiple products can persist, even if, in the medium term, considerable benefits would result from a single standard. This is also likely to be economically inefficient. Additionally, network effects can be bounded, perhaps by geography or by some other defining feature. A single standard could then be local to a bounded group. This may be economically inefficient because such local markets may not be able to benefit from the economies of scale (and

[45] Besen, S. and Farrell, J. (1994), 'Choosing How to Compete: Strategies and Tactics in Standardisation', *Journal of Economic Perspectives,* **8**.

[46] Note that the competitive nature of the standard-setting process can be reduced; one example is GSM discussed in section A3.2.1, where coordination managed to prevail. Another method is to introduce side payments to reduce vested interests in being the standard. In this case, private gains are still the motivation. *Source*: Besen, S. and Saloner, G. (1989), 'The Economics of Telecommunications Standards', in R. W. Crandall, *Changing the Rules*, The Brookings Institution.

other advantages) that would be available if the same standard were to used across all local markets.

Operating system software does not tend to exhibit direct network effects since its primary objective is not to connect individuals for communication, as a telephone network does. There are, however, indirect network effects. All other things equal, consumers will buy the computer with the most applications software available for it. Since applications software is generally written for an operating system, individuals end up choosing the operating system with the most applications ready for use. This can also lead to path dependency, as consumers familiarise themselves with one particular environment, and may well not want to incur the personal costs associated with switching environment. On the supply side, applications developers are often unable to differentiate user groups for which to develop specific applications. As a result, their best strategy is to write applications for the largest user group. The result is a proliferation of software written for a specific operating system, which in turn reinforces consumer choices. The interaction between these can create pressure to deliver a single *universal* standard.

A brief history of operating systems

The establishment of Windows as the (currently) predominant PC operating system software is the result of competition, commercial strategy and luck. Microsoft's success is intimately connected with decisions made by IBM, developers of hardware and software, and with its relationship with Intel.

The initial market in operating systems was reasonably competitive. The closest to a standard was arguably CP/M, developed in the mid-1970s. It ran on different brands of computers and was widely installed. It was not the only such software—another early operating system was the UCSD p-System, and Apple had written its own proprietary operating system for its own hardware.[47] These early software developments were based on 8-bit computers.

Then, crucially, in 1980 IBM licensed the DOS operating system from Microsoft for its first generation of PCs, but did not limit Microsoft itself using the product. IBM also chose Intel as the provider of the microprocessor chips. Intel chips did not support non-Windows operating systems, hence a symbiotic relationship started between the two, as choosing one generally implied choosing the other.

In 1981, the nature of competition shifted with the introduction of the 16-bit IBM PC. Competition not only developed between different operating systems, but between 8-bit and 16-bit systems. Between 1981 and 1983, IBM pulled ahead and PC-DOS/MS-DOS[48] began to emerge as the operating system standard. This system allowed a single user to

[47] However, it was possible for the Apple II to run CP/M once a SoftCard had been written by Microsoft (then a computer languages company).

[48] MS-DOS was the version of the operating system licensed by Microsoft to other manufacturers; PC-DOS was the IBM disk operating system developed by Microsoft.

run a single program and used Intel microprocessors. It pulled ahead due to a combination of factors, but chiefly the fact that the rival CP/M product for 16-bit computers was late and expensive.[49] This happened despite the existence of many applications already written and in use for the CP/M operating system software which could not be run by the new MS-DOS microprocessors. New software had to be developed, including products such as Lotus 1-2-3, word-processing and database programs. This proved compelling enough to induce consumers either to switch systems and relearn, or to venture into computing for the first time. The emergence of MS-DOS hinged on the success of the IBM PC, but also on Microsoft's ability to license MS-DOS for its own account—at the same time as licensing IBM to use and produce DOS, Microsoft had retained the rights to license other manufacturers.

The creation of an 'IBM standard' ultimately benefited Microsoft, as the operating system turned out to hold the economic power. The wide dissemination of the operating system was driven both by the IBM brand name, which inspired considerable confidence, but also by the development of IBM-compatible clones by OEMs, to which Microsoft was able to make available the operating system.[50] As a result, the installed base of IBM PCs and clones, complete with a Microsoft operating system, grew very rapidly. Demand for operating system software is complementary with demand for hardware; increasing demand for PC hardware thus increased diffusion of MS-DOS and aided the development of indirect network externalities. In other words, the large installed base prompted developers to write applications, which ultimately resulted in strong enough network effects to tip the market.

However, despite this initial success, there was still considerable competition during the 1990s. Microsoft reacted to the competitive pressure by shipping new versions of MS-DOS in the late 1980s and early 1990s, and developed Windows Operating Environment in the mid-1980s[51] as a graphical user interface (GUI). Windows did not, however, achieve much commercial success until Windows 3.0 in the early 1990s, and did not develop features comparable with the Apple Mac until 1995 (Windows 95). Apple suffered because, while its operating system was generally thought to be very good, it was relatively more expensive and had relatively less software available for it. In addition, there were no cheap Apple clones, as the Apple operating system was not available to install on non-Apple computers. Unless individuals had a particular reason for choosing Apple, most consumers were likely to choose a computer with Windows 95, which was relatively cheaper due to large manufacturing runs (by IBM and clone manufacturers together), had more software and had improved considerably in terms of usability.

The beginning of Windows' success in the early 1990s was based on increased usability and applications being developed for it, such as Excel, Word and Powerpoint. These

[49] Evans D., Nichols, A. and Reddy, B. (1999), 'The Rise and Fall of Leaders in Personal Computer Software', NERA.
[50] The ability to build a clone depended on manufacturers reverse-engineering the ROM BIOS chip which controls the lowest-level functions of the PC. This was one of the only portions of the PC to which IBM held a copyright.
[51] http://www.usdoj.gov/atr/cases/f3800/msjudgex.htm

eventually came to be bundled together in the Office suite, which dominated the market for such products. There were also advances in hardware that allowed computers to be built with enough speed to handle GUIs. Continuing improvements (notably achieving true WYSIWYG) allowed Windows to move ahead of other DOS-based products. In 1995 Microsoft effectively bundled the operating system and GUI together—Windows 95 replaced MS-DOS and previous versions of Windows. Windows 95 and updates continue to be used widely.

Factors leading to standardisation in operating systems

The fact that Windows won the standardisation battle to become the de facto industry standard is really only of secondary importance to this analysis. The fact that Windows dominated is at least in part due to luck, among other circumstantial factors. For example, the decision by IBM to enter an arrangement with Microsoft was critical to the latter's future. With IBM's presence in manufacturing, the operating system enjoyed rapid diffusion, combined with the fact that Microsoft was able to benefit financially through licensing agreements with the manufacturers of IBM clones. The fact that the *operating system* turned out to be more important from an economic point of view was an additional bonus that was perhaps unforeseen at the time.

The relevant lesson for a generic analysis is why the market resulted in a dominant standard. The answer is in the nature of the indirect network externalities, combined with the fact that applications developers could not distinguish between users, and therefore wrote applications for an undifferentiated consumer group. Consumers benefited from the proliferation of applications for one standard, and so tended towards this particular standard. This in itself lead to path dependency effects among consumers, further linking them to the one operating system. These combined effects were sufficiently strong that it was always likely that one standard would eventually dominate in the market.

A3.5.2 GSM

GSM is the network compatibility standard for 2G digital cellular mobile telecoms in Europe. It is an open, non-proprietary, interoperable standard. The aim of the GSM specification is to describe the functionality and the interface for each component of the system, and to provide guidance on the design of the system.[52] GSM technology allows roaming, data transmission, receipt and sending of faxes, secure encryption, short messaging service, email and Internet access. GSM services were first delivered in 1991.

The GSM case is an important example of cooperative standard setting. Its success depended (and depends) upon the ability to roam across networks internationally, as well as upon the ability to bar roaming nationally for competitive reasons. Work towards establishing the standard began in 1982, following on from development in different countries to establish (incompatible) analogue mobile systems, and work started by the

[52] http://www.comms.eee.strath.ac.uk/~gozalvez/gsm/gsm.html

Scandinavian consortium NTM to establish a mobile standard in the Scandinavian market. The first step towards a GSM standard was motivated by:

- incompatibility between the existing analogue systems, meaning severely limited opportunities for roaming;
- high prices per user for infrastructure and mobile base stations; and
- limited capacity of first generation networks.[53]

The GSM standard has been a significant achievement. It now has around 32m subscribers in over 100 countries on over 130 networks, and is forming the basis for the evolution towards the 3G mobile system. Developing GSM required intense cooperation and coordination between many different participants from private and public bodies across Europe and across the industry. This section considers how this cooperation was initiated and maintained, focusing on the critical factors that were present in the development of GSM.

Critical success factors in the standardisation of GSM

In general, cooperative standardisation does not emerge in an industry with both well-established dominant incumbents and network externalities. In such a market, incumbents would be expected to perhaps see the value of a common standard, but to have a significant vested interest in being the institution to establish the market, and, in so doing, 'win' the market. These dynamics can cause conflict and fragmentation (even when there is some agreement) in standard-setting processes.[54]

In the case of the development and implementation of GSM, cooperative standardisation by well-established incumbents was achieved. The market agreement on the importance of a universal standard was accompanied by willingness to approach the standardisation through coordination, rather than through competition, and incentives to participate were sufficient.

An important question is why did standardisation arise? There were several factors that were critical to bringing the standardisation process to fruition (briefly discussed below), but the key factors lie in the objectives of the project.

GSM's guiding objectives

The participants had at least two clear and guiding objectives, against a background of the development of non-interoperable analogue mobile systems along national lines. First, the offering had to be better than the existing fixed network and mobile analogue systems. Two aspects were important:

[53] Bekkers, R. (2001), *Mobile Telecommunications Standards: GSM, UMTS, TATRA and ERMES*, Artech House.
[54] Besen and Saloner (1989), op. cit.

- international roaming—this implied full interoperability across Europe, which meant greater levels of cooperation; and
- digital technology—this technology was unproven at the time, but there was a certain amount of belief that it would be able to deliver a significantly enhanced service compared to the existing analogue networks, particularly in terms of advanced telephony features, such as data transmission.

An industry Memorandum of Understanding, which specifically allowed for full interoperability across Europe (ie, the ability to use any GSM handset on any non-domestic GSM network), was important to achieving this first goal. It committed participants to: international roaming services; an open, non-proprietary standard; and independent testing on compatibility. Second, the structure had to be able to deliver economies of scale in production.

These two key objectives could only be wholly met through a single standard being adopted across a large number of national markets and nationally based networks. In the case of international roaming, unlike in fixed-wire systems, incompatible mobile networks could not be made to work together through gateways, since the consumers move with their own equipment (ie, handset) *across* networks. A call must be capable of being handled and passed between base stations on different networks, as appropriate, and the customer must ultimately be charged appropriately. This calls for standardisation between the handsets and the base stations of multiple networks.

In the case of achieving economies of scale, the single European market was deemed necessary, in terms of size, to ensure 'critical mass', particularly in the markets for larger capital equipment, such as base stations. Open and detailed specification would, however, ensure that supply was competitive, particularly the supply of handsets.[55] Achieving a single market of this size calls for standardisation across multiple national markets.

Other contributory factors

Given the strong pressures to standardise, derived from the key objectives of the project, the actual process was facilitated by a number of institutional contributory factors. In brief, these were as follows.

- **Industry commitment**—active industry commitment was particularly important to maintaining openness of the standard, despite many obstacles and many opportunities for it to have been diverted or appropriated. The tension between IPRs and standardisation is a good example of this. Industry commitment, and thus the credibility of the GSM project, was solidified in 1987 by the development and signing of a Memorandum of Understanding by telecoms operators. This Memorandum of Understanding served to define the commitment to the GSM

[55] Notwithstanding this, there was a concentration in the equipment market in the process of moving from analogue to digital.

project and the intended outcomes. The commitment had credibility and this helped reduce uncertainty among manufacturers, the public and other industry suppliers.

- **Industry structure**—the European telecoms market at the time was dominated by national monopolies. This had several advantages:

  – these companies generally had large R&D budgets;
  – there was a strong incentive to cooperate since any gains could be appropriated by these national monopoles (ie, there was a strong revenue incentive);
  – the issue of protection of IPRs was, in general (and with a few exceptions), less acute than in a market of private-sector organisations;
  – the structure of the market at that time meant that the incentive to cooperate was not 'polluted' by threats of entry or competition for rents.

- **No *ex ante* major technological commitments**—no participant had yet made major investments or commitments to any specific digital mobile technology. This naturally reduced vested interests and increased the potential for useful cooperation.

- **Few 'stranded assets' or legacy installed base**—the move to a digital mobile system did not imply the immediate redundancy of the analogue mobile system or upset to these users. The analogue market was in any case very small, bounded by spectrum availability, and this market could co-exist alongside the digital market in transition. To meet consumer demand, considerable additional investment would have been necessary to the existing analogue systems. Hence, the *additional* investment required to switch existing analogue networks to GSM operation was small, or non-existent. Further, the small and fragmented nature of the existing analogue market, together with the possibility of continuing service, obviated the need to factor 'backward compatibility' into the technical specification. (One potential problem could have been if countries had chosen to promote analogue systems as an interim solution when GSM experienced capacity problems. Commitment to GSM and the open standard continued, however.) Furthermore, those operators with potentially stranded physical assets were generally recompensed by being awarded a digital licence. Finally, in many countries, the transition from analogue to GSM operation was backed up by the ability of governments or regulators to mandate the switch, through their control of national spectrum.

- **Support**—the European Commission became a firm proponent of GSM technology. Commission support proved useful at several points in the process, notably in ensuring that sufficient radio spectrum could be reserved until the project was ready to become a reality. Part of the explanation for this support lies in the Commission's view of the GSM project as one with 'strategic' interests—the success of the Nordic Mobile Telephone project in Scandinavia had resulted in a comparative advantage of Scandinavian companies in mobile technologies, and there was hope that GSM could revive the European telecoms industry.

Summary

The development of the GSM standard is a good example of how coordination and standardisation can be achieved in mainly deregulated industries. It is of special interest here because of the parallels with broadcasting—particularly the achievement of interoperability. The prime reason that standardisation came about was due to the clarity, nature and *value* of the defining goals—roaming and economies of scale.

A3.5.3 Internet

The Internet is a worldwide network of computers and computer networks. It uses a common communications protocol, TCP/IP, for communication networks nodes (computers or other networks). The computers or computer networks interconnected themselves by the Internet may use a variety of local protocols.[56]

The 'first' Internet was the ARPAnet, created in 1969 by the US Department of Defense to link together universities and high-tech defence contractors.[57] It subsequently grew to include NSFNET (created by the National Science Foundation), regional networks (eg, NYsernet), local networks at a number of universities and research institutions, and a number of military networks.[58] NSFNet took over the job of supplying the network backbone from ARPAnet in 1990.

The Internet is now a global electronic network composed of many interconnected networks. It links together PCs by means of servers, which run specialised operating systems and applications for servicing a network environment.[59] Countries or regions have network backbones supporting the Internet domestically. These backbones connect internationally. Millions of computers are able to exchange information and data using telephone lines, cable and wireless links.

The Internet therefore operates as a global and, more or less, instantaneous medium of exchange. Interoperability is a prerequisite to ensuring that various and diverse individuals, computers, and institutions can communicate and exchange data more or less seamlessly. This requirement for basic communication over the Internet does not mean, however, that the entire Internet is standardised. Above the layer of the transport protocol, interoperability failures do occur. These may or may not be solved, depending on the type of service accessed. The Internet can therefore be characterised as a highly standardised transport protocol, in co-existence with other protocols that may or may not be open to all.

[56] Mackie-Mason, J.K. and Varian H. (1994), 'Economic FAQs About the Internet', *Journal of Economic Perspectives*, **8**.
[57] Maher, M. (1998), 'An Analysis of Internet Standardisation', *Virginia Journal of Law and Technology*.
[58] Hedrik, C.L. (1987), 'Introduction to the Internet Protocols', University of Rutgers NJ, at http://oac3.hsc.uth/tmc.edu/staff/newton/tcp-tutorial/sec1.html
[59] http://www.usdoj.gov/atr/cases/f3800/msjudgex.htm

The following section focuses on how interoperability at the transport layer of the Internet is achieved and maintained through standardisation. It also briefly discusses the non-interoperable services that may be encountered.

How is Internet interoperability achieved?

The key to the Internet is the IP suite. A protocol suite (or protocol stack) is a set of many layers (or units of code that perform well-defined, discrete tasks), and is usually a part of the operating system kernel on machines connected to the Internet.[60]

There are several members of the Internet Protocol suite, known as TCP/IP. This protocol was effectively mandated in 1983 by Defence Advanced Research Projects Agency, for all hosts on ARPAnet. The most traditional services allowed by this protocol are file transfer, remote log-in, and computer mail.

TCP/IP comprises four layers, each of which calls on the services of the one below:

- an application protocol (the highest layer);
- a protocol such as TCP, which provides services needed by many applications;
- IP, the network layer; and
- protocols needed to manage a specific physical medium, such as the Ethernet (the lowest layer).

Information to be sent is broken up into small packets by the TCP layer, each of which is addressed and treated independently. The IP routes the packets to the other end, where they are reassembled. It is thus the network layer protocol responsible for moving data from one host to another. The communication is 'connectionless' in the sense that there is no dedicated end-to-end transmission path set up in the same way that there is, for example, in communication by telephony.[61] By defining how the network layers of two hosts interact, IP ensures media-independent, end-to-end connectivity on a very large scale. IP, as the network layer, is thus described as providing a 'connectionless packet delivery service'.[62] This is the key motivation for standardising the transport protocol. Trying to achieve the same objective by translating protocols at points of interconnection on different networks would not function as efficiently as a packet switching environment.

What were/are the important factors in achieving interoperability at the transport level?

First, the early days of Internet development (until 1983) were initiated and guided by the Department of Defense. This had two specific benefits.

[60] http://www.acm.org/crossroads/columns/connector/july2000.html
[61] Telephony uses circuit switching, which guarantees that the resources to communicate are available throughout the period of the communication—ie, the telephone call.
[62] http://www.acm.org/crossroads/columns/connector/july2000.html

- A single 'leader' meant significantly less conflict over standards—all the conflict and benefits would have been internal to the Department of Defense. The standardisation process could be characterised as manifesting a high degree of agreement over the need for a standard, and clear control over the choice and then imposition of that standard—ie, vested interest in the choice of standard was significantly concentrated in a public-sector institution. This control enabled the transition to TCP/IP, and allowed the Department of Defense to require TCP/IP compatibility with many of its vendors. This process of standardisation led by the Department allowed for much of the growth of the Internet through compatibility of networking software and applications.[63]

- As a public-sector project, the Internet was not subject to the pressures of the private sector—ie, there were no individual private profit motives. In this sense, the Internet project could be characterised in terms of being a 'public good'. As such, public-sector involvement was probably key to the development of the Internet as we know it today. The private sector could have feasibly developed such a project, although it is likely that development would have been different and that the social gains would have been reduced.

Second, the continuing survival of interoperability and TCP/IP has much to do with the work of a particular body, the Internet Engineering Task Force (IETF). This is one of many standards bodies that operate in the realm of the Internet. The IETF is working to ensure backward compatibility of IP version 6 with version 4, and to ensure that IP standards function over new media as they appear (such as cable). The advantage of a single standardisation body working in this area is that there is no competition between standards proposed by different organisations. However, transition to a new technology, in this case IP version 6, may be slowed by the degree to which IP version 4 is entrenched and universally used. This is an example where standardisation has direct and obvious benefits to consumers, but also has some (more indirect) costs in terms of slower diffusion of innovation. Innovation takes on a 'step-wise' sequence that can imply radical change, or at least considerable organisation to induce all participants to migrate at once, rather than a smooth curve as the new technology is diffused. This is a reflection of the network externalities that characterise the Internet.

Third, the goal of the Internet was always clear—it was conceived with inter-networking in mind. DARPA, the US Department of Defense agency responsible for the development of TCP/IP, had a top-level goal to develop an effective technique for linking together existing networks in a practical sense. The goal was to link distinct managed networks with a common utility.[64] Many fundamental choices (such as packet rather than circuit switching) came about as a result of this high-level goal. The Internet was to be

[63] Maher, M. (1998), op. cit.
[64] Clark, D.C. (1998), 'The Design Philosophy of the DARPA Internet Protocols', *Computer Communication Review*, **18**.

independent of the physical medium and of any usage made of higher layers in the protocol stack.[65] As such, IP as a connectionless protocol imposes no requirement on the underlying equipment to keep a record of the flow of information.[66] As a result, interoperability and information exchange have always been fundamental objectives.

Fourth, and related to the previous point, because the Internet was designed with interoperability and information exchange in mind, this results in considerable network effects; fundamentally, the utility of the Internet to a user is a direct function of the size of the user base.

The major factor in ensuring standardisation to achieve network communication was the design goal of communication through a connectionless protocol. This in turn was to meet higher-level security goals.

The Internet and cases of non-interoperability

As mentioned in the introduction, while the transport layer of the Internet is standardised to allow connectionless communication between any pair of machines on the Internet, this does not necessarily ensure interoperability at the level of the user. The extent to which this can be solved depends on the characteristics of the service being accessed.

Service providers with no identifiable user groups may just aim for the widest possible dissemination of documents of other materials. This may or may not be remunerated in some way. In either case, instances of interoperability failures (ie, where the user cannot access the material) can generally be totally, or at least partly, solved—very often, the appropriate software is downloadable with the material. Access to the material is therefore software-, and not hardware-, dependent.

Other service providers, on the other hand, may have defined user groups. These consumers may access the services on a subscription basis, and use proprietary software to do so. This often characterises service providers who provide access to the Internet. These providers have a financial incentive to ensure that a high level of service reaches only their subscriber group. Access to these services is governed by a proprietary software and some sort of password system that is activated when a subscriber signs up to the services (ie, a contract between the subscriber and the services is initiated). Again, access to material is software-, and not hardware-, dependent.

This means that the Internet, while being characterised by a standardised communication protocol, is also an environment where there is a purposeful lack of interoperability in some areas, for commercial reasons, usually to do with providing services to an exclusive group of subscribers who have paid for the service. (In practice, the objective is usually to *exclude* those who have *not* paid for the service.)

[65] Carpenter, B.E. (1998), 'Interoperability among Heterogeneous Communications Networks—An IETF Perspective, *Computer Standards and Interfaces,* **20**.
[66] Carpenter, B.E. (1998), op. cit.

Summary

The Internet is another case, like GSM, where the solution to delivering a defined goal had to be standardisation over the entire user base. In the case of the Internet, it was a secure, connectionless communication environment. Other methods would not have as efficiently achieved this goal.

In addition, the environment in which the Internet was developed allowed the imposition of the architecture on other interested parties. As a result, and as already noted, in the Internet case standardisation co-exists alongside degrees of non-interoperability imposed by proprietary software to protect certain business and commercial activities that use consumer payments in their business models.

There are parallels in this sense between the Internet and digital broadcasting: it is possible to take a view that standardisation at the transport layer of the Internet to allow for basic communication between machines is analogous to standards in broadcasting. This process has not been perfect (for example, the co-existence of PAL and SECAM in Europe); however it has been enough to ensure a fair degree of interoperability at a basic level. In the case of television broadcasting, this produces economies of scale in both broadcast receiving and broadcast transmission equipment, and in the production of services (ie, programming).

The service providers over the Internet that do not differentiate between consumers are similar to the FTA/PSB sector of digital broadcasting. The Internet service providers whose business models depend on being able to discriminate between users and receive a subscription payment, are reflected by the subscription section of digital broadcasting. The FTA/PSB sector is reflected by those service providers on the Internet that do not charge and that aim for the largest distribution possible.

There are, however, some major differences between the Internet and broadcasting:

- consumers on the Internet may change reasonably easily between service providers, as the service is independent of the hardware. This is not the case in the subscription sector of digital TV, where consumers do not always own the hardware and access to different services is highly dependent on the configuration of the hardware;

- problems with access to freely available services on the Internet are solved reasonably easily by making appropriate software easily available. It is not yet clear how the non-subscription broadcasters will manage such issues.

Appendix 4: Digital Broadcasting in Australia and the USA

Digital Broadcasting in Australia and the United States

A report prepared by Network Economics Consulting Group in support of the study on Interoperability, Service Diversity and Business Models in Digital Broadcasting Markets

September 2002

A1.1 Digital broadcasting in Australia

FTA television

1. Australia today has three FTA commercial television networks namely, Seven, Nine and Ten; and two national broadcasters, namely the Australian Broadcasting Corporation (ABC) and the Special Broadcasting Service (SBS). In some areas, there are also non-profit community television stations provided to the public for free.[67]

2. The government-funded ABC, which began its initial years operating radio stations, started its first broadcast in Sydney in 1956, and, by 1960, was broadcasting to all states in Australia.[68]

3. SBS caters to a multicultural audience and commenced its broadcast in Sydney and Melbourne in 1980, spreading to other metropolitan markets five years later. Since then, SBS television has been progressively extended into regional areas, broadcasting in over 60 languages.[69] It is mainly government-funded but has also carried up to five minutes of advertising or sponsorship per hour since early 1992.

4. In addition to commercial and government funded stations, there are community broadcasting licences issued since recommendations made by the Australian Broadcasting Authority (ABA) in 1997, that the last FTA channels, also referred to as the 'sixth channel', be reserved for community access television.[70] ABA argued that another commercial channel would probably carry similar content to the existing commercial networks, while community television would be able to provide more local programming that would contribute towards diversity and Australian cultural identity.[71]

5. There are six community television licensees,[72] valid for five years, after which renewal may be sought.[73] Community broadcasters are partly funded by the government but mainly rely on donations, subscriptions, and local sponsorship for their financial needs.[74] Community broadcasting licensees are limited in

[67] Productivity Commission (2000), 'Broadcasting: Inquiry Report', Report No 11, AusInfo, Canberra, p. 75.
[68] Productivity Commission (2000), op. cit., p. 270.
[69] Refer to SBS corporate information on website, available at http://www.sbs.com.au/sbs_serv_bro.pdf
[70] This followed the ABA's February 1997 findings in its 'Inquiry into the Future Use of the Sixth Television Channel', available at http://www.aba.gov.au/tv/investigations/projects/6th_channel/pdf/6final.pdf
[71] ABA (1997), 'Inquiry into the Future Use of the Sixth Television Channel', February, Sydney, p. 34.
[72] Productivity Commission (2000), op. cit., p. 280.
[73] Broadcasting Services Act 1992, S. 89–90.
[74] Productivity Commission (2000), op. cit., p. 275.

broadcasting sponsorship announcements with the announcements not exceeding, in total, 5 minutes in any hour of broadcast. However announcements before, after and during natural programme breaks are allowed.[75]

6. Table 1 shows the viewing shares of FTA channels in the five metropolitan cities of Sydney, Melbourne, Brisbane, Adelaide and Perth. It shows that in total the commercial networks dominate viewing time with Nine being the most popular network.

Table 1: Share of FTA viewing in aggregated Australian metropolitan markets[76]

Networks	**Share of FTA viewing (%) Metropolitan markets (5 market average)**
Commercial networks	
Seven	27.3
Nine	32.3
Ten	22.3
Total	**81.9**
Non-commercial networks	
ABC	15.5
SBS	2.9
Total	**18.4**

7. The number of commercial licences allowed in any area is limited to a maximum of three. Most metropolitan and larger regional areas have three.[77] Currently there are 48 commercial licences issued.[78] There is a moratorium until at least 2007 on the issuance of new commercial licences, allowing the existing commercial network to undertake the transition to digital broadcasting without competition from new entrants.

8. Most of the commercial television channels are owned by one of the larger metropolitan or regional networks, which in turn are owned by public companies listed on the local stock exchange. Non-Australian ownership is limited to 15%

[75] Productivity Commission (2000), op. cit., p. 280.
[76] Shares are as at 6am to 12 midnight in 2000, but exclude weeks 38–41 that are during the Olympics period. Totals do not sum to 100 as per original data published by ACNielsen. Data sourced from ACNielsen (2001), 'Australian TV Trends 2001', p. 21.
[77] This was achieved via 'aggregation' from 1989 to 1994, where a number of existing markets served by a single network provider were combined into larger markets with up to three television licences in each. The government provided subsidies to assist broadcasters to extend the coverage of their signal over the new aggregated areas.
[78] ABA (2001), 'Annual Report 2000–2001', p. 43, available at http://www.aba.gov.au/abanews/annRpt/an00-01/index.htm

equity in any company that owns or controls a commercial television broadcasting licence.[79],[80]

9. The regional channels are each affiliated with one of the networks in the capital city, and therefore broadcast virtually the same programmes. Table 2 summarises the population coverage in 1999/2000 by each of three main networks: Seven, Nine and Ten programmes.

Table 2: Population coverage by Seven, Nine and Ten networks, 1999/2000[81]

	Population ('000)	Ownership based on network affiliation		
		Seven	Nine	Ten
Metropolitan markets (5 markets and 15 stations)				
Sydney	4,097	SEV	PBL	TEN
Melbourne	3,777	SEV	PBL	TEN
Brisbane	2,261	SEV	PBL	TEN
Perth	1,464	SEV	STV	TEN
Adelaide	1,258	SEV	SCB	TEN
Total metropolitan	*12,854*			
Aggregated Regional markets (5 markets and 14 stations)				
Northern NSW	1,713	PRT	WSP	SCB
Queensland	1,360	SEV	WIN	SCB
Southern NSW	1,253	PRT	WIN	SCB
Victoria	1,047	PRT	WIN	SCB
Tasmania	470	SCB	WIN	SCB
Total aggregated regional	*5,843*			
Other regional markets (14 markets and 19 stations)				
Total other regional[82]	*est 1,200*	-	-	-
All markets	**19,897**			

PRT: Prime Television Ltd, PBL: Publishing & Broadcasting Ltd, SEV: Seven Network Ltd, SCB: Southern Cross Broadcasting (Australia) Ltd, STV: Sunraysia Television Ltd, TEN: The Ten Group Ltd, WSP: Washington H Soul Pattison Ltd, WIN: Win Television Pty Ltd.

[79] See AFC's website at http://www.afc.gov.au/GTP/wftvishistory.html

[80] From the time that the first commercial metropolitan television licences were awarded, most major local newspaper, magazine and radio groups held dominant interests in at least one of these licences, and most either retained or expanded upon those interests until 1987 when newly introduced cross-media rules led to a cessation of cross-media ownership arrangements.

[81] Extracted from AFC, available at: http://www.afc.gov.au/GTP/wftvismarket.html

[82] Of the 14 other regional markets, seven have, or will soon have, two licensed commercial services. Of the 21 licensed commercial services, 15 are owned by aggregated regional service operators, and one is owned by a metropolitan service operator. Of the remaining services, four are owned by small listed public companies and one by a private company.

A4.2 Pay-TV

Development of pay-TV in Australia

10. Subscription television broadcasting had a very slow start with successive attempts at introduction being blocked by governments concerned with the impact on existing FTA services.[83]

11. The development of subscription television services, which were a precursor to more generally available pay-TV services, had its beginnings in 1983 with the passing of the Radiocommunications Act. The Act allowed telecommunications carriers to provide video and audio entertainment services to licensed hotels and to clubs. SportsPlay, Superstation and SkyTV, which initially provided these services, could thus be said to have launched the first subscription-based TV services in Australia.

12. The expansion of these services beyond the limited market allowed for by the Radiocommunications Act, however, was forestalled by the government's decision to impose a five-year moratorium on pay-TV, beginning in September 1989.[84] This moratorium was further extended by a year in 1990.

13. Renewed prospects for the legalisation of pay-TV were created in 1991 when the license for a second national telecommunications carrier was awarded to Optus. As part of the licence tender agreement, Optus acquired Aussat, which had the monopoly authority for domestic satellite services. These satellites were used for international telephone link-ups out of Australia, aviation control, defence and remote broadcasting by the ABC. Acquiring these satellites gave Optus the ability to transmit a multi-channel pay-TV service if it so desired.[85, 86]

14. In the same year the draft Broadcasting Services Bill envisaged the full-scale legalisation of pay-TV and subscription television. The proposal was for a technology neutral regime, with Aussat satellites being the primary carriers for any future services without foreclosing the use of other delivery technologies,

[83] Productivity Commission (2000), op. cit., p. 292.
[84] By 1989, of the three original suppliers of the video and audio entertainment services to pubs and clubs, only Sky TV continued to be active in this market.
[85] The tender for the licence included the purchase of Aussat, which owned two satellites and was in the process of ordering two more. The Aussat system was heavily in debt and incurring substantial losses. It was widely felt at the time that, unless the purchaser of the system was given the ability to transmit a pay-TV service, the attractiveness to potential bidders of the second telecommunications licence would be materially (and perhaps irremediably) damaged.
[86] Productivity Commission (2000), op. cit., p. 293.

such as cable and MMDS.[87] Furthermore, a licensee is also free to negotiate agreements with potential carriers for delivery, or may acquire appropriate apparatus or carriage licences, or seek carriage access rights under other legislation.[88]

15. Two subscription television licences based on the assumption of satellite transmission were auctioned in 1993. The licences were awarded to two media operators—Hi Vision and Ucom—but after a series of defaults and much delay, Ucom obtained both licences.[89] The introduction of a satellite pay-TV service was further delayed because the Broadcasting Services Act 1992 stipulated the use of digital technology which at that point was not yet available.[90] Furthermore, the Act also stipulated that both licence-holders must agree to a common standard and that the standard must employ the use of reception equipment that is capable of being manufactured in Australia. Developing a common standard further delayed subscription television's introduction until 1995,[91] when a hybrid satellite/multipoint distribution system was adopted. Digitally compressed satellite signals were delivered using the DigiCipher compression and transport system to the MMDS head-end where they were subsequently retransmitted in analogue using the PAL transmission standard.[92]

16. Unlike in the USA, there is no geographical restriction on pay-TV broadcast reception area, hence broadcasting services may be transmitted anywhere in Australia.[93, 94]

17. As mentioned in paragraph 15, subscription broadcasting television or pay-TV[95] finally began in Australia in 1995 with Australis Media Ltd as the first provider,

[87] See Productivity Commission (2000), op. cit., pp. 292–4; and Papandrea, F. as cited in Institute of Public Affair's submission on the draft report of the Productivity Commission's Broadcasting Inquiry, available at http://www.pc.gov.au/inquiry/broadcst/subs/subdr242.pdf

[88] Productivity Commission (2000), op. cit., p. 294.

[89] The initial bids for the licences were \$177 million and \$212 million. Ucom finally paid \$77 million and \$117 million respectively.

[90] MPEG-1 was available then, but it was not meant for broadcasting. MPEG-2, which is broadcast quality, was finalised in 1995 and it took until March 1996 before it was adopted in equipments. (See Digital TV Group (1999), 'Introduction to MPEG-2', May, available at http://www.dtg.org.uk/reference/tutorial/mpeg.htm)

[91] Productivity Commission (2000), op. cit., pp. 292–3.

[92] Fist, S. (1994), 'Extracting the Digit from Pay-TV', in *The Australian*, July 5.

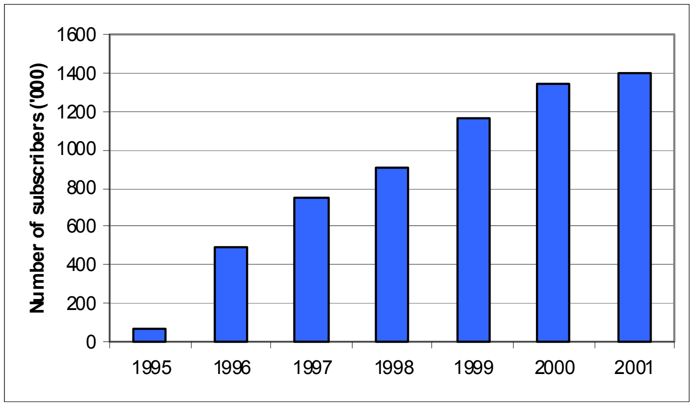
[93] A separate licence is required for each subscription channel, and if the licensee varies the service content according to location, a separate licence is required for each location.

[94] Productivity Commission (2000), op. cit., p. 294.

[95] To be specific, a distinction is to be made between subscription narrowcasting services and subscription broadcasting services. The latter is what is colloquially known as pay-TV and is generally referring to broadcasting of programmes that have a general public appeal. On the other hand, narrowcasting refers to reception of services by a limited audience. For a detailed definition, refer to sections 16 and 17 of the Broadcasting Services Act 1992.

after acquiring one of the pay-TV licences from Ucom. This was followed shortly thereafter by three other pay-TV services: Austar, OptusVision and Foxtel.

Figure 1: Australian pay-TV subscribers, 1995–2001[96]



18. Figure 1 shows the subscription growth in pay-TV and the numbers are still growing at more than 100,000 subscribers per annum.[97]

Pay-TV players and their business models

19. There are currently three major providers of pay-TV services in Australia: Austar, Optus Television (originally called Optus Vision) and Foxtel. The first company to offer pay-TV services, Australis, exited after three years. There are also a number of smaller providers operating in discrete local markets or offering specialised services such as TransAct in Canberra, Neighbourhood Cable servicing some areas in Victoria[98] and Bright in Perth.

20. Australis Media Ltd (Australis) was formed in 1995 by the Tele-communications Inc of US (TCI), Guiness Peat Group (GPG) and Lenfest Communications. The company was plagued with financial problems, and, by 1996, accepted a rescue package that saw changes in ownership and voting rights. However, Australis' financial problems continued and within months of the 1997 decision by the

[96] All data is as at December except for 2001, which is as at June. Data provided by operators to Digital Broadcast Australia (incorporating *Australian Pay-TV News*), as cited by the AFC on its website: http://www.afc.gov .au/GTP/wptvsubsxops.html
[97] Note that the 2001 results present only a half-year comparison, as the data was as at June 2001.
[98] The areas are Ballarat, Bendigo, Geelong and Mildura.

Australian Competition and Consumer Commission (ACCC), to block the proposed merger with Foxtel, Australis was placed in liquidation.[99]

21. The second player to enter the pay-TV market was Austar, commencing operation in August 1995. Austar is part of the US's UnitedGlobalCom Group. Austar caters predominantly to regional areas and Hobart and Darwin, providing pay-TV services mainly via digital satellite technology, but also utilises microwave (MMDS) and cable delivery platforms. It operates Australia's only digital satellite platform in a 50/50 joint venture with Cable & Wireless Optus.[100]Austar was also the first broadcaster in Australia to launch digital interactive services.[101]

22. As at 31 December 2001 Austar reported more than 432,000 pay-TV customers and the capability to service approximately 2.1 million homes, that is one-third of Australia's total homes.[102] This makes it the second-largest multi-channel television operator in Australia. It did, however, face financial problems in late 2001 and was forced to restructure in order to secure refinancing of its debt worth A$400 million. Refinancing was concluded in March 2002.[103]

23. Optus Television started its pay-TV business in September 1995 using a hybrid fibre coaxial (HFC) delivery platform. It was a joint venture between Cable and Wireless Optus,[104] the second national telecommunications network provider, and Continental Cablevision, and was initially named Optus Vision. It is now fully owned by Optus which in turn has been acquired by Singtel. The pay-TV cable network also carries telephony and broadband Internet services.

24. Optus Television cable now passes 2.2 million homes in Brisbane, Melbourne and Sydney. As at June 2001, it had 250,000 customers.[105]

25. Foxtel entered the market in October 1995 as a joint venture between Telstra Corporation and News Limited. The former is Australia's national

[99] CEPU Database available at http://apro.techno.net.au/cepu/toa404.htm#zz
[100] The main pay-TV operator, Foxtel, is a customer of the joint venture.
[101] The websites of Austar and UnitedGlobalCom provide more information on Austar, and can be found at http://www.austarunited.com.au/pdf/Corporate_Fact_Sheets_150302.pdf, and http://www.unitedglobal.com/apAustralia .cfm, respectively. Also see Marriner, C. (2002), 'Austar Ensures It's Dealt Into The Game', in *Sydney Morning Herald*, 1 May, available at http://www.smh.com.au/articles/2002/04/30/1019441372777.html
[102] Austar Corporate Fact Sheets found at http://www.austarunited.com.au/pdf/Corporate_Fact_Sheets_150302.pdf
[103] Lawson, A. (2001), 'Austar to axe jobs, cut outlets', *The Age*, 5 December, also available at: http://www.theage.com.au/business/2001/12/05/FFXBDBZJSUC.html, and media release from Austar dated 25 March 2002, available at http://www.austarunited.com.au/press.asp?action=show&record=6
[104] Optus was launched on 31 January 1992 as a second carrier in Australia.
[105] As reported by the AFC, available at http://www.afc.gov.au/GTP/wptvsubsxops.html

communications carrier and the latter is the Australian subsidiary of the global entertainment and media group, the News Corporation. The Australian based owner of the Nine commercial television network, Publishing and Broadcasting Limited (PBL) acquired a 25% interest in Foxtel from News Limited in November 1998. Currently, Foxtel is managed by News Limited and is owned 25% by News Limited, 25% by PBL and 50% by Telstra. It uses Telstra's HFC cable and satellite to deliver its pay-TV services.[106]

26. In terms of content, there is much cooperation amongst the three pay-TV operators. Optus has an agreement with Austar for non-exclusive distribution rights for Optus' three movie channels until December 2006, and it has the option to distribute additional Optus programming. Austar also offers Foxtel's movie package. Austar and Foxtel both own the content distributor, XYZ Entertainment, which is a significant programme provider in the Australian market. XYZ Entertainment owns and/or distributes six key programming channels, namely Nickelodeon, Discovery, Channel [V], Arena, Lifestyle Channel and MusicMax.[107]

27. Foxtel's cable service passes 2.5 million homes, with substantial overbuild, reported to be 80%, between Telstra and Optus' cable networks. Foxtel also has a satellite service with a footprint over 4 million homes, providing service in metropolitan and selected regional areas where it does not have a cable presence. As at June 2001, Foxtel reported a total of 725,000 subscribers.

28. The number of subscribers for Foxtel, Optus Television and Austar from 1995 until 2001 is illustrated in Figure 2, while Table 3 provides a summary of the players.

[106] Information from Foxtel's website: www.foxtel.com.au
[107] Marriner, C. (2002), 'Austar Ensures It's Dealt Into The Game', in *Sydney Morning Herald*, 1 May, available at http://www.smh.com.au/articles/2002/04/30/1019441372777.html. See also http://www.unitedglobal.com/apAustralia .cfm and http://www.austarunited.com.au/aboutus.asp

Figure 2: Australian pay-TV subscribers, by operator, 1995–2001[108]

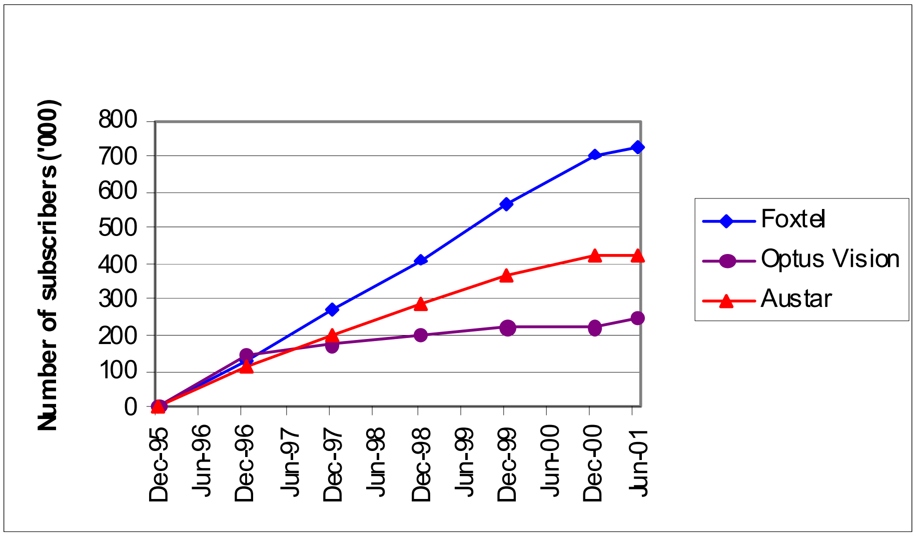


Table 3: Summary of Australian pay-TV operators as at June 2001[109]

Operators	Ownership	Areas of operation	No. of channels	No. of homes passed/ covered (million)	No. of subscribers
Foxtel	Telstra 50% News Ltd 25% Publishing & Broadcasting Ltd 25%	Sydney, Melbourne, Brisbane, Adelaide, Perth, Canberra	39	Total—4.75[110] (Cable—2.5; satellite—4)	725,000
Optus Television	Cable & Wireless Optus 100%	Sydney, Melbourne, Brisbane	37	Cable—2.2	250,000
Austar	United Global Communications 84%	Regional and rural Australia, Darwin	37	2.2	426,000 (Satellite–336,000; MMDS—85,000)

[108] Source: Data published by the AFC (http://www/afc.gov.au/GTP/wptvsubsxops.html), as extracted from Digital Broadcast Australia from figures provided by pay-TV operators.
[109] Source: Digital Broadcast Australia (incorporating *Australian Pay-TV News*), from figures provided by pay-TV operators as cited by the AFC (http://www.afc.gov.au/GTP/wptvismarket.html), and Australian Communications Authority (2001), 'Telecommunication Performance Report 2000–01', p. 210.
[110] The sum of the different delivery platforms is less than the total as there is overlap in the coverage of the two platforms. In certain locations, therefore, pay-TV is available via satellite and cable. However, when this occurs, the subscriber is often offered the cable service.

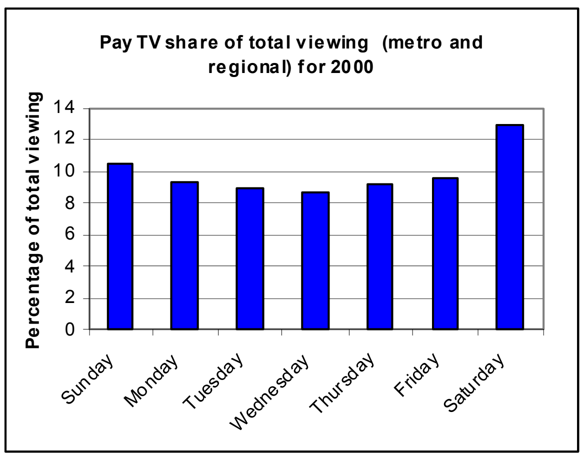
29. The Australian Film Commission (AFC) estimated that, based on a potential 6.8 million TV households in Australia as at June 2001, the penetration rate of pay-TV services of 1.4 million subscribers stands at 20.6%.[111] However, the penetration of each provider of potential homes served is:

- Foxtel—15% (725,000 / 4,750,000);
- Optus—11% (250,000 / 2,200,000); and
- Austar—19% (426,000 / 2,200,000).

30. It is estimated that more than 50% of subscribers of the three major pay-TV operators receive their service via cable, approximately 41% via satellite and the remaining via microwave.

31. In terms of viewing share, ACNielsen reported that, for the year 2000, pay-TV comprised only between 6.4% and 9.6% of total viewing of all people between 6am and 12 midnight. Figure 3 provides details of the share for the days of the week.

Figure 3: Pay-TV share of total viewing between 6am and 12 midnight, 2000[112]



32. All the pay-TV operators offer a basic package onto which additional channels can be added. Table 4 summarises the pay-TV deals offered by the major operators.

[111] AFC estimates are available at www.afc.gov.au/GTP/wptvismarket.html
[112] Weeks 1–53, 2000. Source: ACNielsen (2001), *Australian TV Trends 2001*, p. 15.

Table 4: Pay-TV packages in Australia

Operator	Transmission	Connection fee (A$)	Min. subscription	STB installation (A$)	Deposit (A$)	Rental (A$)	Purchase
Foxtel	Cable	29.95	6 month	Free	None	Free	No
Foxtel	Satellite	119.00	12 month	Free	None	Free	No
Optus Television	Cable	329.90 (or 79.95 if also taking phone)	12 month	Free	None	Free	No
Austar	Satellite, Cable & Wireless Cable	None	12 month	49.95 or 19.95 if paid by direct debit	None	Free	No

Operator	Cost per month (A$)		Options	
	Base package	Max. package	Movies	PPV cost per film
Foxtel (cable)	39.95	49.90	$12.95 for 4 channels + $6.95 for World Movies	Varies by event (sports & music)
Foxtel (satellite)	49.95	59.90	$12.95 for 4 channels + $6.95 for World Movies	Varies by event (sports & music)
Optus Television	37.95	49.95	$7.60 for World Movies	Varies by event (sports & music)
Austar	38.95	72.70	$12.00 per month for Showtime & Encore	Varies by event (sports & movies)

33. Cable pay-TV operators have to retransmit FTA channels without compensation from, or to, the FTA networks. These FTA channels are included in the count of the number of channels offered by the cable provider. Satellite pay-TV operators do not retransmit FTA channels, as the footprint of the satellites which covers a large geographical area would make it difficult for localised advertising services to be offered.

34. Pay-TV operators provide STBs or decoders to their subscribers as part of their subscription, at no separate charge. The operators retain ownership of the STBs, and the boxes are recovered once the subscription is terminated. According to the Australian Communications Authority, this allows the pay-TV operators to retain control over the technology and facilitate any upgrades, which would be difficult if the STBs were privately owned.[113]

[113] Australian Communications Authority (2001), 'Telecommunication Performance Report 2000–01', p. 211.

35. Connection fees charged by the providers vary according to the delivery platforms, bundle of services chosen, contract period and mode of payment. While Optus Television[114] and Austar[115] are allowed to bundle other services such as telephony services with pay-TV, Foxtel has not bundled telephony services from Telstra, which owns 50% of the company.

36. In terms of access to the pay-TV networks, the carriage of analogue pay-TV service was declared by the Australian competition regulator, the ACCC, in September 1999[116]. This declaration also provided access to STBs. In late 2000, in response to Telstra and Foxtel's arguments, amongst them that the ACCC's declaration was invalid, the Federal Court upheld the declaration and ruled for access to the Foxtel network to be provided to any programme provider. Despite the declaration, access has so far not been provided on both the Optus Television and Foxtel networks. C7, the pay-TV arm of the Seven Network, has been seeking access to the Foxtel cable network for the last four years. The matter is currently being arbitrated by the ACCC.[117] C7 channels have however been carried on the Optus Television and Austar networks since 1999 via content agreements.

37. There has been much speculation that there would be consolidation in the pay-TV industry. It was reported earlier in 2002 that Austar was looking at options of a merger with either Foxtel or Optus.[118] This is because after nearly seven years of operation, none of the operators has been able to make a profit from the business[119] and further capital investment is required to offer digital and interactive services.

38. Optus Television and Foxtel have also proposed to share content with effect from November 2002. The arrangement is now under the scrutiny of the ACCC. In June

[114] Optus bundles cable modem Internet and telephony services over its HFC cable.
[115] Austar resells Optus' GSM mobile telephony services and Telstra's CDMA services.
[116] When a service is declared, access providers are required, upon request, to provide the service to access seekers. The parties are encouraged to negotiate the terms of access, failing which the ACCC could undertake arbitration upon request from one of the parties. Alternatively, instead of negotiating with each access seeker, access providers could also provide the ACCC with access undertakings setting out the terms and conditions of access.
[117] Marriner, C. (2002), 'Foxtel offer to take 4 C7 channels', *Sydney Morning Herald*, 21 March, available at http://old.smh.com.au/news/0203/21/biztech/biztech11.html. See also ACCC's media release dated 8 May 2000, available at http://www.accc.gov.au/media/mr2000/mr-89-00.htm.
[118] Bombara, P. (2002), 'Pay-TV Platforms brace themselves for 2002', *B&T Marketing Media*, 27 May.
[119] It has been reported in the *Australian* that Foxtel suffers operating losses of just under A$100 million a year, while Optus makes approximately A$350 million losses on its pay-TV, Internet and local telephony service. For the full story, refer to Westfield, M. (2002), 'Austar Backing Ends Bus Pay-TV Angst', *Australian IT*, 21 May, available at http://australianit.news.com.au/articles/0,7204,4356425%5e15851%5e%5enbv%5e15309,00.html. Further, the Australian Communications Authority notes that, as at 1999–2000, overall losses for the industry amounted to A$676 million. (2001, 'Telecommunications Performance Report 2000–01', p. 219.)

2002 the ACCC announced that it believed the proposed agreement would be likely to lessen competition. In response, Foxtel and Telstra have, in September 2002, provided draft undertakings on access to the Foxtel cable network and the STBs. These undertakings are now being considered by the ACCC.

39. As discussed above, while the government eventually took measures that facilitated entry into the provision of pay-TV services, the protection of FTA broadcasters has always remained an important policy goal. For example, the Broadcasting Services Act imposed a ban on advertising and sponsorship announcements on pay-TV until 1 July 1997.[120] After that date, advertising was permitted, but it was stipulated that revenue must not exceed subscription revenue.[121] According to the Productivity Commission, the main reason for this restriction is to protect the incumbent FTA commercial broadcasters from competition in the advertising market. The Commission argued that this would not have any adverse impact on the pay-TV operators, as they have incentives to limit advertising since lack of advertisements would be one of the selling points for pay-TV.[122]

In response to pressure from the FTA networks seeking to ensure that the transmission of sporting events be reserved to them, the Communications Minister, in May 1994, gazetted an anti-siphoning list that comprehensively covered sporting events. This meant that FTA networks have first access to the TV rights to these events. Pay-TV operators could only acquire rights to these events after the FTA networks have had an opportunity to acquire them.[123],[124]

Digitisation

FTA television

41. To prepare for the transition to digital broadcasting, the Federal Government made amendments to the Broadcasting Services Act in 1998 with the passage of the Television Broadcasting Services (Digital Conversion) Act 1998.

[120] Broadcasting Services Act, S. 101.
[121] Productivity Commission (2000), op. cit., p. 140.
[122] Productivity Commission (2000), op. cit., p. 293.
[123] If the FTA networks choose not to buy the rights, pay-TV operators may then ask the Communications Minister to 'de-list' a particular event. If the Minister agrees to de-list the event, the pay-TV operators may then seek to acquire TV rights.
[124] Currently, the list covers the following categories of sporting events until 31 December 2004: horse racing; Australian Football League; rugby league; rugby union; cricket; soccer; tennis; netball; basketball; golf; and motor sports.

42. Digital terrestrial transmission commenced on 1 January 2001 in capital cities, and will be rolled out progressively in regional areas. All areas are to have digital broadcasting by 1 January 2004. The Broadcasting Services Act also requires the simulcasting of digital and analogue formats for at least eight years from the start of the broadcast of digital format. There will be a review in 2005 to consider the extension of the simulcast period.

43. To facilitate digital conversion, each of the FTA stations in each licensed area was lent an extra 7 megahertz channel, at no additional charge. The spectrum is for simulcasting only, precluding its use for other purposes.[125]

44. A selection panel, consisting of representatives from the main and regional networks, the government and the ABA, was formed to recommend the standard for Australia. A single technical standard for DTT was stipulated, implying that all FTA digital broadcasts of the same format would be receivable on the same equipment. The panel's choice of standard was between the European Digital Video Broadcasting (DVB-T) system and the US Advanced Television Systems Committee (ATSC) system. After comparing the merits of each system against a series of selection criteria as outlined below, the DVB-T system was selected.[126]

45. In reaching its decision, the panel came up with a refined list of selection criteria extracted from an initial list of approximately 50 criteria. As a first step in refining the list, the panel excluded the following criteria from the selection process on the ground that, despite being a necessary consideration in the overall system design, they did not clearly identify performance differences between the two systems: [127]

- need for co-siting;
- availability of transmission, modulation and multiplex equipment;
- compatibility with digital studio-to-transmitter links and satellite programme services;
- system operating costs;
- multi-programme/multi-channel support;
- arrangements for programme-associated data;
- arrangements for non-programme-associated data;
- stability and reliability of the technology;
- system upgrade and further development capability;

[125] Broadcasting Services Act, Sch. 4, paragraph 6.
[126] This was following recommendations by the Digital Terrestrial Television Broadcasting (DTTB) Selection Panel on 18 June 1998.
[127] Digital Video Broadcasting (1999), 'DVB-T Field Trials Around the World', Australian Assessment of DTTB, June. Available at http://www.broadcastpapers.com/tvtran/DVB-TFieldTrialsAroundtheWorld.pdf

- consideration of STBs;
- interoperability with VCRs;
- receiver operating system;
- EPGs;
- CA;
- receiver and STB MP@HL capability;
- interlace versus progressive scanning (receivers);
- baseband input (receivers).

46. Criteria that might have affected the choice but were not able to be quantified were also excluded from the selection process. These included:

- technology royalty costs;
- location of receiver manufacturing.

47. Criteria included in the selection process were sorted with other related criteria into the groups of coverage, system design elements, operational modes supported, overall system, and receiver elements. Against the coverage group criteria, each of the systems was judged on its relative coverage potential, weighted to the affected proportion of the audience. Coverage, in general, was expected to match that achieved by the PAL. However, it was recognised that, in certain circumstances, coverage performance would be either inferior or superior to the PAL. For example, some levels of lesser performance were expected, arising from the power limits imposed by non-interference to PAL because of the extensive use of channels adjacent to the existing PAL services for DTTB. Additionally, ghosting limitations were expected to be areas of improved reception performance. The system design elements criteria, in the main, looked at broadcasters' relative cost components in implementing the DTTB system with respect to the transmission structure and associated programme distribution systems. The purpose of the operational modes supported criteria was to assess the system's flexibility to provide potentially needed service modes. The receiver elements group of criteria captured issues relating to the availability of receivers suitable to meet the broadcast service objectives for Australian digital broadcasting.

48. Each of the groups and its selection criteria elements are listed below:

Coverage criteria

- Percentage of primary coverage area population served.
- Percentage of secondary coverage population served.
- Set-top antennae performance.
- Mobile reception capability.
- Co-channel performance.
- Adjacent channel performance (d-a, a-d and d-d).
- Multi-path performance.
- Immunity to electrical interference.
- Ability to be conveyed in MATV and cabled systems.

System design elements criteria

- Combining to use common transmit antennas (PAL & DTTB).
- Ease of use and cost of implementing translators.
- Common channel translator capability.
- Ability to use existing transmitters.

Operational modes supported criteria

- HDTV support.
- Support for closed captions.
- Support for multi-language audio.
- Audio system.

Overall system criteria

- Adoption of an accepted rather than unique system for HDTV.
- Performance within a 7 MHz channel.
- Number of useful million bits per second per 7 MHz channel.
- Overall encode/decode delay.
- System upgrade and further development capability.

Receiver elements criteria

- Receiver availability features and cost.
- Receiver and STB MP@HL capability.
- Receivers with both PAL and DTTB capability.
- Receivers not specifically designed for Australia.
- Receiver applications software upgrades and tools.
- Receiver lock-up time.
- Ability to provide automatic channel selection for Australian channelling.[128]

49. Despite selecting the European DVB-T standard, rather than the European standard audio format of MPEG-2 stereo and AAC surround sound, Australia chose to implement MPEG Audio Layer 3 stereo and/or Dolby AC-3 surround sound. This means that, although complying with European standards, receiver equipment, such as STBs, bought in Europe would not be fully compatible with the Australian standard, and in particular would not support surround sound.

50. In terms of the transmission format, the government mandated the transmission of standard definition television (SDTV) signals at all times. However, by January

[128] Ibid.

2003, network operators in metropolitan areas are also required to carry at least 20 hours per week of broadcast in high-definition television (HDTV) format. Such broadcasts must also be simulcast in SDTV format.[129] The government implemented the 'must carry standard definition' rule in an attempt to ensure a faster take-up of DTV, as SDTV equipment is cheaper. The hope is that people will convert to HDTV when the equipment becomes cheaper.

51. Some networks have appealed to the government either to delay the implementation of HDTV or to reduce the 20-hour quota. The government has expressed the view that it may consider lowering the quota, but reconfirmed its commitment to implementing HDTV.[130] In August 2002, the government announced the extension of the deadline for implementing the 20-hour quota by six months to July 2003.[131]

52. Material, originally produced in SDTV format, can be 'up-converted' to HDTV formats through a technical process involving line doubling and other technical improvements. Such 'up-converted' material will not count towards the fulfilment of the 20-hour high-definition broadcasting quota for commercial FTA providers and the ABC. However, SBS is treated differently because the majority of its programmes are sourced from Europe, where they are not produced in high-definition formats. At least until 2003, SBS's broadcast of 'up-converted' programmes will count towards the fulfilment of its 20-hour quota.[132]

53. There is no requirement for HDTV transmission in remote areas, subject to review in 2003, as remote areas are largely served by satellite system. The Department of Communications, Information Technology and the Arts (DCITA) had said that this was due to insufficient bandwidth to cater for HDTV transmissions. Furthermore, the implementation of HDTV broadcasts would require upgrades in DTH and self-help retransmission equipment, which would place significant financial burden on remote communities. The DTH users of satellite services have already made the conversion from analogue to digital reception equipment[133] and

[129] Broadcasting Services Act, Sch. 4, paragraph 37E.
[130] See Crabb, A. (2002), 'ABC calls for digital delay', *The Age*, 2 May, available at http://www.theage.com.au/articles /2002/05/01/1019441390807.html
[131] Schulze, J. (2002), 'Government delays HDTV regime', *Australian* IT, 28 August.
[132] As per explanations provided by the Department of Communications, Information Technology and the Arts (DCITA) available at: http://www.dcita.gov.au/graphics_welcome.html
[133] Note that the nature of satellite allows digital signals to be transmitted much more easily than analogue. Thus, when the digital transmission technology was available, it was natural for providers to make the transition to digital.

the conversion to high-definition formats would mean that the equipment would have to be converted again.[134]

54. In Australia, SDTV will have 576 lines in the picture, each with at least 720 pixels, and the system will use interlaced scanning. The aspect ratio of SDTV is either 4:3 or 16:9.[135]

55. There are a number of HDTV standards that have been chosen by the broadcasting industry, through Standards Australia, for use in Australia. Australian Standard AS4599-1999 covers a range of possible formats from 576 horizontal lines with progressive scanning (known as 576p) to 1080 lines with interlaced scanning (known as 1080i). The most commonly used formats are expected to be 576p, 720p or 1080i. HDTV normally uses a widescreen format that is an aspect ratio of 16:9.

56. Because of the implementation of both standard and high-definition formats, the receivers required would therefore be:

a) SDTV STBs that receive the SDTV digital signal and convert it into a picture suitable for an analogue set; or
b) SDTV digital televisions that receive the SDTV digital signal and show an SDTV picture; or
c) HDTV STBs that receive the SDTV and HDTV digital signals and convert them into a picture suitable for an analogue set; or
d) HDTV televisions that receive the SDTV and HDTV digital signals and show an HDTV or up-sampled SDTV picture.

57. There are currently at least four STBs, and one integrated DTV offered in the Australian market[136] retailing:

- between A$499 and A$750 for standard definition STB;
- at A$899 for the first high-definition STB, when it was first released; and
- at A$4,499 for the standard definition integrated television when it was first released in December 2001.

This equipment can be obtained from major electrical and electronic outlets.

[134] As per explanations provided by DCITA available at: http://www.dcita.gov.au/graphics_welcome.html
[135] Ibid.
[136] These are Thomson Standard Definition Digital TV STB, TEAC Standard Definition Digital TV STB, Zinwell ZDT-310 Standard Definition TV STB, DGTEC High Definition Digital TV STB, and Sony SDTV.

58. To help ensure equipment availability, the commercial networks had allocated $6 million to underwrite the first shipment of 10,000 units of STBs from Thompson Multi Media.[137] After an agreed period, the commercial networks would buy back from Thomson any unsold units.[138] However, they do not provide any retail subsidy.

59. The commercial networks have adopted the Multi-Home Open Platform (MHP) to provide interactive services. This decision was based on having an open rather than a proprietary API, which left only two systems in contention, namely MHP and MHEG.[139] The decision to adopt MHP was influenced by MHEG problems experienced in the initial stage of MHEG's introduction in the UK.

60. To protect the current commercial FTA licensees, no new commercial television licences are to be issued in any licence area before 31 December 2006.

61. Multi-channelling or the provision of separate programmes on one channel is also disallowed for the commercial networks to protect pay-TV operators, but subject to a review by the end of 2005. However, multi-channelling is allowed for the national non-commercial broadcasters, with the additional channels used for educational programmes, regional news and current affairs, science and arts programmes, children's programmes and occasional drama. ABC and SBS will also be able to retransmit their radio services through these television channels.

62. There is currently much debate over the appropriateness of the multi-channelling restrictions. The media had reported a leaked government document supporting the review on the prohibition on multi-channelling by commercial networks, in an attempt to encourage take-up of DTV. It is expected that the additional channels offered would make it attractive for viewers to switch to digital. However, both the Nine and Ten Networks are keen for the prohibition to remain.[140] These networks fear that multi-channelling would reduce their ability to offer advertisers a mass market on a single channel.[141]

[137] This was confirmed with the DCITA. See also http://www.aph.gov.au/library/intguide/sp/digdata.htm#Receiving%20Equipment
[138] Sandberg, P. (undated), 'Digital Receiver Roll Out', available at http://www.digitaltvtrader.com/news/news.htm
[139] Sandberg, P. (2001), *Consumers and API Top Concerns*, available at http://www.digitaltvtrader.com/features/features.htm
[140] Rumble, C., Hoare, D., and Schilze, J. (2002), 'Push For Digital TV Review', *Australian* IT, 29 April, available at http://australianit.news.com.au/articles/0,7204,4218575%5e15333%5e%5enbv%5e15306-15321,00.html
[141] Scevak, N. (2002), 'TV—When Three's A Crowd', 24 April, available at http://australia.internet.com/r/article/jsp/sid/11894

63. To allow limited competition without breaching the prohibition on new broadcasting licences being issued, the government created a regulatory artifice—datacasting—but constrained its development. Datacasting was defined in the Broadcasting Services Act as an information service other than a broadcasting service.

64. Datacasting, as defined by the government, can be provided by both the broadcaster and a new class of providers called datacasters. Datacasters are able to provide services such as information programmes, interactive home shopping, banking and bill paying, education programmes, interactive games, access to selected Internet services, and email. The FTA television operators have been able to provide datacasting services since 1 January 2002, but no services have yet commenced.[142] The auction for datacasting licences for datacasters, which was to be conducted in April 2001, was cancelled, as the government felt that too little interest had been shown and hence not enough competition would be generated. Furthermore, it felt that the bid prices were not reflective of the long-term value of these licences.[143]

65. As an indication of the penetration of DTV in the market, it has been reported that, as at April 2002, 44,000 widescreen (16:9) television sets have been shipped to retailers since the introduction of DTV in January 2001.[144] Furthermore, only 25,000 STBs are believed to be in service.[145]

Pay-TV

66. In terms of pay-TV operators, Austar was the first to launch DTV (including an interactive TV service) in 2000, across 305,000 of its satellite subscribers. Austar has found the most popular services to be on-screen games and channel enhancements. Subscribers were slow to take up the shopping and email via television services.[146] As at June 2001, about two-thirds of Austar's customers had

[142] Digital Broadcasting Authority (2002), 'Frequently Asked Questions About Digital Television', 5 April, available at http://www.dba.org.au/templates/files/DBA_FAQ_April2002.PDF

[143] See Media Release dated 9 May 2001 at http://www.dcita.gov.au/nsapi-graphics/?MIval=dca_dispdoc&ID=5708&template=Newsroom

[144] Data as reported by the Digital Broadcasting Authority—see http://www.dba.org.au/publishedContent/recordDocView.asp?siteName=dba&contentFolderName=News%5F%5Faustralian%5FNews&htmlFileName=DVD%5Fand%5FDTV%5Fdrive%5Fwidescreen%5Fsales%5Fin%5F2002%2Ehtml, or 2001 data and http://www.dba.org.au/newsletter/IB-jun02-full.asp#PRODUCT2 for data for the first four months of 2002.

[145] Schulze (2002), op. cit.

[146] Bombara, P. (2002), 'Pay-TV Platforms brace themselves for 2002', *B&T Marketing Media*, 27 May.

STBs with interactive capability, with some having telephone line back channel connection.[147]

67. Both Austar and Foxtel satellite services use the European DVB-S transmission standard and Open TV application programme interfaces in their STBs. [148]

68. Optus has also been digitalising its cable pay-TV service. In its 2001 annual report the company reported that the cost of digitisation was minimal since the cable was originally built as a two-way network and Optus was only using the analogue portion of the cable.

69. In late 2001, Optus Television launched a two-way interactive DTV trial with 300 users and more than 35 content partners. The trial employed Pace Micro Technology STBs and Liberate middleware. Similar to the arrangements with its analogue service, the STB was provided by Optus Television with subscription. Services offered include digital radio, digital EPG to 40 TV channels, TV email, TV access to specially provisioned websites, shopping and broking services (t-commerce) and web games.[149] Unlike Austar, Optus Television found video-on-demand and email via the TV to be the most sought-after services, scoring weekly usage rates of 90% and 80% respectively.[150]

70. On its cable, Foxtel has not offered any digital services nor conducted an interactive television trial. Instead, it has initially requested an access holiday—that is to not have to provide access to its cable to access seekers. It would also like to have the option to commence digital services one year later.[151] The access holiday has since become an undertaking from Foxtel to allow access at a prescribed rate.

STB interoperability

71. Setting of the SDTV and HDTV standards has enabled receivers capable of receiving these formats to be made available at retail outlets. The current receivers do not have interactive capability, although Teac/Netgem had announced the release of a receiver with interactive capability by September 2002.[152] In general, these receivers would be able to receive digital FTA

[147] Australian Communications Authority (2001), 'Telecommunications Performance Report 2000–01', p. 212.
[148] Ibid, p. 212.
[149] Ibid, p. 213.
[150] Bombara, P. (2002), op. cit.
[151] Ibid.
[152] See Teac's media release available at http://www.dba.org.au/templates/files/TEAC_PR_020226.pdf

throughout Australia (as long as there are digital signals transmitted). HDTV receivers would also be able to process SDTV signals, although not vice versa. [153]

72. However, take up of DTV has been slow. This is largely because STBs are still expensive. The government is considering multi-channelling by commercial networks, which is currently banned, to increase the attractiveness of content to viewers. However, only one commercial channel has shown an interest, with other networks viewing it as additional cost without a matching increase in advertising revenue.

73. In terms of pay-TV, historically, pay-TV analogue STBs have been proprietary, being provided to subscribers by the providers. It is likely that, absent regulation, this practice will continue in the move to digital service. Optus Television is already doing so with its interactive TV, as are Austar and Foxtel in their satellite services. Neither of the cable operators, Optus Television and Foxtel, has indicated an interest in developing interoperable STBs. Furthermore, there has been no regulation to ensure that they should be compatible with the FTA terrestrial STBs.

74. As mentioned in paragraph 36, although access to analogue STBs has been declared, so far commercial negotiations for access have failed. However, in order to placate the ACCC of its concerns in the proposed content sharing deal with Optus, Foxtel has recently provided undertakings, including that it will provide access to its analogue cable STBs. Foxtel has calculated that the shared cost, which makes up the bulk of access costs of the STBs, is A$325 per STB per annum. The shared cost is to be allocated between Foxtel and the access seekers based on revenue[154] shares.

75. Foxtel has also offered an undertaking for access to its digital STBs when it commences retail digital pay-TV services. Nevertheless, it proposes that the access obligation would only materialise after it has deployed 100,000 cable digital STBs. In terms of pricing, Foxtel proposes to develop a 'ratecard'. At the beginning of each year, Foxtel would confirm its pricing methodology and publish a forecast ratecard. At the end of each year, the actual costs would be compared against the ratecard, and any variance would be adjusted in the following year's cost pool. Foxtel proposes that the charges be determined based

[153] As per explanations provided by DCITA, available at: http://www.dcita.gov.au/graphics_welcome.html
[154] The revenue would be the greater of actual or imputed revenue. The imputed revenue would be determined based on a rating or the audience share of the access seeker.

on four cost pools namely, the capital costs pool, the installed base acquisition costs pool,[155], the operations and maintenance costs pool, and the overhead costs pool.[156] The undertakings (both analogue and digital) are now under ACCC's consideration.

76. In considering interoperability across platforms (for example with cable, terrestrial and satellite), the STBs required may cost more to manufacture, and in Australia there has been no indication of any interest in achieving such interoperability.

77. Within the analogue and digital simulcasting period and while multi-channelling is prohibited, cable viewers will not be too concerned with the lack of interoperability between FTA and cable pay-TV services boxes, as FTA channels are currently retransmitted by cable operators and form part of their basic packages. However, although programmes may be broadcast in digital by the FTA network, the retransmission by cable operators may be in analogue. Lack of interoperability between FTA and satellite pay-TV is, however, a relevant concern, as FTA is not retransmitted over a satellite pay-TV service. This is due to the satellite footprint that covers a vast region of Australia, which would result in localised advertising on FTA being broadcast outside the targeted region.

78. FTA network operators are likely to be the party most concerned with lack of pay-TV operators' interest, especially that of satellite operators, which do not retransmit FTA, to ensure interoperability with FTA signals. For example, Ten has requested the government to ensure FTA's access to common pay-TV STBs.[157]

79. The issue of lack of interoperability has not gone unnoticed by the government and regulators. The Australian Communications Authority noted that there may be significant issue of 'the potential for incompatibility between free-to-air digital TV STBs and the boxes already provided to over 600,000 satellite pay-TV homes.'[158]

[155] In its undertaking, Foxtel defined the installed base acquisition costs as those associated with the development of its subscriber base that were not recovered or will not to be recovered prior to the cessation of the analogue subscription television business. These costs represent the minimum amount that a digital subscription television business would need to pay the analogue business to purchase its subscriber base to make the analogue subscription business willing to cease operations.

[156] Further details are provided on the ACCC's website available at http://www.accc.gov.au/telco/fs-telecom.htm

[157] Rumble, C., Hoare, D. and Schilze, J. (2002), 'Push For Digital TV Review', *Australian* IT, 29 April, available at http://australianit.news.com.au/articles/0,7204,4218575%5e15333%5e%5enbv%5e15306-15321,00.html

[158] Australian Communications Authority (2001), 'Telecommunication Performance Report 2000–01', p. 222.

80. The government has also written to the wide range of interested parties within the industry seeking their comments on the issue. Recently, the government has indicated its intention to hold a summit on STBs later this year to resolve the issue of interoperability. However, the Minister has indicated that he does not view having multiple STBs in a home as a problem.[159]

A4.3 Digital broadcasting in the USA

FTA television

81. There are three well-established major commercial networks in the USA. They are American Broadcasting Corporation (ABC), Columbia Broadcasting System (CBS) and National Broadcasting Corporation (NBC). In 1980, before cable TV operators started offering additional services on top of their basic services, they accounted for around 92% of US television viewers.

82. NBC was formed by Radio Corporation of America (RCA) in 1926, in line with the push by RCA's parent company, General Electric (GE), to produce content, broadcasts, transmitters and receivers. In 1932, GE was forced to divest RCA (and thus NBC). Starting as a radio broadcaster, NBC evolved into a television broadcaster in the 1940s. In 1986, RCA, faced with financial woes, was re-acquired by GE. GE still wholly owns and operates NBC today. In addition to the NBC Television Network and the NBC Television Stations Division, the company owns CNBC, which it claims to be the global leader in business news, reaching 198 million homes worldwide. In partnership with Microsoft, NBC operates MSNBC, which is a cable-news channel and also a news site on the Internet.[160]

83. The ABC was originally established during the 1920s as the second radio network, also known as the Blue Network, of the NBC. In 1941, due to the Federal Communication Commission's (FCC) concern about the lack of competition, NBC was forced to spin off ABC. Currently, ABC is owned by the Walt Disney Company.

84. CBS has its beginnings in 1927 as United Independent Broadcasters (UIB). UIB restructured the following year and, with 47 affiliate stations, it became CBS. CBS

[159] Banhan, C. (2002), 'TV's Future: One Box Or Three', *Sydney Morning Herald*, July 29.
[160] Information compiled from NBC's website available at http://www.nbc.com/nbc/header/Corporate_Info.shtml, and ketupa.net media profiles available at http://www.ketupa.net/nbc.htm.

is part of the Viacom[161] global media company, which also owns MTV Networks. MTV Networks owns and operates many of the most popular basic cable television programming services in the USA. Viacom is also a major content developer and distributor.[162]

85. Besides the three major networks of ABC, NBC and CBS, there are other smaller commercial networks, such as Fox, Warner Brothers and UPN Networks.

86. Public Broadcasting System (PBS) is the publicly funded television network, which provides television programming and related services to 349 non-commercial stations in all 50 states, Puerto Rico, the US Virgin Islands, Guam and American Samoa. Public television broadcast is available to 99% of all US homes that have a television.[163]

87. For the period from September 2000 to August 2001, there were 1,580 FTA television stations in the USA, of which 87% or 1,376 are affiliated to a network, whether commercial or public, with the remaining 204 being independents.[164] Table 5 summarises the number of commercial stations affiliated to the larger networks.

Table 5: Number of commercial TV stations by primary network affiliation (Sept 2000–Aug 01)[165]

Networks	Number of stations
ABC	219
CBS	215
NBC	219
FOX	183
WB	182
UPN	79

[161] Viacom was originally created by CBS in 1971 to get around an FCC ruling that prohibited television networks from owning cable systems and TV stations in the same market. It then began buying cable systems around the USA. (Information on Viacom available at http://www.ketupa.net/viacom.htm)
[162] Information compiled from Viacom's website available at http://www.viacom.com/thefacts.tin, and ketupa.net media profiles available at http://www.ketupa.net/viacom.htm
[163] Information on PBS obtained from PBS website at http://www.pbs.org/insidepbs/facts/index.html
[164] Sourced from Nielsen Media Research and cited in MPA (2001), '2001 US Economic Review', p. 36.
[165] Ibid, p. 35.

Pay-TV

88. The main pay-TV delivery platforms in the USA are cable and satellite.

89. Cable television was invented in 1948 as a way to improve television reception in rural areas.[166] The first cable systems were known as CATV systems.[167] Cable antennae were located in good reception areas to pick up broadcast signals, and then redistributed them via coaxial cable to subscribers for a fee.[168]

90. In the late 1950s additional television signals (imported from stations in distant cities) began to be supplied. Importation was cheaper than purchasing programme materials directly because there was no requirement for cable operators to pay royalties to the stations originating the signals.

91. Cable did not become prevalent in urban areas until the 1980s. In 1950, there were only 70 CATV systems in the USA serving 14,000 homes.[169] By 1990 approximately 90% of all television households in the USA had access to cable, and 50% of these were subscribers.[170] In October 1998, there were more than 1,700 cable systems serving more than 65 million subscribers in more than 32,000 communities.[171], [172]

92. The FCC asserted full regulatory jurisdiction over cable in 1972. This included, in the main, the requirement for cable systems to provide various public-service obligations, including, for civic purposes, the donation of free channels, referred to as 'public access' channels.

93. During the 1980s, the restrictive rules regarding cable television were abolished by the FCC. For example, the Cable Communications Policy Act in 1984 deregulated rates so that operators could charge what they wanted for different service tiers as long as there was 'effective competition'[173] to the service.

[166] Owen, B. and Wildman, S. (1992), *Video Economics*, Harvard University Press, Cambridge, p. 211.
[167] Vogel, H. (1994), *Entertainment Industry Economics—A Guide for Financial Analysis*, Third Edition, Cambridge University Press, p. 177.
[168] FCC (2000), 'Fact Sheet: Cable Television Information Bulletin', p. 1, available at http://www/fcc.gov/csb/facts/csgen.html
[169] Ibid.
[170] Owen, B. and Wildman, S. (1992), op. cit., p. 211.
[171] FCC (2000), p. 1, available at http://www/fcc.gov/csb/facts/csgen.html
[172] Two factors have contributed significantly to the rapid penetration of cable television in the USA. First, the FCC's restriction on the number of over-the-air channels left an excess consumer and advertiser demand for television, far in excess of the number of allowed channels. Second, since the early 1970s, there has been a proliferation of domestic communications satellites. Because of these satellites it was easy and inexpensive for cable systems to obtain programme services. (Source: Owen, B. and Wildman, S. (1992), pp. 211–3).
[173] Effective competition was defined as the presence of three or more over-the-air signals.

Furthermore, in 1987, the retransmission or must carry rule, which required cable systems to carry local television signals, was abolished. However the *Cable* Television Consumer Protection and Competition Act 1992 reinstated the must-carry rule, with FTA broadcasters being compensated for their channels. Furthermore, the Act also re-implemented regulation of the rates for basic and premium services. At this time there was a push towards reducing government regulation and promoting market forces in industries such as telephony (an industry fast becoming interested in cable technology). As a result the Telecommunications Act 1996 replaced some of the 1992 Cable Act rules. Most significantly, it set a deadline of 1999 for rate regulation to be eliminated for all cable services except those in the basic tier.[174]

94. After being freed from regulatory constraints in 1980s, the cable industry started offering different and new services to subscribers. One such service came in the form of premium services, offered to subscribers at an additional monthly fee. Home Box Office (HBO), a pay-TV movie distribution service, was the first premium service, specialising in movies that had not yet been shown on FTA television.

95. There are three tiers of cable service: basic service, cable programming service (CPS), and per-channel or per-programme service. The basic service is the lowest level of cable service that must be taken by a subscriber. The content of basic service varies widely among cable systems, but, pursuant to the Communications Act, must include all local television signals and public, educational, and governmental access channels. At the discretion of the cable operator, basic service may also include satellite delivered programming channels delivered to a cable head-end for distribution within the system. CPS, also known as expanded basic, covers all channels that are not included in the basic service but are not separately offered as a per-channel or per-programme service. These expanded tiers of service usually include additional satellite delivered cable programming channels. Per-channel service or premium services are also available at a monthly fee, while pay-per-view services, as the name suggests, charge on a per-programme basis.[175]

[174] See http://www.museum.tv/archives/etv/U/htmlU/unitedstatesc/unitedstatesc.htm
[175] 47 U.S.C.§§ 543(b)(7), 543(l)(2), as cited in FCC (2002*a*), 'Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming', CS Docket No. 01-129, Eight Annual Report, p. 11 (footnotes).

96. In general, cable STBs have always been leased by analogue cable providers for a monthly fee.[176]

97. The cable industry is consolidating as cable operators acquire and trade systems. FCC estimates that the ten largest operators are reported to serve close to 87% of the US cable market.[177] This is supported by data from the National Cable & Telecommunications Association (NCTA), which shows that the top ten multiple system operators (MSOs)[178] have more than 84% of total subscribers. The top ten MSOs and their number of subscribers are listed in Table 6.

Table 6: Top ten MSOs by subscriber number as at December 2001[179]

Rank	MSO	No of subscribers	Market share (%)[180]
1	AT & T Broadband	13,560,000	18.9
2	Time Warner Cable[181]	12,798,000	17.8
3	Comcast Cable Communications	8,471,100	11.8
4	Charter Communications	6,953,700	9.7
5	Cox Communications	6,237,900	8.7
6	Adelphia Communications	5,810,300	8.1
7	Cablevision Systems Corp	3,008,000	4.2
8	Mediacom LLC	1,595,000	2.2
9	Insight Communications[182]	1,283,700	1.8
10	CableOne	752,000	1.0

98. The second most important pay-TV delivery platform is satellite. There are several satellite delivery systems, namely DBS, home satellite dishes (HSD), and SMATV. MMDS is another delivery platform that uses microwave technology. The FCC reports that the potential number of homes with a serviceable line-of-sight to an MMDS operator's transmission facilities was approximately 62 million and the number of homes actually capable of receiving an MMDS signal was

[176] Ibid, para. 37.
[177] Ibid, para. 14.
[178] MSO refers to companies that provide entertainment services; they usually operate multiple systems in different geographic areas (see definition provided by Texas Instruments at http://www.ti.com/sc/docs/glossary/comm.htm)
[179] Source Kagan World Media and *Cable TV Investor* as cited by NCTA. See http://www.ncta.com/industry_overview /top50mso.cfm
[180] Based on total cable subscribers of 71.74 million as at December 2001.
[181] Time Warner Cable's subscribers include those from TWE-A/N (7 million); TWE/Non-TWEAN (4.1 million); TWI (1.7 million).
[182] Insight Ohio is consolidated into the results of Insight Communications.

approximately 36 million.[183] However, the number of MMDS subscribers is only 700,000.

99. Table 7 provides a summary of the number of subscribers for the different delivery platforms, including cable.

100. Kagan World Media estimates that, as at April 2002, there were 98.6 million homes passed by cable, which is approximately 94% for all TV households, as identified in Table 7. [184]

101. Table 7 also shows that, of the 98.6 million homes with access to cable, there were 72 million subscribers as at December 2001. This produces a cable penetration rate of households with a television of 68%.[185]

102. HSD or the C band segment of the satellite industry continues to see falling subscriber numbers. As at June 2001, there were a little over 1 million subscribers.

Table 7: US penetration of competing multi-channel delivery technologies, December 2001[186]

Technology	Households (millions)	% of multi-channel homes
All TV households (Feb 2002)	105.4	
All multi-channel households	93.4	100.0
Cable	71.7	76.8
DBS	17.4	18.6
MMDS	0.7	0.7
SMATV	1.5	1.6
HSD (C-band)	0.9	1.0
Others[187]	1.2	1.3

103. SMATV systems are also known as private cable operators or private communication operators.[188] SMATV systems are usually satellite-based and distribute television signals to urban and suburban multiple dwelling units. With SMATV a receiving dish can pull pay-channel signals from satellite transponders and distribute them to dwellings via internal hard-wired system located within

[183] FCC (2002*a*), op. cit. para. 71.
[184] NCTA (2002*a*), 'Cable & Telecommunications Industry Overview 2002 Mid-year', p. 21.
[185] Ibid.
[186] Source: Nielson Media Research, Kagan World Media, *Cable Program* Investor, SkyReport, *Media Business Corp*, as cited in NCTA (2002*a*), op. cit., p. 17.
[187] Others include local telephone companies and broadband competitors.
[188] 47 U.S.C. § 522(7) as cited in FCC (2002*a*), op. cit., para. 73.

the building.[189] Most SMATV operators have 3,000 to 4,000 customers, but the larger ones may have 15,000 to 55,000 customers.[190] As at December 2001, there were 1.5 million subscribers.

104. Among the satellite systems, DBS is the most popular. It is a nationally distributed subscription video service that delivers programming via satellite. Signals are delivered to a small 'dish' antenna located at the viewer's home. [191]

105. There are currently four companies licensed by the FCC to provide DBS service namely DirecTV, EchoStar (marketed as the DISH Network), Dominion Video Satellite Inc. (marketed as Sky Angel and specialising in Christian themes) and R/L DBS Company, which is preparing to launch its service.[192] EchoStar and DirecTV have made an application to merge and the proposal is now under consideration by the Senate Committee.

106. DBS is a strong competitor to cable and had more than 18 million subscribers as at April 2002, with DirecTV having 10.6 million subscribers and EchoStar 7.3 million.[193].

107. DirecTV offers 225 digital channels along with its customisable on-screen programme guide. It provides customers with the option of buying receivers from it online, or alternatively buying from an authorised local dealer. DirecTV allows equipment to be sold separately by retailers, at a subsidised price, enabling customers to choose the best combination that will help them receive the mix of features and services they want.[194]

108. DirecTV started before there were industry standards. When EchoStar entered the market later, it chose to follow the European standard for DVB satellite distribution, which had then been introduced. So while EchoStar uses MPEG transport packets of 188 bytes, DirecTV uses 132-byte packets. In addition, EchoStar uses the MPEG audio coding rather than the US Dolby audio coding.[195]

[189] Vogel, H. (1994), p. 191.
[190] FCC (2002*a*), op. cit., para 75.
[191] Ibid., para 55.
[192] Ibid.
[193] As reported by SkyReport. See http://www.skyreport.com/dth_counts.htm#two,
[194] See DirecTV website at www.directv.com
[195] Krauss, J. (2002), 'Technical Problems With The DirecTV/EchoStar Merger', *CED Magazine*, February, available at http://www.cedmagazine.com/ced/2002/0202/02cc.htm

109. DBS suppliers also offer local broadcast stations in some of its packages and DirecTV has found this to have a significant impact on its subscriber growth.[196] Some DBS suppliers, such as EchoStar and DirecTV, also offer satellite-based two-way broadband Internet access service.[197]

110. Table 8 provides a sample of some of the packages offered by cable and satellite operators in New York.

Table 8: Sample of pay-TV packages available in New York

Operator	Transmission	Connection fee (US$)	Min. subscription	STB installation (US$)	Deposit (US$)	Rental (US$)	Purchase
AT&T	Cable	27.99 (pre-wired) or 43.99 (new)	12 months	Free	none	None	n/a
Time Warner	Cable	43.00		Free	25.00	4.50 for each additional STU	n/a
DirecTV	Satellite	<$50.00	12 months	DirecTV, independent retailer or self-install	May be required if use DirecTV	<4.99 for additional units	Required—DirecTV or independent retailer
Dish Network	Satellite	199.00	12 months	By supplier of system	none	4.99 for additional units	System: 149-699 Receiver only: 99–499
Adelphia Comms	Cable						
Charter Comms	Cable						

196 FCC (2002*a*), op. cit., para 60.
197 Ibid, para 62.

Operator	No. of channels		Cost per month (US$)		Options (US$)	
	Base package	Max. package	Base package	Max. package	Movies	PPV cost per film
AT&T			46.99		12.99 for 12 channels	
Time Warner	>60	Various options	40.91	79.81	12.95 for 2 channels	Varies per content
DirecTV	>110	>180	31.99	81.99	Various options	Available
Dish Network	69	198	22.99	72.99	Various options	Available
Adelphia						Available
Charter Comms						Available

Digitalisation
FTA television

111. The current focus of broadcasting regulation is on DTV—also known as advanced television (ATV).

112. The process to set a digital standard started in 1987 with the creation of the Advisory Committee on Advanced Television Service (ACATS) by the FCC to assist in the establishment of a new video standard for the USA.

113. Initially in the process the FCC decided not to allocate additional spectrum for FTA television broadcasts. However, the decision was made to allow broadcasters to update their existing transmission technology as long as the public was not affected during the transition process. It was later decided that the most efficient and non-disruptive manner by which ATV could be introduced was to allocate a 6MHz channel to broadcasters, independent from their existing National Television Standards Committee[198] analogue channel, for free.

114. Twenty-three ATV proposals were presented to ACATS, but these were subsequently reduced to six in 1991, with four being HDTV systems. ACATS developed extensive test procedures which were implemented by three independent laboratories. The FCC subsequently announced preference for simulcast broadcasting and requested the contenders to deliver proposals for

[198] The Committee established the standards for the current analogue method of television broadcasting used in North America.

HDTV in a single 6 MHz broadcast channel. In February 1993, the FCC had narrowed its choice to the four HDTV systems proposed. [199]

115. Although all the four HDTV systems performed well, each had one or more deficiencies that required improvement. While authorising some modifications for improvements to be made, ACATS also expressed an interest in a single system that would combine the best elements from each of the four systems.

116. This led to the formation of the Grand Alliance to develop an appropriate standard. The Grand Alliance was made up of the proponents of the four systems, namely AT&T, General Instrument Corporation, Massachusetts Institute of Technology (MIT), Philips Electronics North America Corporation, David Sarnoff Research Center, Thomson Consumer Electronics, and Zenith Electronics Corporation.

117. The Grand Alliance proceeded to build a final prototype system which was again put through vigorous testing. The DTV standard (with the exception of certain video format constraints), which was documented in the ATSC DTV standard, was finally adopted by the FCC on 24 December 1996.[200] It was based on the following subsystems.

- *Scanning*—two HDTV formats of 720 lines × 1,280 pixels per line format at 24, 30 and 60 frames per second progressively scanned and a 1,080 × 1,920 pixels per line format at 24 and 30 frames per second progressively scanned and 60 fields per second interlaced scanned.
- *Video and audio compression*—digital video compression MPEG-2 parameters, including B frames, audio compression employing 5.1-channel Dolby AC-3 techniques.
- *Transport*—packetised data transport system which incorporates features and services of MPEG-2 that are applicable to ATV and which is provided for in the MPEG-2 transport layer.
- *Transmission*—sub-system is based on 8- and 16-VSB technology for broadcasting and cable, respectively.[201]

118. The Telecommunications Act 1996 established the basic framework by which the FCC would issue licences for DTV. The Act provided that initial eligibility for a DTV licence should be limited to

[199] See ‘Development of the ATSC Digital Television Standard’, available at http://www.atsc.org/history.html
[200] FCC (1996), ‘Fourth Report and Order’, MM Docket No. 87-268.
[201] FCC (1997), ‘Fifth Report and Order’, MM Docket No. 87-268, p. 19.

> those broadcasters who, as of the date of issuance of the initial licences, hold a licence to operate a television broadcast station or a permit to construct such a station, or both.[202]

This was conditional on the eventual return of either the current 6 MHz channel or the new digital channel.

119. The FCC chose to refrain from regulation, if possible, in the implementation of DTV. It summarised its approach as:

> We recognise the challenges that will by faced by broadcasters in adopting this technology. Accordingly, we have generally refrained from regulation and have sought to maximize broadcasters' flexibility to provide a digital service to meet the audience's needs and desires. Where appropriate, however, we have adopted rules we believe will ensure a smooth transition to digital television for broadcasters and viewers. These rules include an aggressive but reasonable construction schedule, a requirement that broadcasters continue to provide a free, over-the-air television service, and a simulcasting requirement phased in at the end of the transition period. Further we recognise that digital broadcasters remain public trustees with a responsibility to serve the public interest.[203]

120. The FCC established an aggressive schedule for television stations to construct their DTV facilities. All network-affiliated television stations (ABC, CBS, NBC and Fox stations) in the top 10 television markets were to have constructed digital facilities by May 1 1999. All network-affiliated DTV stations in the top 30 television markets were to be constructed by November 1 1999. All remaining commercial DTV stations were to be constructed by May 1 2002, and all non-commercial DTV stations are to be constructed by May 1 2003.[204]

121. In an effort to assist stations to meet the May 2002 deadline, in November 2001 the FCC modified several of its DTV transition rules to allow a gradual approach to providing DTV. Broadcasters are no longer required to replicate their entire analogue signal. They are allowed initially to build lower-powered, and less

[202] Ibid., p. 9.
[203] Ibid., p. 9.
[204] See http://www.fcc.gov/dtv/dtv_hatfield725.txt

expensive, DTV stations, expanding their reach over time. Digital broadcasts are now only required during prime time.[205]

122. The FCC deadlines have not been met. In February 2002, the FCC reported that there were 256 DTV stations operating and that DTV is available to 76% of households.[206] As at April 2002, the NCTA claims that only 205 of the commercial stations, or less than 16% of all full-powered commercial stations (of a total of approximately 1,300 such stations) transmitted digital signals. These 205 stations collectively cater for 81 of the total of 210 markets in the USA. 66 public television stations have already been digitalised. Furthermore, more than 850 stations have requested an extension from the FCC.[207]

123. Some of the reasons given for this delay are the economic downturn, the lack of equipment, and delay in granting approval to siting towers. Furthermore, there has been much dispute over the digital transmission standard (8-VSB) that caused uncertainty among the broadcasters and the STB manufacturers. Sinclair Broadcasting Group had campaigned for a review of the 8-VSB standard, asking the FCC to allow broadcasters to transmit using COFDM, an alternative modulation method. More than 400 commercial and public stations supported Sinclair Broadcasting Group's request. In support of this review, ABC and NBC had complained that the 8-VSB standard did not provide reliable reception to viewers. However in January 2001 the FCC reaffirmed its support for the 8-VSB modulation system. [208]

124. There is no requirement for broadcasters to provide a minimum amount of HDTV programming. This decision is left to the licensee's discretion.[209] However, few broadcasters have committed to providing a primarily HDTV service.[210]

125. While larger broadcast or FTA networks have made some attempts to provide some HDTV content, local stations are more interested in providing a standard definition duplicate of the analogue signal over their digital spectrum, reserving the extra spectrum for other commercial applications such as datacasting.[211]

[205] NCTA (2002*b*), 'The Transition to Digital Television', April, p. 5.
[206] FCC DTF Task Force (2002), 'Digital Television Transition', 20 February (Powerpoint presentations from the FCC Speak 2002), available at http://www.fcc.gov/dtv/2002ForumDTVTransition.ppt
[207] NCTA (2002*b*), op. cit., p. 5.
[208] Ibid, p. 6 and footnote 23.
[209] FCC (1997), op. cit., p. 19.
[210] NCTA (2002*b*), op. cit., p. 7.
[211] Ibid.

126. The National Television Standards Committee analogue broadcast is targeted to cease and analogue spectrum be returned in 2006. However, there is a condition in the Balanced Budget Act 1997, whereby broadcasters are not required to return the spectrum until 85% of the television households in their market are capable of receiving digital broadcasts, either over the air or through an MVPD.[212]

127. The FCC stated that, while it expected the fundamental use of the 6MHz DTV licence would be for the provision of an FTA television service, broadcasters are also permitted to develop additional revenue streams through the provision of supplementary and ancillary services that do not interfere with FTA programming.[213] Examples of such services include computer software distribution, subscription television programming, data transmissions, teletext, interactive services and audio signals.[214]

128. The Telecommunications Act 1996 requires the FCC to establish a fee programme for such supplementary or ancillary services if subscription fees are required in order to receive these services, or if the licensee directly or indirectly receives compensation from a third party in return for transmitting material furnished by such a third party.[215] This fee was later established as 5% of gross revenues received from such services.[216]

129. An indicator of the pace of digital adoption by consumers is the number of DTV sets that have been sold. According to the Consumer Electronics Association (CEA), almost 1.5 million DTV products were shipped to dealers in 2001. Of this, about 130,000 were STBs, about 70,000 integrated DTV units and the remaining 1.3 million would be DTV monitors.[217] The CEA estimates that 2.1 million DTV units, including STBs and monitors, will be sold this year, increasing to 10.5 million in 2006.[218]

[212] NCTA (2002b), op. cit., p. 4.
[213] FCC (1997), op. cit., p. 13.
[214] Ibid, p.14.
[215] Ibid, p.16.
[216] FCC (1998), 'Sixth Report and Order', Docket No. 97-247.
[217] According to CEA, DTV 'is an umbrella term given to a new class of TV sets and monitors that can accept the higher-frequency scan rates of DTV broadcast formats to produce images with more than twice the resolution of traditional analog TVs'. DTV should be capable of presenting a picture with at least 480 progressively scanned active vertical lines. CEA (undated), 'Digital Television Takes Off', available at http://www.ce.org/publications/books_references/digital_america/video/dtv_takes_off.asp
[218] CEA (2002), 'February DTV Sales Up 83 Percent in 2002', 27 March, available at http://www.ce.org/press_room /press_release_detail.asp?id=9917

130. It is likely that the increase in the current demand for the DTV monitor is due to the penetration of DVD players in homes. This is shown by the exponential increase in the demand for DVD players. In 2001, sales of DVD players totalled 13 million, which is a 25% household penetration. This penetration has been achieved at a much faster rate than has ever been achieved by any other product.[219]

131. The FCC Chairman also proposed the following schedule for FTA DTV tuners to be incorporated in television:

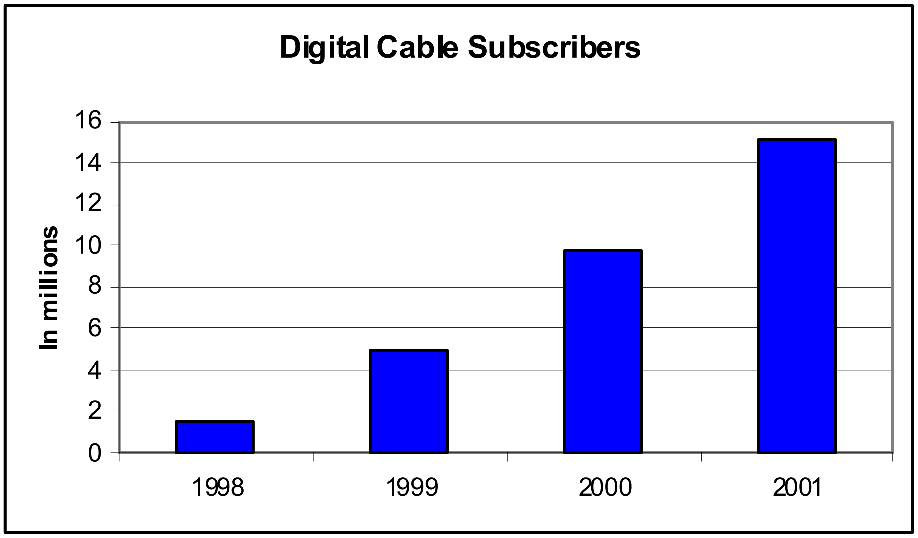
- sets 36″ and above—50% of units to have DTV tuners by January 1 2004; 100% by January 1 2005;
- sets 25″–35″—50% of units to have DTV tuners by January 1 2005; 100% by January 1 2006;
- Sets 23″–24″—100% of units to have DTV tuners by December 31 2006.[220]

Pay-TV

132. The NCTA reported that 83% of cable operators offered a digital tier as part of their service in 2001. As at the end of 2001, 15.5 million or 21% of US cable customers received digital cable service.[221] This is an increase from 9.7 million in the previous year, as is shown in Figure 4.

[219] As reported in *WESA Newsletter* for Jan–Feb 2002, p. 8.
[220] FCC (2002*b*), 'Proposal for Voluntary Industry Actions to Speed the Digital Television Transition', available at http://www.fcc.gov/commissioners/powell/mkp_proposal_to_speed_dtv_transition.pdf
[221] NCTA (2002*a*), op. cit., p. 4.

Figure 4: Digital cable subscribers, 1998–2001[222]



133. Furthermore, major cable operators are also beginning to carry the HDTV signals. For example, in October 2001, Comcast announced the launch of an HDTV service to more than 1.3 million customers that will broadcast HDTV programming from ABC, NBC, CBS, HBO, and Showtime. All equipment required to receive the HDTV signals, except DTV monitors, are leased to subscribers. Initially, Comcast supplied the Motorola HDD 200 decoder, which would work alongside existing STBs from Comcast.[223] Comcast will also be deploying Scientific-Atlanta's Explorer 3100 HD integrated STBs soon, as trials of this equipment have been completed. The Explorer 3100 HD would allow interactive functions including VoD, as well as decoding HDTV signals, all in one box. Comcast also plans to deploy the Motorola DCT5100 STB eventually, as these boxes could handle both HD signals and MPEG compressed signals.[224] The Motorola DCT5100 is also expandable, being able to cater for future IP and video-based interactivity.[225]

[222] Source: NCTA and Kagan World Media, as cited by NCTA (2002a), op. cit., p. 4.
[223] Note that before launching the HDTV services, Comcast was already providing video on demand and interactive shopping services.
[224] Tombes, J. (2002), 'Operators, Vendors Focus on HDTV', in *Communications Technology*, 27 August, available at http://www.cabletoday.com/ct2/archives/0502/0502pulse_hdtv.htm
[225] See 'Motorola Announces Major Customer Wins for Its Scalable, High-Definition DCT-5100', dated 7 May 2002, at http://www.motorola.com/mediacenter/news/detail/0,1958,1451_1113_23,00.html

134. Time Warner has also agreed to carry HDTV signals that will be broadcast by television stations owned and operated by the ABC, CBS, NBC, and Fox networks, and by nearly all public television stations in Time Warner Cable's operating areas.[226] Charter Communications plans to launch HDTV tiers in seven of its markets later in 2002.[227]

135. FTA broadcasters had lobbied the government to mandate that the cable operators must carry every local station's digital signals in addition to its analogue signals, during the transition years. The FCC expressed its initial views in January 2001 that it would not support the request, deeming it 'unconstitutional'. However, in April 2002, the FCC Chairman proposed that the cable and satellite industry voluntarily offer to carry, at no extra cost, the signals of up to five digital broadcasts or other digital programming during 50% of their prime-time schedule.

136. Digital transmission is already provided by satellite operators, with HDTV being provided by both DirecTV and EchoStar. To receive DirecTV's HDTV service, subscribers must purchase either a HDTV set with a built-in DirecTV receiver, or a separate decoder box, and a second satellite dish that is capable of receiving the signals.[228]

Interoperability

137. There is significant regulatory activity surrounding navigation devices, which include STBs, to access programming and other services from cable operators and other MVPDs.[229] Section 629 of the Telecommunications Act 1996 directed the FCC to adopt rules to assure commercial availability of 'navigation devices'. The aim of the legislation was to increase competition by limiting the extent to which cable operators provide proprietary receiving devices and allow consumers to purchase STBs from retail electronics stores.

138. To assist in ensuring the commercial availability of navigation devices, in 1998 the FCC adopted rules that require MVPDs to unbundle security from other functions of the digital navigation device, and by July 1 2000, to make available point-of-

[226] FCC (2002*a*), para 42.
[227] NCTA (2002a), op. cit., p. 17.
[228] FCC (2002a), op. cit., para 63, and see information on DirecTV's website at http://www.directv.com /DTVAPP/imagine/HDTVQA.jsp#differenthdtv
[229] The MVPDs covered by section 629 broadly include DBS, cable television, MMDS, and SMATV, as documented in FCC (1998), 'Report and Order in the Matter of Section 304 of the Telecommunications Act 1996, Commercial Availability of Navigation Devices', CS Docket No 97-80, p. 4.

deployment modules (PODs) to perform this function. Equipment that controls the security aspects of access to programming from cable operators and some other MVPDs has generally only been available for lease, so that only those who subscribe may receive service. Signal security control or descrambler units tend to be combined with other control equipment such as signal tuners and remote controls.

139. Thus, with the unbundling of security, an MVPD subscriber will be able to obtain an STB without the security features (host device) from retailers and only remain reliant on the MVPD to provide a POD for security functions. The POD requirement is intended to permit portability among STBs, which will increase the market base and facilitate volume production.[230]

140. Through the OpenCable project that began in 1997, CableLabs, a non-profit research and development consortium founded by members of the cable television industry, has developed specifications for the POD module as well as the interface that a host device requires to accommodate the POD.[231]

141. An area of concern to the cable operators is subscribers' ability to copy and therefore pirate the high-resolution signals received. To address this problem CableLabs has developed the POD-Host Licensing Agreement ('PHILA'). The PHILA is 'the licence agreement in which CableLabs provides a secure technology for the interface between the POD modules supplied by the cable operator and the retail "hosts" they plug into'.[232] This technology is crucial because, once a signal is unscrambled by the POD module, it would be susceptible to piracy. Therefore, CableLabs provides an encryption program to secure the signal that is only recognisable to a receiver that meets the PHILA requirements.[233]

142. Despite the availability of PODs, the CEA maintains that retailers have not been carrying cable STBs. This is because consumer electronics manufacturers contend that the standards developed by CableLabs are not sufficiently settled to allow

[230] FCC (2002*a*), para. 191.
[231] Ibid, para. 192.
[232] Submission by CableLabs to FCC in the matter of CS Docket No. 97-80; PP Docket No 00-67, dated 8 April 2002, p. 7.
[233] Ibid.

the manufacture of STBs that are competitive with the equipment supplied to subscribers by cable operators.[234], [235]

143. The CEA has claimed that until the OpenCable Application Platform (OCAP) software (a middleware) standard is complete, manufacturers will not be able to build advanced STBs for a retail market.[236] Although the specification for OCAP 1.0 was released in December 2001, the CEA is of the view that it is still not ready to be relied on for ensuring cable compatibility.[237] The OCAP 1.0 specification includes a set of APIs designed to enhance the portability of OpenCable products across brands and operating systems. Theoretically OCAP would allow a nationally portable device. OCAP is based on the DVB-MHP specification.[238]

144. Furthermore, the consumer electronics manufacturers are also not enthusiastic about what they deemed to be overly restrictive rules on copying contained in the PHILA. The manufacturers are afraid that overly restrictive home copying rules would render the equipments unattractive to subscribers.[239] In May 2002, a roundtable discussion was organised by the FCC to discuss the March 22 draft version of the PHILA. No solution was reached at the meeting.

145. MVPDs are not prohibited from offering equipment to their subscribers and continue to do so as long as subscribers are happy to lease equipment from them, which they apparently are. MVPDs may themselves continue to offer equipment if the system operator's charges to consumers for such devices and equipment are separately stated and not subsidised by charges for multi-channel video programming and other services.[240],[241] Furthermore, rate regulation set by Congress allows costs to be averaged over equipment classes. Therefore, as long as digital STBs are a small fraction of the total STBs on offer, they could be subsidised by those who are leasing analogue boxes.

146. In contrast to cable, customer ownership of satellite earth stations receivers and signal decoding equipment (including STBs) has been the norm in the DBS field,

[234] FCC (2002*a*), para. 192.
[235] NCTA (2001), 'Response of the National Cable & Telecommunications Association to the Consumer Electronics Retailers Coalition Ex Parte Submission', 21 September, pp. 5–6.
[236] FCC (2002*a*), para. 193.
[237] Submission by CEA to FCC in the matter of CS Docket No. 97-80; PP Docket No 00-67, dated 30 April 2002, p. 6.
[238] Submission by CableLabs and NCTA to FCC in the matter of CS Docket No. 97-80; PP Docket No 00-67, dated 6 June 2002, p. 2.
[239] Ibid.
[240] Telecommunications Act 1996, S. 659.
[241] It is not clear how compliance would be monitored.

where a subscriber would be able to obtain equipment and sign up for service from retailers which are agents for the DBS provider and hence are paid for signing up subscribers. The DBS receivers and decoders are proprietary, for example, equipments receiving DirecTV would not be able to receive EchoStar's transmission.

147. Regulation has set the path for a plug-and-play STB to be made available and cable operators, via CableLabs, have determined the standard for the PODs and OCAP. However, from a commercial point of view, achieving a plug-and-play cable STB that is nationally portable is still a long way away. There are three reasons for this.

i. Cable operators are still leasing proprietary STBs and customers are still happy with such arrangements. Therefore there is no impetus for cable operators to change this arrangement, nor would they want to, absent regulation.

ii. Despite the availability of standards, the computer electronic manufacturers will not be producing these STBs until they are assured of demand for such devices. However with the leasing arrangements offered by cable providers in place, there is no incentive for customers to demand a universal STB that can be ported amongst cable operators.

iii. Finally, the computer electronic retailers also do not have the incentive to market such products. Unlike the business model with DBS where retailers receive a commission on programming sales from the DBS provider who sign up the subscriber, a universal STB for cable would not provide the retailer with such a revenue stream.

148. From examining the events that have occurred in the USA, it is clear that achieving a standard interoperable STB is difficult, due to both technical issues and problems with acceptance by the key players within the industry.

149. There has been further development in STBs in 2001 and 2002. Cable operators are found to be favouring less powerful and less expensive STBs.[242] According to the FCC these so-called 'thin' boxes would likely require more processing power at the head-end or nodal sites to accomplish the same functionalities of the more powerful boxes, thick boxes. The FCC concluded 'it remains unclear, however,

[242] For example, Motorola's DCT 2000 and Scientific Atlanta's Explorer boxes.

whether the industries have modified their plans for advanced services around these thin boxes'.[243] It is also unclear what impact, if any, these boxes would have on interoperability.

150. While the developments outlined above have mainly been looking at interoperability in terms of obtaining a standard host STB where a module could then be added by a cable operators from which the subscribers obtains service, there appears to be little development in the area of interoperability between different delivery platforms such as satellite, cable and terrestrial. Such interoperability would probably not be feasible due to the higher costs involved.

A4.4 Regulation in Australia and the USA

Australia

151. The main legislation that governs the broadcasting industry in Australia is the Broadcasting Service Act 1992, with the ABA undertaking key regulatory oversight functions.[244] Its duties include planning broadcasting service bands, licensing broadcasting services, collecting licence fees, assistance in developing code of practice, monitoring compliance, dealing with complaints and conducting research. The ABA identifies its role as:

> *i.* *To regulate and monitor the broadcasting industry, the datacasting industry and the Internet industry*
>
> *ii.* *To exercise its powers and functions to produce regulatory arrangements that are stable, predictable and deal effectively with breaches of the rules established by this Act.* [245]

152. The Australian Communications Authority is the regulatory body that oversees the industry, acting as a spectrum manager. It is charged with delegating management of the broadcasting services bands to the ABA and managing and licensing broadcasters' use of spectrum outside the broadcasting services bands.[246]

153. The Australian competition regulator, the ACCC, is also part of the institutional infrastructure of broadcasting regulation, policing breaches of the Trade Practices Act 1974. The Broadcasting Services Act also provides for the ACCC to be

[243] FCC (2002*a*), p. 75.
[244] The powers bestowed on the ABA are enshrined in Parts 12 and 13 of the Broadcasting Services Act.
[245] Sourced from ABA's website: http://www.aba.gov.au/legislation/bsa/index.htm
[246] Productivity Commission (2000), 'Broadcasting: Inquiry Report', Report No 11, AusInfo, Canberra, p. 57.

consulted by the ABA with respect to the monitoring of cross-media ownership in the allocation of pay-TV licences.[247]

154. The Foreign Investment Review Board has the task of administering the Foreign Acquisitions and Takeovers Act 1975. It examines proposals by foreign persons who wish to acquire a controlling interest in an Australian company (including radio, television, subscription broadcasting and newspaper companies). Working together with the Australian Communications Authority, the Foreign Investment Review Board is able to recommend that an acquisition be approved.[248]

USA

155. Broadcasting in the USA is heavily regulated by the FCC. Such regulation has developed largely as a result of the scarcity of space in the broadcast frequency spectrum in the earlier years of the industry.[249]

156. The Communications Act 1934 is the main legislation that governs interstate and foreign communication by radio, television, wire, satellite and cable. The FCC is also established by the Act. Amendments to the Communications Act were also introduced by the Telecommunications Act 1996, which sought to introduce greater competition in the telecommunications market.

157. In terms of regulation in the cable industry, the Cable Communications Policy Act 1984 Act and the Cable Television Consumer Protection and Competition Act 1992 deal with areas such as ownership, channel usage, franchise provision, subscriber rates and jurisdictional boundaries among federal state and local authorities with regard to regulating the cable television systems.

158. A variety of other laws and regulations exist at the state and local level. For example, in some states, cable is regulated by local governments such as a city cable commission, city council, town council, or even a board of supervisors.[250]

[247] Broadcasting Services Act 1992, S. 96.
[248] PC (2000), op. cit., p. 58.
[249] Harold, L.V. (1994), *Entertainment Economics: A Guide for Financial Analysis*, Third Edition, Cambridge University Press, pp. 157–8.
[250] FCC (2000), 'Fact Sheet: Cable Television Information Bulletin', p. 4, available at http://www/fcc.gov /csb/facts/csgen.html

Glossary of Terms and Terminology

16:9	see ‘widescreen’
ABA	Australian Broadcasting Authority
ABC	Australian Broadcasting Corporation, in the Australian context
ABC	American Broadcasting Corporation, in the American context
ACA	Australian Communications Authority
ACATS	Advisory Committee on Advanced Television Service
ACTE	Association des Télévisions Commerciales Européennes (association of commercial European broadcasters)
ADSL	asynchronous digital subscriber line: software technology allowing broadband communication on traditional telephone copper lines in the local loop. While ADSL already delivers mainly high-speed Internet, other xDSL technologies can compete with digital cable to deliver VoD
AFC	Australian Film Commission
API	applications programming interface
ARD	German PSB
ARPU	average revenue per user (or subscribing home). Used with reference to pay-TV
ASP	application service provider
ATSC	Advanced Television Systems Committee. US body responsible for overseeing the digital HDTV standards
ATV	advanced television
BBC	UK PSB
BIOS	basic instruction operating service
box	see ‘STB’
BREMA	British Radio & Electric Equipment Manufacturers Association; trade association of consumer electronics manufacturers
BSkyB	British Sky Broadcasting: operator of various bouquets of digital pay-TV services, based in the UK
BTBS	British Telecom Broadcast Services
CA	conditional access (see ‘CAS’)
cable countries	countries in which cable reception is today the predominant television delivery mechanism. Germany, Belgium, Luxembourg and the Netherlands fall into this category
CAS	conditional access system: a system that comprises a combination of scrambling and encryption to prevent unauthorised reception
CATV	community-antenna television
CBS	Columbia Broadcasting System
CDMA	coded division multiple access
CE	consumer electronics (ie, the goods)
CEA	Consumer Electronics Association
CI	common interface (see entry below)
closed standard	the term ‘closed’ is used to denote a standard that is not freely available to third parties
CSA	common scrambling algorithm
COFDM	coded orthogonal frequency-division multiplex: the modulation system for the digital terrestrial broadcasting transmission system specified by the Digital Video Broadcasting project
common interface	connection for plug-in computer card into the digital receiver, designed to carry the conditional access subsystem. Part of the multicrypt approach to CA
consumer equipment	see ‘decoder’
CRT	cathode ray tube
CP/M	control program for microcomputers
CPS	cable programming service
CPU	central processing unit
D2-MAC	analogue TV broadcasting system used for services from DTH satellites in accordance with Article 2 of Directive 95/47/EC

DAB	digital audio broadcasting
DBS	direct broadcast satellite
DCITA	Department of Communications, Information Technology and the Arts (Australia)
decoder	see 'STB'
DigiTAG	Digital Terrestrial Action Group
Digital	refers to all binary encoded information. Once encoded, the information can be compressed and transmitted on a variety of networks to a variety of terminals
digital divide	the division that exists between those who have access to digital networks and those who do not
D-ILA	digital image light amplifier
Directive 95/47	Directive of the EU to establish a regulatory regime adapted to the start-up phase of DTV services, while also providing adequate continuity with the earlier regulatory environment for advanced television services based on analogue technology
DLP	digital light processing
DRAM	dynamic random access memory
DRM	digital rights management
DTG	Digital Television Group
DTH	direct-to-home. Refers to direct satellite reception with individual dishes (as distinct from cable TV (in which head-ends are fed by satellite transmission), or SMATV, which is direct satellite reception but with a collective dish
DTP	desk-top publishing
DTT	digital terrestrial television
DTV	digital television
durable good	consumer good, such as a car or washing machine, which yields services or utility over time
DVB	Digital Video Broadcasting. The group behind the development of many digital standards (DVB-T, DVB-S, DVB-C, DVB-J)
DVB-RC	DVB return channel for interactive services on cable networks and LMDS
DVB-T	Digital Video Broadcasting—the DTT standard
DVD	digital versatile disc—ie, multimedia storage system
EBU-UER	European Broadcasting Union/Union Européenne de Radiodiffusion (Association of European PSBs)
ECCA	European Cable Communications Association
ECM	entitlement control message
economies of scale	factors that cause the average cost of producing a good to fall as output rises. For example, when output can be doubled with a less than commensurate increase in costs
economies of scope	factors that make it cheaper to produce a range of related products than to produce any of the individual products on its own
EMM	entitlement management message
EPG	electronic programme guide: interactive on-screen display of broadcast information about available services
ETSI	European Telecommunications Standardisation Institute
experience good	a good whose value and attributes are only discernible on experiencing it
externality	consequences for welfare or costs not fully taken into account in the pricing mechanism. Pollution is an example of a negative externality because its effects are rarely treated as a cost to the polluter; similarly, those affected are rarely compensated
FCC	Federal Communications Commission: national regulatory authority in the USA
free-rider problem	this arises when a firm is unable to inhibit rivals from taking advantage of its investment in a product or service. As the rivals cannot be compelled to contribute towards the investment cost, they have an incentive not to do so, and to free-ride on the investment by the original firm. Frequently, the outcome of such a situation is that none of the firms engages in the required investment
FRND/FRAND	fair, reasonable and non-discriminatory
FTA	free-to-air television: television services for which access is not based on a subscription. Includes all television that constitutes a basic package of programmes for which the consumer does not *in general* make a conscious purchase decision. Also includes all television financed by a licence fee and all PSB transmissions. Can be broadcast on any platform type

FTV	free-to-view television: encrypted FTA (for copyright reasons). A smartcard is needed for conditional access
GE	General Electric
GSM	global system for mobile communication: the network compatibility standard for second-generation (2G) digital cellular communications
GUI	graphical user interface
HBO	Home Box Office
HDTV	high-definition television
head-end	central distribution point for a cable network, where programmes are received from satellite and VOD films storage
horizontal markets	see section 1.2.1
HSD	home satellite dishes
HTML	hypertext mark-up language: a text description language that is used for electronic publishing, especially on the World Wide Web
ICT	information and communication technology
IDATE	audio-visual consultants, based in France
iDTV	integrated digital TV receiver—ie, with a built-in digital tuner, and either a built-in CAS or a CI slot
IETF	Internet Engineering Task Force
Information Society	refers to a widespread citizen access to information technologies (Internet, mobile telecommunications, DTV, etc), which would trigger dramatic changes in the society (access to information and learning, electronic democracy) and in the economy
interoperability	see section 1.2.2
IP	Internet protocol
IPR	intellectual property rights
IRD	integrated receiver-decoder: see ‘STB’
ISP/IAP	Internet service provider, Internet access provider
LCD	liquid crystal display
LCoS	liquid crystal on silicon
LMDS	local to multipoint distribution system
MAC	multiplexed analogue components: a family of transmission standards for DBS and cable
market failure	a situation in which economic efficiency has not been achieved due to imperfections in the market mechanism. Resources are therefore distributed appropriately. Sources of market failures are asymmetries of information between market participants, market power and externalities
MHEG	Multimedia & Hypermedia Experts Group
MHP	multimedia home platform: a DVB standard for middleware, based on a Java virtual machine
middleware	non-operating system software that exposes APIs to applications developers. In the context of digital broadcasting, API and middleware are generally used interchangeably
migration	in the context of APIs, migration refers to the process of moving from a legacy API to a situation where that legacy API is no longer in use
MMDS	multi-channel multipoint distribution system (refers to wireless cable television)
modem	modulator/demodulator. A device that transforms a typical two-level computer signal into a form suitable for transmission over a telephone line. It also functions in the reverse direction—transforms an encoded signal on a telephone line into a two-level computer signal
MPEG	Moving Picture Expert Group. This group defines standards, such as the MPEG-2 standard that is used for compression in DTV and incorporated into DVB standards
MS-DOS	Microsoft disk operating system
MSO	multiple systems operator. A cable operator running several local networks (as opposed to local operators of local networks). All major cable operators are MSOs
multicrypt	part of the two approaches to conditional access allowed for in Directive 95/47. Multicrypt is an open system which makes use of the common interface to allow competing CA systems, subject only to the requirement that the service provider

	must transmit entitlement messages for each CA provider
multiplex	a UHF channel that is used to carry digital signals. By means of compression, several services can be carried in the same channel
MVPD	multi-channel video programming distributors
NBC	National Broadcasting Corporation
network externalities	these arise when the value of a service increases with the number of users. For instance, a mobile telephony service is of little value when there are few subscribers
non-proprietary standard	a standard that is not 'owned' by a private body, but has been set through the consensus of a representative body
non-subscription television	see FTA
NRA	national regulatory authority
NTSC	National Television System Committee (US analogue television standard or the organisation that developed this standard, currently in use in the USA, Canada, and Japan)
NVOD	near video on demand: impulse PPV with higher flexibility (eg, a new screening session starting every 20 minutes)
OCAP	OpenCable application platform
OEM	original equipment manufacturer
open standard	a standard that is available to third parties either free of charge or on an FRND basis, regardless of ownership
operating system	computing software that controls the allocation and use of the main computer hardware resources, and supports the functions of applications software programs
operator	usually refers to the operator of some kind of pay-network, be it television or mobile telephony
packet-switched transmission	method of transmission of digital information in small packets which are then reassembled at the destination. This method allows a safer transmission and a much more efficient use of the network's bandwidth than the traditional method, especially for point-to-point communications
PAL	phase alternate lines: one of two analogue colour-TV transmission standards in Europe (the other being SECAM)
PALplus	analogue widescreen transmission standard, an extended version of PAL, with sharper pictures and better quality sound
pay-TV platform	package of TV channels and other services available on a subscription basis
pay-TV	television consumption that the consumer has made a conscious decision to subscribe to and pay for, above and beyond the basic services available to everyone for a minimum fee
PBS	public broadcasting system
PC	personal computer
PC	Productivity Commission (Australia)
PCMCIA	personal computer memory card international association: specifications of compact interface used for example to enable peripherals to be connected to portable PCs. Used in the common interface
POD	point-of-deployment modules
platform	used to denote the *communications* platform—cable, satellite, terrestrial, ADSL, etc
PPV	pay-per-view service
proprietary standard	used to denote private ownership of a standard. Such a standard may be open or closed
PSB	public service broadcaster
PSTN	public switched telephone network
public good	a public good is a good that would typically be undersupplied by the private sector since the benefits are hard to appropriate exclusively. Some form of public-sector involvement is usually the solution. A classic example of a public good is national defence spending
PVR	personal video recorder
RCA	Radio Corporation of America
re-authoring	changing an application that has been developed for one middleware to make it function with a different middleware
receiver	generally refers to the television receiver, unless preceded by 'digital', in which

	case, see ‘STB’
ROM	read-only memory
SBS	special broadcasting service
SECAM	sequential colour and memory: one of two analogue colour-TV standards in Europe (the other being PAL)
SI	service information: machine-readable details of available services to update the EPG or other navigator
simulcrypt	simultaneous transmission of one programme with the conditional access messages corresponding to several different CAS
smartcard	card needed in some STBs to complete the decryption of the broadcast stream
SMATV	satellite master antenna television system
SMS	subscriber management systems
STB	set-top box: consumer hardware necessary for the consumption of broadcast digital services. It contains the necessary software and conditional access. With respect to an analogue television, the decoder will be housed externally to the television set, most likely in an STB or PVR. With respect to an iDTV, the decoder is integrated into the television set. Also known as ‘integrated receiver-decoder’ or ‘box’
stranded asset	an asset that is no longer supported or upgraded
subscription television	see ‘pay-TV’
switch-off	termination of analogue transmission
switchover	the gradual replacement of analogue transmission and reception by digital transmission and reception
TCP/IP	transmission control protocol/Internet protocol—the Internet protocol suite
transcontrol	transfer of control from one CAS to another, notably where CATV operators take over control of pay-TV services relayed by satellites from pay-TV operators
UIB	united independent broadcasters
UCSD	University of California at San Diego
VoD	video-on-demand service—interactive video delivery
widescreen	television programming that has an aspect ratio of 16:9 (width to height), compared with the traditional ratio of 4:3. The term can also be applied to television sets with the same meaning, but referring to the screen size
WYSIWYG	what you see is what you get
X-DSL	X-digital subscriber line: generic name for broadband systems which carry digital signals, including television signals over the PSTN