



OXFORD ECONOMIC RESEARCH ASSOCIATES

EUROPEAN COMMISSION

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

EXECUTIVE SUMMARY

FEBRUARY 2003

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OXERA has been commissioned by the European Commission to carry out a study on ‘Interoperability, Service Diversity and Business Models in Digital Broadcasting Markets’,¹ in order to help inform Commission policy towards digital broadcasting as the sector grows and matures.

As noted in the terms of reference, this study is intended to provide the Commission with a set of policy options for:

- stimulating competition in horizontal retail markets through increased interoperability;
- encouraging increased take-up of related display formats, such as widescreen; and
- addressing the barriers to the take-up of digital audio broadcasting (DAB).

The study analyses these topics using a common methodology, with the aim of achieving successful horizontal markets. This Executive Summary is in three sections that deal with interoperability and horizontal markets, screen formats, and DAB respectively.

1. Interoperability and Horizontal Markets

The primary focus of this study is to identify the ways in which interoperability could be developed in the European digital broadcasting market, and to assess the relative merits of the different options that are identified. A further concern relates to the development of horizontal markets for the supply of receiving equipment.

For the purposes of policy development, the Commission Services has identified the need to understand the relationship between interoperability and horizontal markets. The former allows receiving equipment or content to be used on different network infrastructures platform that may or may not be using different technological standards, while horizontal markets for the supply of receiving equipment are essential for the penetration of stand-alone free-to-air (FTA) services, as there is no single platform operator that could subsidise or coordinate the provision of equipment to consumers.²

On the issues of interoperability and horizontal markets, the study has two aims:

- to consider the issues arising from standardisation and interoperability with respect to digital television (DTV), and develop policy options to address any market failures identified; and
- to assess objectively the trade-offs involved in promoting horizontal markets.

The study aims to determine the extent to which the *market* may be expected to deliver these two outcomes. In the absence of a market-led introduction of, or progress towards,

¹ See *Official Journal of the European Communities*, Issue S41.

² This applies where FTA content is provided outside of an existing pay-TV operation.

interoperability and/or horizontal retail markets, the study will present possible policy options/initiatives.

These options have been developed within the context of the existing European Union objectives in the area of digital broadcasting, which are to:

- increase consumer welfare;
- promote a non-discriminatory competitive market in Europe;
- promote incentives to invest in innovation;
- ensure relative ease of implementation; and
- remain vigilant concerning security issues.³

The report critiques a full range of options, from those that facilitate the introduction of interoperability and horizontal markets to those that only encourage the development of the market in these areas. The study highlights the key judgements underpinning the appraisal of such options, and is informed by a robust understanding of the current market participants, the likely incentives arising from economic theory, and analyses of the development of standards in DTV elsewhere in the world and in other technology markets.

The report provides an economic analysis of the issues in question, and the options that are derived. It does not consider the political implications and feasibility of implementing the options; these are for the Commission Services and Member States to consider.

This study provides the Commission with tools for assessing policy options designed to encourage interoperability and the establishment of horizontal markets, and the associated costs and benefits. As such, it will contribute to the analysis to be undertaken by the Commission under Article 18 (3) of the Framework Directive—ie, to examine whether ‘interoperability and freedom of choice for users have ... been adequately achieved in one or more Member States’. However, legal interpretation of that Article is outside the scope of this study.

Digital broadcasting policy options

The relevant policy options for introducing interoperability and horizontal markets into digital broadcasting have been determined through a consideration of the DTV market in Europe, an understanding of the technical aspects of DTV delivery, a consideration of the way in which similar problems have been addressed in different countries and industries around the world, and application of the relevant economic theory.

³ These objectives have been ascertained from a variety of EU consultation documents and approaches to related topics, and reflect the drivers of EU policy in this area. As is often the case with broad policy objectives, there is likely to be some inherent conflict between specific policy objectives (for example, between competition and investment). In this case, some judgement may need to be made on the relative importance of different objectives.

The options are outlined in the following bullet points. A summary of the results of their evaluation is then presented against the EU policy objectives and the goals of the study in the section below. It should be noted that no legal analysis has been conducted in relation to the feasibility of these objectives, especially with regard to state aid.

- *Non-intervention*—this option is for the market to be allowed to develop of its own accord, and represents the least interventionist approach. There would be no regulatory intervention to move the industry to a single common applications programming interface (API) or to introduce horizontal markets, although either or both of these outcomes may naturally arise in all or part of the market.
- *Mandate an API*—at a superficial level, this policy option seems straightforward. It demands that, from a certain date, all interactive services must be written to a common API *at least*, and that all new set-top boxes (STBs) must support the common API *at least*. However, such a policy could be implemented in a variety of ways, so there are a number of forms of this option. These options could all be ultimately achieved (with varying levels of cost) via some kind of migration strategy.
- *Mandate that all digital receivers and all content be ‘interoperable’, by a specified date*—this ‘mandation’ option specifies interoperability as the outcome, but does not specify the means of achieving it. In other words, broadcasters and platform operators could use different migration methods. The option could result in a single API outcome across both sectors. Equally, however, it is possible that the market may never move quite that far. Rather, the methods of achieving interoperability without a single, universal API in place may prove insufficient to result in the tipping of the whole market to a single standard. In addition, the type of interoperability that emerged would depend on the level required by the regulator.
- *Mandate the use of mark-up languages or some other method of removing the need to have compatibility between applications and APIs*—this option would reduce the importance of the choice of API on any particular network. It would require all APIs to be capable of understanding a common set of instructions—a kind of common language between APIs. Applications written to be understood by the common language would be largely transportable between different networks. At present this could be achieved using a mark-up language (such as HTML or XML). However, a drawback with this option is that the functionality of the mark-up language is likely to be lower, possibly considerably so, than that of all or most of the underlying APIs. Thus there would be a reduction (which might be severe) in the available functionality if STBs were to be fully interoperable.
- *Mandate horizontal markets*—for this option, it would be mandated that consumers had to acquire equipment through an independent horizontal equipment market. In effect, this option would prohibit the platform operators from acting as gatekeepers of STBs and only allow certain manufacturers to provide STBs for their networks. Absent the ability to have tight control over the STB specification and then actively manage the network, network management would have to be achieved through the use of a robust API. Hence, this option would effectively mandate that all operators use a robust API that allows independent testing of

equipment for compliance with the API specification. Platform and network operators would then have to allow any certified equipment onto their network. In addition, any subsidy offered to consumers, by platform operators, on the acquisition of STBs (or similar) would have to be made available in a non-discriminatory way, so as to avoid distortion of the horizontal market. Given that this is how FTA equipment is likely to be supplied anyway, this policy option would only in practice affect pay-TV operators.

- *Influence the market towards interoperability using subsidies of either equipment or content*—under this option, the Commission would subsidise the retail sale price of equipment available through the horizontal market that contained a particular API. This API would in effect be the common API, as determined by the Commission. The subsidy would be applied for a definite period of time. Another option for encouraging market-led take-up of a common API would be to subsidise content written for a particular API. The subsidy could apply to just new content, or to re-authoring of existing applications and content to the common API. For both of these options, their impact on the market will be proportional to the degree of subsidy provided. The greater the subsidy, the more likely the effects outlined below are to arise.

Evaluation of digital broadcasting options

The options were evaluated using a quantitative methodology derived from an analysis of the impacts on the various stakeholders. The results of the evaluation process were tested for robustness by means of sensitivity tests and scenario building. At the end of this exercise it was determined that the evaluation process was operating correctly.

The ranking of the evaluated options depends on how the component elements of the evaluation process are weighted. The different weightings could be based on factors such as relative importance within overall policy objectives, or views about the likelihood of particular market outcomes (such as the size of potential economies of scale). The default case that has been adopted for exposition is where all components of the evaluation are weighted equally.

An important issue for the Commission to consider when using this analysis is the relative weights that should be assigned to different goals and objectives in order to make appropriate trade-offs. The aim of determining the weights would be to understand the trade-offs implicit within particular options across the goals and objectives. For example, although one approach may be highly successful in achieving interoperability, if it is costly in terms of innovation incentives, it may harm the overarching goals of the Commission. An option that is less successful in directly achieving interoperability may still perform well on horizontal markets and may meet the broader goals more closely. It is for the Commission to determine the relative importance of (in this case, for example) achieving interoperability as opposed to innovation or horizontal markets, and weight these goals and objectives accordingly. By exposing these trade-offs, informed policy choices can be made.

The evaluation process assessed the performance of each variant of each option against the two goals of the study (interoperability and horizontal markets) and the EU objectives in this area outlined above. The latter included the costs of implementation that are considerable for some of the options.

The full list of the options evaluated is shown in the table below. The detailed evaluation results are not presented in this summary, but the ‘Conclusion’ section below outlines the outcome of this process.

Summary of the policy options

Option	
1	Non-intervention
2a	Mandate a low-specification API
2b	Mandate a high-specification API
2c	Treat FTA as a separate market
2d	Treat FTA and greenfield pay-TV together
2e	Mandate a transition to a robust API via an interim lighter version
3	Mandate interoperability, without specifying how
4	Remove the need for compatibility between APIs and applications
5	Mandate horizontal markets
6a	Subsidise equipment for a particular API
6b	Subsidise content written for a particular API

Interoperability and horizontal markets: conclusion

Determining the preferred option depends crucially on the weighting given to the different goals and objectives. A variant of option 2 is consistently the highest-ranked option using the neutral weightings presented in the default evaluation. If implementation costs were not important, option 2b (or 2b via a migration path, 2e) would seem to be appealing policy choices. These options meet exactly the goal of interoperability at all levels of the market, and are also the best at developing successful horizontal markets. However, these options would be difficult to implement, and easier options that also perform well against the goals are 2c and 6a.

The benefits of 2c are that it is one of the least interventionist options, mandating a specific API only for FTA services, and leaving pay-TV operators to determine their own choice of API. Therefore, although it is not the best at achieving the goals, it is relatively good at meeting the objectives of increasing consumer welfare, stimulating a competitive market and providing adequate incentives for innovation, while also being relatively easy to implement.

If an option that does not require mandating is desired then option 6a would be a potential candidate. It performs reasonably well against the goals, but less well against the first three objectives; its overall score on objectives is substantially increased by the fact that it is one of the easiest to implement.

This summary is based on the full economic evaluation of the issues relating to interoperability and horizontal markets in DTV in the main report. However, no recommendations are made as to the appropriate *policy* that should be adopted. Trading off the various aspects of policy, and determining the appropriate weights for the areas of concern is the task of the Commission. The study is designed to assist in the process by

providing a framework for balancing the conflicting pressures that arise from the different options available to the Commission, Member State governments or regulatory agencies.

2. Screen Formats

Improved digital service diversity—a more balanced offering of all types of generic digital service (multi-channel, interactive television, better pictures)—may widen the appeal of DTV beyond those interested in multi-channel digital television. Screen formats are associated with picture quality and can help differentiate digital from analogue services. Moreover, the evaluation⁴ of the European Union's widescreen television Action Plan indicated a need for some further reflection on remaining barriers to the take-up of widescreen in digital broadcasting.

The general framework developed for the analysis of introducing interoperability and horizontal markets into digital broadcasting can also be applied to other changes in the broadcasting systems. In particular, to consider:

- the introduction of widescreen aspect ratio television pictures (ie 16:9, rather than 4:3);
- displaying the pictures on televisions using progressive scanning (rather than interlaced scanning); and
- the increase in the resolution of broadcast pictures by increasing the number of lines drawn for each frame in the television picture (ie, high-definition television, HDTV).

Although the same analytical approach can be used, there are some significant differences between the introduction of interoperability and horizontal markets into a broadcasting system and these other display-based developments. In particular, there are no real issues of either property standards being used, nor existing vertical business models, to interact with the process of transformation from the current set of standards to the adoption of the new set of standards throughout the broadcasting chain. As a result, there are no fundamental barriers to a horizontal market in the requisite consumer equipment—indeed, there are already widescreen televisions and progressive-scanning television displays on sale in Europe.

However, the possibility of a horizontal market does not ensure that the relevant changes necessary to upgrade to a new display format actually take place. Other potential problems still exist, particularly the requirement for coordination throughout the broadcast chain (most importantly, between the broadcasters and consumers), and, in some cases, between different broadcasters using the same network infrastructure.

⁴ IDATE (2000), 'Final Evaluation of the 16:9 Action Plan', November.

The innovative display formats listed above do not create the opportunity for fundamentally different broadcast services to be delivered to users (although they may expand the range of non-broadcast content that could be displayed). They are therefore improvements on the existing set of services that consumers currently receive.

As with digital broadcasting receiver equipment, consumers purchase display equipment on the basis of the net benefits they can derive from using the television. This is the benefit from the viewing experience net of the costs (mainly the price of the good) that consumers incur to receive this benefit. A significant proportion of the benefit is related to the provision of the appropriate content in the correct format, and this exhibits indirect network externalities. In addition, uncertainty about the durability of any particular standard will reduce the future benefit a consumer expects to receive, as they are not sure whether the equipment they are purchasing will be of the right standard. Hence, risk can adversely affect the purchase decision.

Similarly, manufacturers produce the equipment in response to a variety of factors, including consumer demand and the determination of standards. If consumer demand is uncertain, or there is not a clear market standard, manufacturers may delay investment in developing new products, or at best reduce their current investment. These issues can also affect content providers, reducing the likelihood that they will produce content for the relevant standard.

Therefore, risk over standards and content availability can be identified as the two crucial factors that are relevant to the development of the market for a new, technologically advanced television receiver. Risk itself exacerbates the market failure that may exist due to indirect network effects based on content availability. Since content availability is important as a driver of the demand for televisions, there is a (negative) feedback loop between the supply and demand sides of the market:

- consumers perceive the standards risk associated with purchasing a new type of television to be significant, and as a result may fear being left with a stranded asset. They see little benefit from purchasing the equipment when there is little content available that exploits the full functionality of the display; and
- the uncertainty over consumer demand exacerbates manufacturers' and content providers' concerns about the appropriate standard, and so less equipment and content is supplied.

Underlying this interdependency are two coordination problems:

- the requirement for content to be both created and broadcast (or otherwise made available) in the relevant display format; and
- the need for consumers' receiving equipment to be compatible with the screen standard(s) used by the broadcaster.

In general, innovative screen formats are best exploited by having content that is both created and broadcast in the format on which it is intended to be displayed.⁵ To benefit from any content delivered using an improved format, consumers would also need to have a receiver that is compatible with the broadcast format. Commitment by the supply side to (investing in and) employing the relevant screen format may provide a positive signal to consumers over the permanence of the standard, and increase confidence in purchasing the receiving equipment.

However, there is a coordination problem between the manufacturers of television sets and content providers that must be solved before full delivery of content can be achieved. This is called the stand-off problem: as the full benefit of an innovative screen format can only be appreciated by consumers if both elements of the supply side coordinate together, neither supply-side participant is willing to risk investing in the new format if they do not have a guarantee that their counterparty will also commit. That is, either manufacturers wait for content to be provided in the new format before manufacturing such equipment, or vice versa.

The second element above—the need for compatibility between consumers' equipment and the broadcast display format—is generally not a problem that arises in a static market environment (that is, one where the display standard has been set and there is a substantial installed base of compatible equipment). The current analogue 4:3 situation is an example. However, in moving to a new display format, coordination on the supply side and subsequent consumer market penetration will only occur over time. Therefore, there may be a period of transition as the old broadcasting and receiver formats are replaced by the new ones. This transition period could persist indefinitely if only some consumers experience enough of a net benefit to be willing to upgrade (and there is some backwards compatibility so that consumers using the new format can access content in a previous format), or it could end as the market tips on the establishment of a critical mass of receivers of the new format.

Within this economic framework, the transitions to widescreen, progressive scanning, HDTV and DAB can be analysed.

Screen formats: conclusions and recommendations

As a result of the use of digital infrastructure in both broadcast and non-broadcast content distribution systems, the coordination (and other) problems encountered in upgrading to an innovative display format are being reduced. As long as there is a consumer benefit (net of the relevant costs) to the new format(s), the upgrade is likely to occur over time. However, the problems of introducing the new format(s) are not completely eliminated by digitisation, so administrative intervention to reduce them could still be justified to speed the transition process.

⁵ This is particularly the case for widescreen and HDTV, but the benefits of such full coordination are minimal for progressive scanning.

A range of options for stimulating the development and take-up of alternative display formats is detailed below, along with a link to the market problems that they might contribute to overcoming. The options range in their effect on the market and their difficulty to implement. The choice of option(s) to be implemented (if any) will depend on the relevant policy issues and the relative difficulty of each option. This is an issue for the Commission or Member States to determine. Further, it should be noted that no legal analysis has been conducted in relation to the feasibility of these objectives, especially with regard to state aid.

- *Subsidise the cost to consumers of the specific television format*—this lowers the cost to consumers, reducing the risk of investment and increasing the likelihood that the net benefit is positive (and greater than the substitutes).
- *Subsidise the supply side (as for the Widescreen Action Plan) for producing and broadcasting content in the specified format*—this contributes to overcoming the market failure caused by indirect network effects in the supply of content.
- *Subsidise research and development costs for manufacturers*—this may stimulate greater innovation and investment in the specified format. It may also help to reduce the price of the sets, increasing the likelihood that consumers purchase them.
- *Mandate that a certain number of hours are broadcast in the specified format*—this would increase the volume of content available, thus addressing one of the consumer risk factors.
- *Mandate that all television sets conform to a number of formats, including the existing standard*—this may help to solve the transition problem by removing issues of backwards and forwards compatibility, and may reduce the risk for both consumers and content providers.
- *Specify that other content (DVDs, Internet downloads) be available in the specified format*—this could be important if it is believed that demand for non-broadcast content and services will be important in stimulating consumer purchase of a particular format.
- *Specify that STBs have the ability to convert between a variety of formats*—as consumers will need STBs anyway to receive a digital signal, this is potentially a low-cost method of reducing risk for both consumers and suppliers.
- *Encourage broadcasters, other content providers and manufacturers to work together to reduce the effect of coordination problems*—increased information on the benefits of the new formats, and the perception of coordination on the supply side may reduce consumers' risk and increase their valuation of the format(s).
- *Mandate that all digital services must use particular screen format(s)*—innovative display formats are easiest to manipulate, and cause the fewest concerns in relation to bandwidth, when used with a digital signal. This option would also significantly increase consumer confidence on the format(s), reducing their perceived risk.

- *Switch off all analogue signals*—forcing consumers to move to a digital broadcast environment significantly reduces the transition problems for new display formats, and may cause consumers to upgrade their televisions.

Of note by its absence among the options above is the use of the Internet (and Internet-related content and services). For the foreseeable future, delivery of the Internet over a progressive-scanned television does not appear to be a cost-effective alternative to personal computers. Progressive-scanned displays of a size large enough to be incorporated into a television remain expensive, particularly when compared with the cost of purchasing both a basic computer and a standard television.

3. Digital Audio Broadcasting

The final component of the study examines the success of DAB. Most radio broadcasters consider digital radio as the only route to ensure survival in the long term. They argue that, while audio services will always exist, digitisation of content and the existence of multi-purpose receivers could squeeze out the possibility of having a dedicated radio platform with its own players, services and listeners.⁶

Digital radio technology is operational and has been commercially available since 1995. DAB (the commercial name for the digital radio standard developed under the Eureka 147 project)⁷ is now a recognised world standard, operational or in development in over 40 countries worldwide. More than 285m people around the world can now receive around 550 DAB services. Despite this, digital radio take-up across Europe has been slow; the obstacles to growth can be explained within the framework outlined in this study.

The key attributes of this market are as follows:

- the technical coverage of DAB is above 50% in several countries;
- there is a supply of DAB services, although most of these are also available as analogue services;
- the current market potential of digital radio services has been estimated at 33m households in Europe;
- a horizontal market for DAB receivers already exists;

⁶ Digital radio is not necessarily limited to terrestrial DAB. It is also possible to use its satellite version (S-DAB). Other technologies are also developing, such as web-radio and mobile networks (UMTS). This raises the question of the profitability of the traditional business model of radio, but it may also be considered as an opportunity to introduce new models and new revenues.

⁷ Eureka 147 is a consortium of partners from the broadcasting and consumer electronics industries. DAB is recognised as a standard by ETSI, see <http://www.etsi.org>

⁶ WorldDab (1997), 'The Market Potential for Digital Audio Broadcasting (DAB)', July.

- DAB receivers remain expensive relative to analogue receivers. Few low-price DAB receivers are currently available on the market, and the prices of low-cost DAB receivers are three times as high as low-cost analogue receivers;
- consumers' additional willingness to pay for digital services is in the range of 30–55%.⁶

Thus, penetration has been limited, despite the established standards and the existence of a number of manufacturers of the receivers. There is a relatively straightforward economic explanation for this. Consumers will only purchase a digital radio receiver if they gain a sufficient benefit from that purchase decision. That is, the net benefit from a purchase is positive and greater than the net benefit from the alternatives. At present, DAB receivers do not meet these requirements:

- the benefits are restricted to some additional features and some improvement in sound quality; however, there is little real differentiation of content;
- coverage is also restricted, so a consumer will not be certain that they will receive uniform service, if on the move;
- low-cost DAB receivers are approximately three times as expensive as low-cost analogue receivers. This exceeds the willingness to pay of even those consumers most interested in the additional features of digital radio, who consider a premium of 35–55% appropriate for the additional functions that arise from a digital radio receiver.

Without better differentiation of services, consumers are not willing to pay significantly more for the receiver. Looking forward, consumers still see considerable uncertainty over the future of digital radio. Coverage remains poor in many countries and there is no evidence of new applications exclusively designed for the digital platform. Thus, consumers see benefits from delaying purchase decisions until there is a clearer view of market developments.

From the supply side, there is already a reasonably well-established horizontal market in DAB tuners, except for portable models. Price is expected to fall if the market grows, although the extent to which there are economies of scale to be exploited is not clear. The difficulties arise because of the coordination problems between content providers, broadcasters and manufacturers.

There is little incentive for the supply of innovative complementary services across the digital radio platform. The additional functionality does not, as yet, significantly change the radio experience. The ability for content providers to invest in innovative radio products is hampered by the lack of ability to charge for the specific service provided. Given the likely low audience at present because of poor penetration, it will also be difficult to attract advertising revenue. Hence, the business case for investing in these services is poor.

In other markets, service providers might subsidise initial receiver purchases to ensure that a sufficient installed base is developed to underpin complementary products. This form of risk-sharing is often an important way of assisting a new technology market to develop, although it requires an ongoing commercial relationship for the product supplied over the device to offset the up-front subsidy. However, given that radio is exclusively FTA, there is no business model for providing subsidies.

There are also problems associated with transition, since digital radio will replace analogue radio. The main element of this transition problem is the coordination between content and equipment, since a digital radio signal can only be received on digital receiver equipment. Thus, a dual-function receiver requires two tuners, and broadcasters must consider simulcasting while there remains a considerable proportion of analogue-only listeners. This simulcasting is costly in terms of bandwidth, and is difficult to insert in existing radio bands. As a consequence, it may require new frequency bands to be allocated or the release of existing radio bands (which could be made available through the termination of some analogue radio services).

With this structure of transition incentives, with high costs from incompatibility, both receiver manufacturers and broadcasters are likely to be reluctant to move to digital-only services. Content providers then also see limited benefits from investing in digital-only content. The driving force to encourage greater penetration will be that consumers see the benefits from the new format and upgrade themselves. Given that the transition incentives limit the differentiation of the new digital services and there is only limited willingness to pay for apparently small service differences, consumers are also reluctant to change.

Without the possibility of up-front subsidies to bring the upgrade costs into line with consumers' willingness to pay at this early stage of development, a critical mass of listeners cannot be established. If such a critical mass existed, the stand-off problem would be reduced for content providers, the differentiation between analogue and digital services would increase, and more consumers would consider the upgrade worthwhile. Thus, the indirect network externalities are working against the effective establishment of a viable DAB service market.

Digital audio broadcasting: conclusions

Policy recommendations for improved digital radio penetration could focus on either reducing the cost of the equipment to bring it within the range of interest of the early adopters, or improving the available content to expand the base of listeners who would be interested in upgrading to digital radio. Options include subsidising content or receivers, perhaps focusing on car manufacturers for the latter. A final option would be to ensure that effective licensing regimes are in place to support coverage growth, which are important for underpinning investment. Compared to the subsidies suggested above, this option is relatively cheap. It should be noted that no legal analysis has been conducted in relation to the feasibility of these objectives, especially with regard to state aid.