Electronic Communications Committee (ECC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

INITIAL IDEAS CONCERNING THE REVISION OF THE STOCKHOLM (1961) AGREEMENT

Lisbon, January 2002

Summary

A decision to revise the Stockholm 1961 Regional Agreement (ST61) for digital broadcasting services has been taken and the ITU Council has decided on the agenda and date for the first session of a Regional Radiocommunication Conference in 2004 (RRC04). This report gives initial ideas on the issues that will need to be considered in preparing for this conference and the "all digital world", both in terms of a revision of the existing broadcast frequency plan and the routes by which digital migration might be achieved. The technical aspects are covered in an accompanying annex which covers the planning methods and planning criteria. Many of the ideas and concepts described will be further studied and developed in the ongoing CEPT preparations for the RRC04.

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INITIAL IDEAS CONCERNING THE REVISION OF THE STOCKHOLM (1961) AGREEMENT

1 INTRODUCTION

There has been a clear prospect internationally for some years that existing analogue television and radio transmissions will be replaced by digital transmissions. Terrestrial digital broadcasting offers a series of benefits in comparison to terrestrial analogue broadcasting, not least being a more efficient use of frequency resources. This opens the way for new opportunities including more services, and with appropriate transmitter network design, portable indoor television reception and mobile television reception.

As far as sound broadcasting is concerned, the Stockholm Agreement was superseded by the Geneva Agreement of 1984. It is not currently proposed to revise this Agreement. However, digital sound broadcasting, for T-DAB, was the subject of the Wiesbaden 1995 Special Arrangement. Some means needs to be found to include T-DAB in any revision of the Stockholm Agreement, especially as there is no mechanism for including T-DAB stations in the updated Stockholm Plan.

The original Stockholm Plan made in 1961, provided, with some regional variations, for effectively, three to four television coverages in all countries in Europe, although for a variety of reasons there were cases where the channels were actually used for non-broadcasting services, such as Radioastronomy, Radiolocation and Mobile services in accordance with the ITU Radio Regulations. One of the television coverages is usually in the VHF bands with the remaining coverages at UHF. In the subsequent years a large number of lower power fill-in, or relay, transmitting stations have been co-ordinated in the context of the Stockholm Agreement to provide nearly complete coverage of a territory, or in some cases additional services. The total number of stations now exceeds 85,000, although not all of these are included in the updated Stockholm Plan.

More recently, to facilitate the early introduction of terrestrial digital television broadcasting, 34 CEPT countries have signed the "Multilateral Co-ordination Agreement relating to Technical Criteria, Co-ordination Principles and procedures for the introduction of Terrestrial Digital Video Broadcasting (DVB-T), Chester, 1997".

The Agreements of Stockholm 1961 and Chester 1997 enable the start of digital television broadcasting transmissions and ensure the compatibility of existing analogue transmissions with current and future digital transmissions. The Chester Agreement is considered an adequate basis in order to get the transition to digital transmissions started. It established the means to co-ordinate digital stations based on reference interference situations for existing stations by the use of sets of test point locations and usable field strength values. An agreed set of CEPT transmitter data from the member countries, from which to calculate these test points, is expected by the end of 2001.

We now have DVB-T services in operation in some European countries, plans for their introduction in many other countries and ideas for interactive DVB-T being formulated in a few countries. Thus the present situation consists of a mixed analogue television and DVB-T scenario where the number of DVB-T stations is increasing.

However, the existing agreements are by no means ideal to meet the objective of a fully digital broadcasting scenario since they were optimised for an "analogue world" with the digital services simply “added on”. It is therefore necessary to consider a major revision of the existing arrangements. This report provides some initial ideas on the issues that will need to be considered in preparing for the all "digital world", both in terms of a revision of the existing broadcast frequency plan, and the routes by which digital migration might be achieved.

2 REVISION OF THE STOCKHOLM AGREEMENT

In order to make the most efficient use of the available frequency spectrum and to realise the full potential of terrestrial digital television and radio services[1], a new frequency plan must be developed. This calls for the revision of the European Broadcasting Agreement, Stockholm, 1961.

As a result of a CEPT initiative, the Secretary-General of the ITU consulted (letter DM-1163) the administrations of the European Broadcasting Area (EBA - see APPENDIX 1) in August 2000 concerning the possible convening of a Regional Radiocommunication Conference (RRC) for the revision of the Stockholm

[1] In the context of Europe the DVB-T and T-DAB systems have been adopted.

Agreement, 1961 (ST61). As a result of this consultation 43 out of 56 countries in the EBA indicated their support of the revision of ST61.

At the ITU Council meeting in June 2001 there were extensive discussions on this topic and it now seems possible that the geographic scope of the RRC will be extended to include all of Region 1 and some, possibly many, of the neighbouring countries. In this respect, a consultation process was initiated by Council Resolution 1180. It is anticipated the geographic scope of the proposed conference will be decided by January 2002.

2.1 Purpose of the Conference

The general purpose of the Conference (as defined in ITU Council Resolution 1185 - see Appendix 2) is to establish an agreement and associated frequency plan for:

- terrestrial digital broadcasting in the frequency band 174 to 230 MHz[2];
- terrestrial digital broadcasting in the frequency band 470 to 862 MHz[3].

The Conference will also have to establish co-ordination procedures for the transition from analogue to some future broadcasting situation. From the point of view of Europe, the latter would be an all-digital broadcasting situation, but it is not yet clear if that will be agreed as part of the target for the conference. However, it does not prevent the CEPT from having that as its target.

The technical criteria of the ST61 Agreement were established for analogue sound and television broadcasting. However, no provision of the ST61 Agreement prohibits the use of the frequency bands concerned by digital television, whereas the provisions of the ST61 Agreement do not cover the introduction of terrestrial digital sound broadcasting in the band 174 - 230 MHz, because it is stipulated by the ITU-RRB that this band is for television usage.

2.2 Number of sessions, duration and tasks of the RRC

It is proposed to convene the Conference in two sessions. The first session is intended to establish the technical basis for the second session, including the following elements:

- determination of the planning method or methods;
- determination of protection criteria between analogue and digital sound and television broadcasting stations and between digital sound and television broadcasting stations and stations of other services to which the frequency bands in question are also allocated;
- equitable access to the spectrum;
- planning exercises;
- consideration of an orderly transition from analogue to digital television broadcasting.
- other issues yet to be identified.

The first session of the conference will take place in May 2004 and the second session of the Conference, which will develop a revised Agreement and associated frequency plan, will take place sometime in the year 2005 or 2006. The exact date of the second session will be determined by the ITU Plenpotentiary to fit into the overall schedule of ITU conferences and meetings

In between the two sessions – a period about two years - administrations are expected to prepare their requirements, to undertake planning exercises and to make preliminary co-ordinations of those requirements with neighbouring countries.

Taking into account the complexity of the task of the RRC, which includes the development of a scenario for the migration from analogue to digital broadcasting, the duration of the first session is three weeks and that of the second session is a maximum of five weeks.

2.3 The new plan

The new plan will need to deal with the development of digital services in the absence of the constraints imposed by the transmission of analogue signals and the need to protect them from interference. It is not reasonable to imagine that the ITU Planning Conference will establish, once and forever, a plan for the future environment.

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[2] In CEPT member countries, the band 174 to 230 MHz is foreseen for use for T-DAB and DVB-T services.
[3] It should be noted that the situation regarding Band I will need to be clarified.

Rather, it should set a framework within which development can take place. Neither the ST61 nor the GE84[4] broadcasting plans represented the final position for television and radio planning and service development, and there is no reason to suppose that any new Plan will do so either. However, the new plan must be sufficiently forward-looking and sufficiently flexible to cover developments in digital technology in future years.

2.4 Timescale for transition

In general, different countries will have their own timescales for implementation of digital radio and television or may even wish to continue with analogue broadcasting for the foreseeable future. In some countries the timescale for the introduction of digital services may be critical when faced with a rapid penetration of digital satellite and cable services.

Nevertheless, it can be assumed that within the EBA the introduction and market penetration of digital transmission techniques will represent a long-term process in which analogue and digital transmissions will have to be broadcast in parallel over a significant period of time.

Furthermore, the different market developments in the various countries of the EBA necessitate different conversion scenarios that will have to be drawn up at national level. Whilst there will be a need to stipulate phase-out dates for analogue broadcasting systems, which should probably lie between 2006 and 2020, an adequate transition period is needed so that consumers and industry can plan on a reliable basis.

It can be considered that there are two phases of the transition process. The first is the transition from analogue-only to mixed analogue and digital, which might be achieved in a relatively short time scale. The second is a transition from mixed analogue/digital to all-digital, which is likely to take many years. It is probable that the two periods will overlap as it to be expected that each country will need to develop its own timetable and that such timetables will be subject to revision to meet changing circumstances. This process is illustrated in Figure 1.

2.4.1 Start of terrestrial digital broadcasting services

The situation for DVB-T services in Europe (taken from DigiTAG in November 2000) is:

countries having already started:	3
countries planning to start in 2000-2001:	5
countries planning to start in 2002-2003:	11

The situation for T-DAB services in Europe (taken from WorldDAB in 2001) is:

countries having already started:	12
countries planning to start:	9

2.4.2 Start of the all-digital period

This is the period from the analogue switch-off date onwards. The European situation for the terrestrial analogue television switch-off date (also taken from DigiTAG) is:

countries planning for 2005-2010:	3
countries planning for 2010-2015:	5

Comparable proposals for a switch-off for analogue radio are not available. Nevertheless, Germany has taken the lead by setting a goal that will enable analogue radio to be phased out between 2010 and 2015, a target which will be reviewed in 2003.

[4] ITU Regional Administrative Conference for FM Sound Broadcasting in the VHF band (Region 1 and certain countries in Region 3) (2nd session), Geneva 1984.

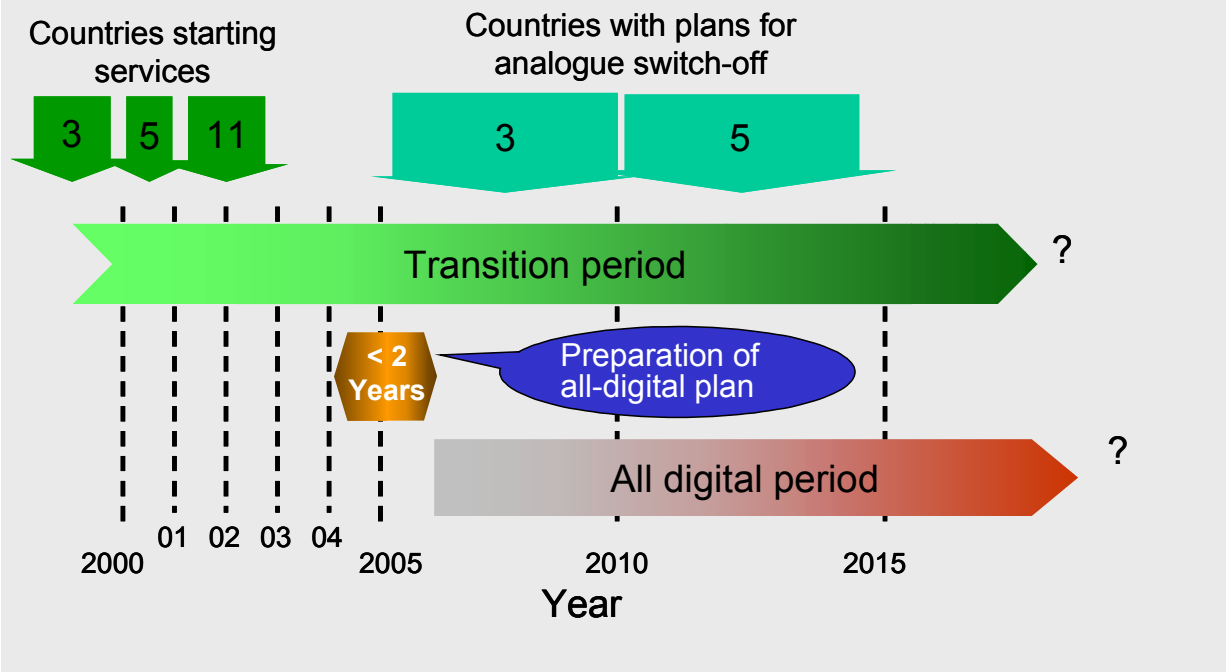


Figure 1 : Timescales for implementation of DVB-T as of November 2000

2.5 Relationship to other plans

The geographic scope of the conference is not yet certain but it is clear that the GE89 Plan for VHF/UHF Television Broadcasting in the African Broadcasting Area and neighbouring Countries (Geneva, 1989) will need to be taken into account in the planning, whether or not the conference covers all of Region 1.

Some European geographical areas (e.g. the Canary Islands) are not within the EBA.

2.6 Relationship to other services

In addition to the other services given in CH97, it will be necessary to identify all other services within co-ordination range of all countries within the area to be covered by the conference.

3 SERVICE REQUIREMENTS FOR AN ALL-DIGITAL PLAN

3.1 General considerations

For television, the global aim is the introduction of DVB-T on a European wide scale and the closure of the less spectrum efficient analogue services – thus providing the opportunity for more or different types of service. In order to achieve this goal and to facilitate the planning the following points need to be decided upon at a national level and will probably differ from country to country:

- **Coverage targets** – coverage requirements for public service networks may differ from those of commercial networks. Near-universal coverage is usually required for public service networks. Furthermore, for each country the number of national, regional and local services will need to be decided.
- **Capacity (multiplex) requirements** – typically many countries are planning for five or more multiplexes or the equivalent data capacity, say 65 to 125 MB/s. Additional capacity may be desired in the all-digital future, for example for the introduction of interactive or data services.
- **Spectrum availability** – DVB-T will use the frequency bands currently allocated to broadcasting services, noting that the availability of spectrum varies from country to country.
- **Reception target** – planning may be required for fixed, portable (indoor and outdoor) or mobile reception. In those countries where only a small percentage of households rely solely on terrestrial reception, portable and mobile reception may provide the market opportunities for the introduction of DVB-T.
- **Transmission infrastructure** – This will not be a conference issue, but is likely to have a significant impact on the preparation of plans and pre-co-ordination of requirements and is an important element in the preparation of requirements for the conference and will have an impact on cost and spectrum efficiency.

Many of the above issues are inter-related.

3.2 Coverage Requirements

Individual coverage requirements for both radio and television can be identified as national, regional, or local. For a large majority of countries, there is a clear need for all of these three for radio coverages and for both national and regional coverages for television.

In this context, a **national** coverage is assumed to cover the national territory with the same programme material without any sub-division at any time. Similarly, a **regional** coverage carries the same programme material throughout a region without any sub-division at any time.

Local coverages are primarily intended to cover only part of the more densely populated areas to provide for local programme needs.

For each of these coverage requirements, different network configurations may be appropriate (MFN, SFN or mixed MFN/SFN) See Technical Annex for further details.

The results of an EBU Questionnaire sent at the beginning 1999 indicated that about half of the analogue television programmes had national coverage. For the other half, the number of regions varied between 2 and 24 depending on country size and the region size varied from diameters of 20 km to up to more than 100 km. The number and the size of the European regions were very different from one country to another, even for countries of comparable size. Clearly, the size of the country and any internal linguistic or cultural conditions has a major impact on the size of the coverage requirement. In the case of radio, in many countries there are more local radio coverages than there are national ones.

The ability to provide local and regional coverage is an additional feature of terrestrial broadcasting which is likely to need to be extended in the all-digital world.

3.3 Existing known requirements

By looking at the existing known terrestrial digital television (DVB-T) requirements, based on EBU and DigiTAG surveys, for a number of countries in Europe, the following requirements have emerged:

- the number of multiplexes is typically five or more, representing a capacity of 65 to 125 MB/s;
- the minimum coverage required before analogue television can be switched off is >90%;
- reception conditions include fixed, portable and in the future, mobile reception;
- interactivity is important;
- high speed delivery of internet data may be a future application which can be included in the spectrum requirement; the extent of coverage may vary between services even within a single country.

3.4 Individual countries' DVB-T requirements

In order to gain an impression of various countries' requirements the table in APPENDIX 3 has been prepared as a summary of current proposals based on information taken from DigiTAG or FM PT24 Members. APPENDIX 4 provides further details of ideas on migration from a few individual countries.

From the information currently available it is clear that:

- it is unlikely that there will be a common analogue television switch-off date for all countries;
- the key parameters of the regulatory framework for DVB-T are being defined at the national level with considerable variation between different countries as a result of distinct legal, market and cultural conditions.

3.5 Individual countries' T-DAB requirements

In 2000 WorldDAB Spectrum Lobbying Committee (SLC) carried out planning exercises in order give indications on spectrum demand for T-DAB in Europe[5]. Five areas were selected to illustrate different situations in Europe such as big cities surrounded by medium size cities, countries where only the 1.5 GHz band can be used in the short term, countries where only VHF can be used in the short term, countries with a particular administrative subdivision and countries separated from other countries by water.

The investigation based on the premise that if DAB is to be successful it should provide the listeners with at least what FM already offers today. It produced the following results:

European Area	Estimated service requirements					
	2000		2005		2010	
	Migrating analogue services	New digital services	Migrating analogue services	New digital services	Migrating analogue services	New digital services
London and South East England	28	16	113	28	117	43
Stuttgart and South West Germany	76	-	135	39	135	165
Rome and environs	13	-	194	11	217	38
Malmoe and Southern Baltic	27	10	123	60	284	110
Paris and environs*	27	10	45	9	54	18

*If satellite systems work, there will be a need to find T-DAB spectrum in band III, even in France

It should be noted that the above service requirements comprise of national, regional, sub-regional and local. In the case of local services service requirements, which account for some of the large numbers indicated above, it is generally considered in the WorldDAB study that the requirements would be met in the 1.5 GHz band.

[5] "Can we satisfy the future DAB spectrum demand", World DAB Forum, SLC Report on DAB Spectrum Demand 2000-09-06.

4 FREQUENCY BANDS

4.1 General

The DVB-T system can in principle be applied in all television bands. However, the system was primarily designed for DVB-T services to operate within the existing UHF spectrum allocation for analogue television; with 8 MHz channel spacing. There are also indications that the use of Band III (174 to 230 MHz) is being considered in some countries. Band III propagation is particularly suitable for portable and mobile reception, because of the homogeneous field strength distribution that can be achieved in that band, together with power budget considerations regarding large area coverage. For the same reason Band IV may be preferred to Band V for portable and mobile reception.

A challenge to be faced within Band III is the existence of several channelling arrangements, including the use of 7 MHz and 8 MHz bandwidth channels – see Technical Annex. Any possible move to a uniform channel raster presents a long-term challenge due to the existing complex situation. – see also Technical Annex.

A further consideration in Band III is its use for T-DAB, for which the block spacing was based on the use of a 7 MHz channel raster for television in some countries. Whilst the frequency band from 174 to 216 MHz is primarily used for terrestrial analogue television, there are some T-DAB allotments in this band. The frequency band 216 to 230 MHz (240 MHz in some countries) is mainly allocated to T-DAB in CEPT member countries; nevertheless there is still widespread use of part of this band for television.

In order to meet the future needs of digital television and T-DAB in Band III there will need to be either a complete split of Band III between digital television and T-DAB, or some form of sharing of the available channels between these two services. Perhaps one approach to the revision of ST61 would be to plan DVB-T from the lower frequencies up and T-DAB from the top channels down. Further consideration on the future use of Band III is given in the Technical Annex.

4.2 The Future of the Wiesbaden 95 Arrangement

As regards the Wiesbaden Special Arrangement, there are a number of options for the future:

- A complete re-plan of Band III T-DAB;
- Transfer the WI95 plan into the revised ST61.

The geographical difference between Region 1, the European Broadcasting Area and the CEPT countries is a complicating factor, because countries outside the CEPT are not party to WI95 and are unlikely to accept any constraints based on its direct transfer into a revised plan.

Ultimately a flexible approach is likely to need to be adopted as regards the use of T-DAB or DVB-T in specific channels in Band III because of the different situations and timeframes all over Europe, or even within one country. Sharing criteria and clear procedures for both kinds of use are thus likely to be needed. Such an approach might allow for the inclusion in a revised ST61 plan of allotments/assignments which might be implemented as either DVB-T or multiple T-DAB blocks.

A recent WorldDAB study leads to the conclusion that the spectrum requirements for T-DAB are not geographically uniform and that the success of T-DAB depends on increased spectrum availability within the next 10 years and this includes in Band III.

4.3 DVB-T in Band III

The following advantages have led to an increased interest in DVB-T in VHF Band III:

- Coverage for large areas is achieved with fewer transmitters than are required at UHF);
- Mobile reception (reduction of Doppler effect).

In VHF the propagation conditions are different from UHF, therefore networks can be built in an alternative way.

At VHF the Doppler shift for mobile reception is less than at UHF due to the lower frequency. This is a clear advantage for VHF when administrations consider deploying mobile DVB-T.

4.4 Mobile DVB-T

Whilst the implementation of DVB-T in Band III for fixed/portable reception has not been a priority to date, it is likely that a revision of ST61 will lead to more detailed study of the possibilities by countries. The provision of DVB-T to mobile receivers has been studied for some time. Band III has advantages over UHF with respect to mobile reception of DVB-T (e.g. reduced Doppler effect). These advantages have been discussed and explained in other fora (such as the ACTS Motivate project). It will be necessary to determine the parameters required within a revised ST61 Plan to define the stations and coverage area of any mobile DVB-T service.

4.5 Equitable access to spectrum in Band III

DVB-T in the UHF bands will use a channel bandwidth of 8 MHz. In parts of Western Europe the VHF channels, at present, have a bandwidth of 7 MHz while in other (the greater) parts 8 MHz channels are used.

A 7 MHz channel offers a lower DVB-T transmission capacity than an 8 MHz channel.

It has been announced by some countries that they want DVB-T in Band III and the Mandate for the Conference (2006) will include this Band. It is, at present, considered unlikely that the VHF channels in the range 174 – 216 MHz can provide full coverage by means of the available 6 channels (7 MHz each). It can therefore be expected that UHF channels will be needed to complete the coverage of these networks. In order to avoid dual encoding and multiplexing of the DVB-T signals (one for VHF and another for UHF) it would be desirable to have the same transmission capacity in both VHF and UHF channels, i.e. 8 MHz.

Changing the VHF channel width from 7 to 8 MHz also offers another advantage: the problem with overlapping channels would disappear and thereby facilitate planning.

5 PLANNING METHODS

Details of planning methods can be found in the Technical Annex.

6 PLANNING TOOLS

Due to the complex nature of the foreseen requirements and the many variables that can be input to the planning process, it is considered that the planning should be computerised both for the work at the conference, including planning studies, and the inter session work.

Nevertheless, the broadcast requirements will need to be stated in advance and the plan optimised at the end, otherwise it is likely that the plan will be re-created during each intermediate step in the planning process. It is important to note that the intermediate steps in the planning process will not necessarily provide optimum spectrum utilisation or optimum coverage as this would normally mean frequency changes at each step and this is likely to be very disruptive for both viewers and broadcasters.

In preparation for the RRC it is anticipated that a suitable ITU group will be established to develop planning tools in order to aid administrations in the preparation of their requirements prior to the second session of the RRC. Furthermore, it is expected that an ITU Planning Project Team will be established to undertake planning exercises prior to the second session of the RRC. It is probable that CEPT and EBU will be requested to play a leading role in the development of software planning tools.

7 SPECTRUM REQUIREMENTS

7.1 Spectrum requirements for DVB-T

7.1.1 General

In terms of spectrum requirements, guidance can be obtained from a report on the results of the theoretical studies on the amount of spectrum required in the all-digital future to provide digital television coverage throughout Europe[6].

The theoretical studies have concentrated on the amount of spectrum required to provide digital television coverage throughout Europe for a set of representative coverage requirements in the all-digital future. These studies allow different scenarios to be compared, and demonstrate the complexity of a trying to achieve a single planning solution for the whole of Europe.

This is an initial study using theoretical considerations and will need to be followed by the further study which will take into account 'real world' constraints such as national boundaries and the use of existing transmitter sites to form the backbone of the coverage. The work to date (March 2001) has concentrated on the spectrum requirements for fixed and portable reception of terrestrial digital television transmissions occupying spectrum in the UHF bands currently used for analogue television. The results of further studies extending the work to Band III are expected in early 2002.

For the purpose of the studies so far it has been assumed that UHF bands have been cleared of the existing analogue television transmissions so that it was not necessary to consider any interactions except those between digital television services.

The number of channels required depends on many parameters including the DVB-T system variant (as outlined in the Technical Annex), reception conditions, transmitting antenna height, distance between transmitters, coverage targets and network structure.

7.1.2 Results of studies carried out up to March 2001

The DVB-T standard offers numerous possibilities, compared to analogue transmissions and therefore many different possibilities for providing different types of coverage were analysed. It is **multi-criteria** due to the large choice of DVB-T variants and also **multi-parameter** due to the many possible network configurations that can be used. It therefore must be recognised that this is a multidimensional subject, requiring inputs from many parties, with no single and universal solution. As a consequence, the studies were limited to a sub-set of the criteria that were being proposed for use, or are already in use, in different countries, but extended to permit the examination of a wide range of planning parameters, not all of which would be realisable in practice.

The studies are theoretical and assume the ideal case of a quasi-infinite area where the population is distributed evenly. They do not take into account country boundaries or any subdivision of a country into regions or interaction with any other services, including analogue television. In order to allow investigation of the number of channels needed for less than 100% coverage, the term "percentage pixel coverage" has been introduced. The provision of complete coverage, where at least one specific television multiplex is receivable at any location, is described as 100% pixel coverage (see the Technical Annex).

The results of the calculations of the number of RF channels needed to provide coverage for MFN and for SFN network structures are presented in two ways. Firstly in terms of the "numbers of channels" per multiplex and secondly, in terms of the "equivalent number of channels" needed to provide a given data capacity. A comparison of the spectrum requirements for different DVB-T variants can easily be made using the concept of ''equivalent number of channels''.

A set of curves, which give the "number of channels" and "equivalent number of channels", needed to provide a given level of coverage, can be examined with a desired network configuration in mind. This examination will show which of the DVB-T system variants needs the lowest number of channels to provide a specified data

[6] "Report from ad-hoc group B/CAI-FM24 to B/MDT and FM PT24 on spectrum requirements for DVB-T implementation", March 2001. EBU BPN 038.

capacity – an important factor in any comparison of variants. However, it must be remembered that the "equivalent number of channels" concept is an artificial one and does not represent any absolute quantity of spectrum; on the other hand, the concept of 'multiplex' is not really meaningful unless there is also a specification of what it can achieve in terms of programme capacity. Furthermore, it must be remembered that the whole process is a theoretical one based on a semi-infinite plane populated by a uniform lattice of transmitters. An example of a set of curves giving the number of channels and equivalent number of channels needed for fixed antenna reception for different modulation and for 95% of locations and 100% of pixels is provided in figures 2 and 3 at the end of this paragraph. This is only an extract, BPN 038 gives curves for other DVB-T variants and for many networks configurations for fixed and portable reception.

For many reasons, countries may adopt different configurations of network: MFN, SFN or mixed MFN-SFN and different DVB-T variants. The choice of variant would probably be mainly 64 QAM and 16 QAM, but QPSK and hierarchical variants cannot be excluded. Each choice can be justified by the particular needs of each country or network operator. *It is therefore impossible to give a simple and unique answer to meet every country's requirements*.

To illustrate this, for an MFN, a simple example would be where 18 channels are made available to provide a data capacity of 48 Mb/s with a specific target (say, fixed antennas, 95% of the locations, 100% pixel coverage). The transmissions could use either: three 16 QAM multiplexes each using 6 RF channels; or, two 64 QAM multiplexes each using 9 RF channels.

The same illustration could be made for an example of SFN planning (fixed reception, 95% location, 100% pixel coverage) with 50 km service area width, which needs 9 channels to transmit a multiplex of 64QAM or 7 channels to transmit a multiplex of 16 QAM. Referring to the 'equivalent' channel requirements to carry the same data capacity", the figures would be 9 channels (72 MHz) for 64 QAM and 11 channels (88 MHz) for 16 QAM. Considerable care is needed with this example because of the distorting effect of rounding the number of channels needed upwards to a rhombic number. Each solution presents advantages or disadvantages depending on different national points of view.

Depending on the theoretical scenario chosen, the number of channels needed for complete coverage of a multiplex is in the range:

I. **For fixed antenna rooftop level reception and the MFN case**, 6 to 9 (for 64 QAM with a capacity of 20 to 24 MB/s) and 4 to 6 (for 16 QAM, with a capacity of 13 to 16 MB/s) (the range depends mainly on the distance between transmitters and on the effective antenna height).

MFN – Fixed antenna reception 95% locations, 100% pixel, distance transmitters 50 – 100 km				
Effective antenna height (m)	Number of channels		Equivalent number of channels	
	64 QAM	16 QAM	64 QAM	16 QAM
150	9	6	9	9
300	6	4	6	6

II. **For portable indoor antenna reception and SFN case**, 4 to 16 (for 64 QAM) and 4 to 12 (for 16 QAM) (the range depends mainly on the service area width). (*Note: this calculation for MFN gives an unrealistic number*)

SFN – Portable indoor reception, 95% locations, 100% pixels						
Service area diameter	Number of channels			Equivalent number of channels		
	64 QAM	16 QAM	QPSK	64 QAM	16 QAM	QPSK
50 km	16	12	7	16	18	21
150 km	4	4	3	4	6	9

It is important to recognise that the spectrum requirements given above, which show that a minimum of 4 channels would be needed for complete coverage for one multiplex, are theoretical values and will be higher for practical situations. For instance, in an MFN this would only be possible with very small distances between transmitters (less than 20 km) and with a uniform antenna height of between 150 m and 300 m. For an SFN, this would only be possible with highly symmetrical hexagonal coverage areas. It would not be possible to apply these constraints in most European countries.

Furthermore, the studies assumed that population is evenly distributed (which is not true) and that they do not take into account country boundaries or any subdivision of a country into regions. In this respect the impact of real-world considerations, which are sometimes far from the models (even if some countries fall completely within one of the models) will distort the theoretical results.

In terms of spectrum requirements for MFN and SFN solutions, it is not realistic to make direct comparisons in terms of number of channels needed, due to the complexity of the scenario. The frequency planners must compare the two network configurations, MFN & SFN, by means of specific calculations taking into account the criteria and parameters chosen and the actual assumptions of the area to be covered.

Overall, it should be noted that the above results are based purely on theoretical studies and that future work will be based on practical situations. Studies are also needed to evaluate the spectrum requirements for digital television transmissions in VHF band III and for mobile television reception at both VHF and UHF.

An example (from BPN 038) of curves giving the number of channels needed for fixed antenna reception (Figure 2) and equivalent number of channels for fixed antenna reception, (Figure 3), for 95%locations, 100% pixels, is as follows:

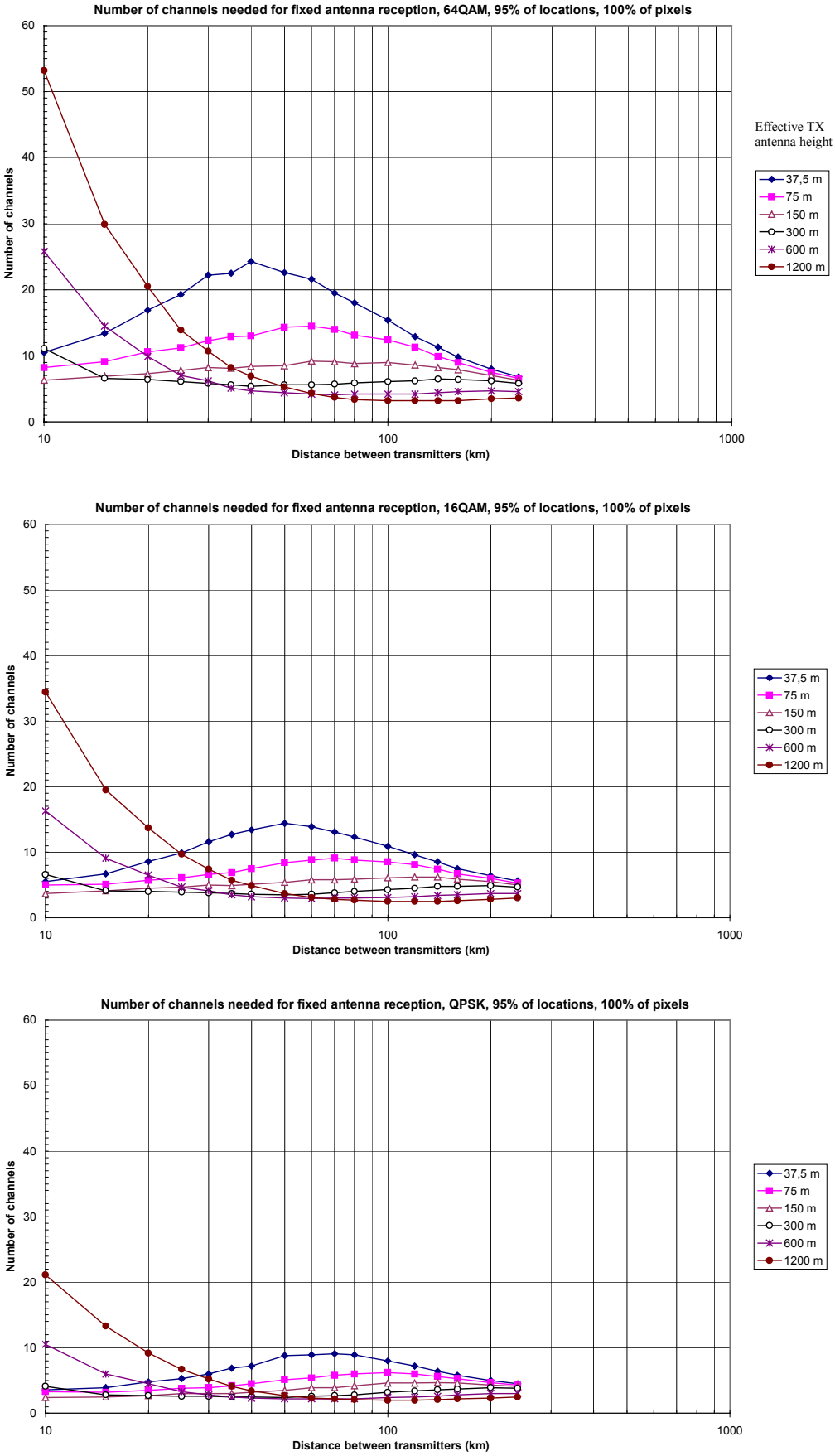


Figure 2 : Number of channels needed for coverage with 1 multiplex, for fixed antenna reception, using 64QAM, 16QAM or QPSK, giving different data capacities, Location probability: 95%, pixel coverage: 100%.

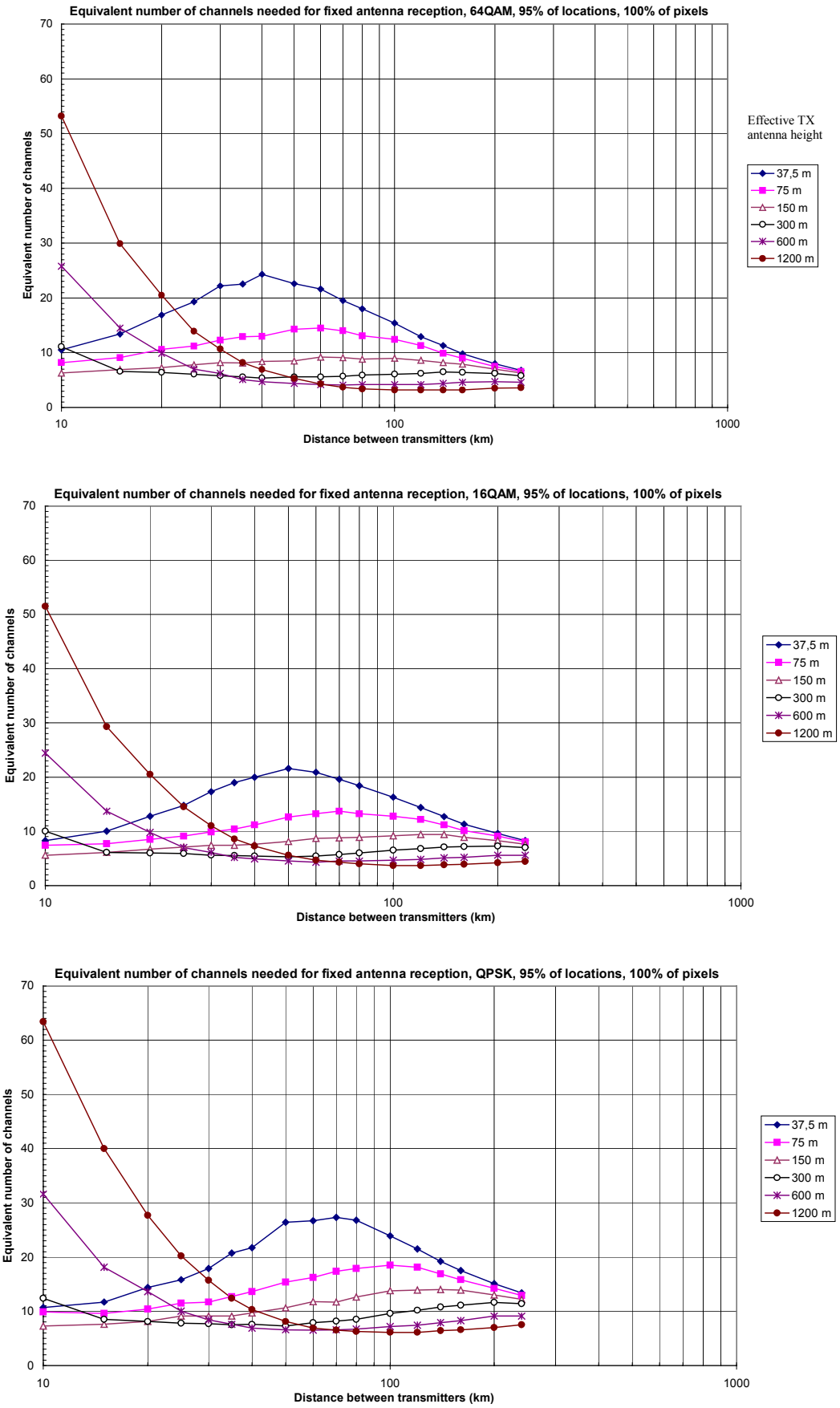


Figure 3 : Equivalent number of channels needed for coverage with the same data capacity (20-24 Mb/s), for fixed antenna reception, using 64QAM, 16QAM or QPSK, Location probability: 95%, pixel coverage: 100%.

7.1.3 Initial conclusions from spectrum requirement studies

- It must be recognised that any study into the frequency requirements for future digital television in Europe is a multidimensional subject requiring inputs from many parties.
- It appears that digital television will use less spectrum than analogue television to carry the same number of programmes under the same conditions and will offer the possibility of new services.
- The results given in the current studies are for a wide choice of network configurations, which demonstrates the influences of the criteria and parameters on the number of channels needed for a complete coverage of one multiplex.
- The final choice of system must be made on a country-by-country basis as each country may have different requirements to those of its neighbours and therefore there is no single and universal solution.
- It will be necessary for administrations to decide, knowing all the parameters and criteria and including the possibilities of new multimedia services, how to use the spectrum in a new frequency plan in preparation for the revision of the Stockholm (1961) Agreement.
- In Band III the sub-band 216 - 230 MHz must be considered fully occupied by T-DAB. It is furthermore expected that some countries will require more T-DAB capacity in this Band than already available.
- Further work is required to study spectrum requirements in the real world environment, to evaluate the spectrum requirements for digital television transmissions in VHF Band III and for mobile television reception at both VHF and UHF. This will be carried out by EBU project group B/MDT-M1.

7.2 Spectrum requirements for T-DAB

As a result of the T-DAB programme requirements as given in Section 3.5 the WorldDAB Forum have calculated that for five representative European areas the projected frequency block requirements (1.536 MHz per block plus guard bands) for Band III are as follows:

European Area	Estimated frequency blocks required		
	2000	2005	2010
London and South East England	5	6	7
Stuttgart and South West Germany	3	8	9
Rome and environs	2	9	10
Malmoe and Southern Baltic	9	18	22
Paris and environs*	0	0	0

*If satellite systems work, there will be a need to find T-DAB spectrum in band III, even in France

It is clear from these projections that the Band III spectrum requirements for T-DAB are not uniform across Europe. Furthermore, it was concluded that more spectrum is required in metropolitan areas where there are already many radio stations and in areas where there are coordination issues between countries.

8 FREQUENCY PLANNING OPTIONS FOR DVB-T[7]

8.1 Frequency Planning Options for the transition to the all digital period

There are basically three obvious options for achieving an all-digital plan for terrestrial television in Europe:

a. the conversion of existing analogue assignments into digital assignments. The analogue assignments may either be currently in use or unused for analogue television broadcasting;
b. a plan based on current digital television assignments (new frequencies not previously used or reserved for analogue television);
c. a completely new plan.

[7] Frequency planning options for T-DAB need to be developed.

These options may be combined, for instance:

- the current digital television assignments could be retained and the existing analogue assignments converted;
- part of the spectrum could be completely re-planned but existing assignments could be retained in another part of the spectrum.

In many countries, television station assignments for channels 61 to 69 are not included in the Stockholm plan and so a new digital plan could be devised for that part of the spectrum.

Some approaches to the all-digital future (e.g. wide area SFNs) may only be achievable with a re-plan.

8.1.1 Advantages and disadvantages of various Frequency Planning Options

A. Conversions in accordance with CH 97

Advantages

- Conversions will generally be compatible with existing analogue services in neighbouring countries, and in the same country.
- Countries can retain their assignment rights.
- The transition to an all-digital future can take place by the bilateral agreement between countries inherent in the conversion process.
- For fixed reception, it should, in general, be possible to match the existing analogue coverage for each digital transmitter.
- There is scope for further extension and improvement when the analogue service is switched off.

Disadvantages

- It may not lead to equitable access because of the changes which have taken place in spectrum usage since the Stockholm Conference and because of the development of differing requirements in different countries;
- It will not lead to the optimum plan for efficient use of the spectrum by digital services.
- If the frequency to be converted is still in use for analogue broadcasting, then viewers will undergo an abrupt transition when the conversion takes place.
- It restricts the scope for SFN planning.
- There may not be sufficient capacity i.e. in many countries there are fewer analogue networks to convert than the number of digital multiplexes required unless further developments take place.
- It may be more difficult to find contiguous blocks of spectrum which could be used for additional applications.

B. Existing DVB-T Network

Advantages

- The transmission equipment would already be in place.
- Viewers who can receive the new digital services will not notice any transition.
- Any necessary co-ordination agreements will already be in place.
- There is scope for further extension and improvement when the analogue services are switched off.

Disadvantages

- Not many countries have DVB-T networks; it may not lead to equitable access.
- It may not provide optimal spectrum efficiency initially.
- Coverage will be limited during the transition period due to the need to protect the analogue services.
- It may be more difficult to find contiguous blocks of spectrum which could be used for additional applications.

C. Complete re-plan

Advantages

- It is more likely to lead to equitable access.
- It should be better optimised for spectrum efficiency.
- It should provide the identification of spectrum for additional applications.

Disadvantages

- The transition will be more difficult.
- For fixed reception, new receiving antennas may be required in some cases.
- Synchronising the transition to the all-digital future between different countries will be more difficult.
- New co-ordination agreements are required.

8.2 The need for a flexible planning approach

Given that there are likely to be different service requirements, timescales and frequency availability in different countries a flexible approach to the planning and implementation process will be essential. Moreover, the difficulty expected in building an optimised and efficient plan, with equitable access for all countries, and without service disruption for viewers, also demands a flexible approach.

8.3 Two session approach to establishing a plan

The two-session approach envisaged for the revision of ST61 (and probably GE89) will help to meet the "flexible" requirement, with:

- a 1st Session to establish the technical basis and agree on the detailed planning method;
- a 2nd Session to draw up the Agreement and the associated Plan;

.

This procedure[8] means that:

- national requirements can be formulated on an internationally agreed basis;
- pre-co-ordination of the national requirements with neighbouring administrations is encouraged;
- the basis of which interference calculations and incompatibility checks can be made;
- progress on unresolved questions can be reached by intersessional work.

By following this procedure the drawing up of the international plan is facilitated, interference problems are minimised, or at least controlled, and national requirements, (i.e. national plans) become, after successful coordination, a part of the international plan. Amendments of national plans after the coming into force of the international plan are of course possible, provided that they are within the internationally limits for increases of interference.

8.4 Stepped approach to implementation of a plan

An approach to the implementation of an all-digital plan might be to agree a plan at the RRC05 and then adopt a stepped approach to it via interim plans at a multilateral level.

This approach would be based on a computerised plan synthesis and analysis for the final all-digital plan and also for any intermediate steps where only a number of countries want to go fully digital. The station characteristics (analogue and digital) in each interim plan would almost certainly have to change to a certain extent. The more countries in a certain area that go digital, the more the latest version of the interim plan could mirror the final digital plan for that area.

The dominant feature will almost certainly be the requirement to continue to protect the stations which remain analogue and this requirement will need to be built into the agreement.

[8] This approach was successfully applied in the preparations for conferences such as the VHF Sound Broadcasting Conference (1984) and the African Broadcasting Conference (1989).

9 PLANNING ELEMENTS

The revised plan, as agreed at the planning conference, will need to provide a framework in which individual countries can continue to develop their individual and different requirements on an equitable basis, if they wish to do so. The plan should however, be sufficiently complete that further work by administrations is not seen to be mandatory. Moreover, the planning concepts will need to be simple such that the overall plan can be maintained with the minimum of resources

The following sub-sections are intended to provide some further ideas on the topics that may need to be included in preparing a set of planning elements.

9.1 General conditions to be defined

a) Equitable access
b) Frequency Bands to be used
c) A set of system values
d) Reception modes
e) Network structures
f) Planning to be based on assignments and/or allotments

9.2 Planning elements

a) Coverage definitions
b) Co-ordination distances
c) Test-points
d) Interference Margins
e) Necessary characteristics of assignments or allotments

9.3 Agreed migration strategies

Proposals will need to be developed if migration strategies are to be agreed. This will particularly concern the extent to which pre existing analogue and digital coverages will have to be protected.

10 TRANSITION FROM ANALOGUE TO THE ALL-DIGITAL BROADCASTING SITUATION

The new planning process will probably have to consider how to achieve the transfer of services to a digital form while neither:

- disrupting millions of viewers (and listeners as T-DAB is likely to be involved if a part of Band III is also planned for DVB-T); nor,
- creating a non-equitable distribution of resources between countries,

as it is unlikely that many of the countries in Region 1 will be satisfied with a new agreement which does not also include a migration approach. This may not be necessary in the case of T-DAB as it will be regarded as an additional service by many people rather than a replacement. This should help to reduce any possible difficulties.

It will be very important to minimise disruption of terrestrial services since viewers will have the choice of other delivery media (e.g. cable and satellite) and it will be easy to lose consumer loyalty if the transition process is not handled carefully and sensitively. The process is different from that of previous conferences in that the new digital services are being introduced into bands where existing services have to be maintained for the near future.

The equitable distribution of spectrum is likely to be a major political issue as not all countries will want to, or be able to make the transition in the same timeframe, indeed there are likely to be differences of timeframe even within a single country. Special solutions will be required in national border regions where countries do not introduce digital services at the same time. It could be argued that one of the primary tasks for the Conference will be to ensure that any difficulties are only temporary and, ideally, that they affect to a greater extent the country which wishes to change to digital first.

10.1 Three possible approaches

Whilst three examples of the approach to transition are given below, these are not likely to be optimal, nor will they meet the requirements of all countries. Rather, they are ideas being considered in one or more countries. Therefore, it is to be expected that other ideas will be developed in the fullness of time.

10.1.1 Example 1*: Insular digitisation and simulcast*

A move from analogue to digital television transmission would be made substantially easier by the provision of a sufficient number of additional frequencies. These are not currently available in many countries in Europe, except in channels above 60 in some countries. Therefore, frequencies needed for digital transmissions below channel 60 must basically be obtained by converting some of the current analogue transmissions. Where this process is not possible on a simultaneous and nation-wide basis, it needs to be implemented in a spatially restricted and staggered fashion in "islands". An island consists of the coverage area of the analogue transmitter to be converted

In order to provide digital services to as large a section of the population as possible and as quickly as possible, and thereby to give the manufacturers of DVB-T reception equipment the opportunity to produce price-lowering volumes of units, it makes sense to begin simultaneously in several islands with a high proportion of the population and with transmitters with a high coverage range. By its definition, the island concept will not provide full geographical coverage and this will only be achieved on the basis of the results of the conference.

In order to protect the consumers and to ensure planning certainty, there is in principle a need for a simulcast phase. This will have to be longer at the beginning of the conversion process than at the end and may differ from island to island for various reasons. In some islands, resources may not permit full simulcast operations. The reception of the analogue programmes being broadcast may also deteriorate. For the switch-off, switch-off criteria must be stipulated. These can include a defined digital penetration target and minimum and maximum periods for the simulcast. The impact of the criteria may be subject to regional variation.

10.1.2 Example 2*: Receiver penetration threshold*

In this scenario DVB-T will be introduced and simulcast in parallel with current analogue transmissions until the digital services take-up reaches a certain percentage.

Based on the "coverage reaches a certain percentage" case, one particular country is considering the following implementation model based on conversions of analogue transmitters:

- Continue to introduce a parallel DVB-T infrastructure, initially in the main cities, alongside analogue television. It is anticipated that there could be a freeze of parallel DVB-T introduction when its coverage reaches about 95% of the population.
- Identify regions with the highest digital take-up. For each of these regions arrange to make DVB-T "free" basic receivers available to analogue only households. Run information messages on analogue to inform consumers that they will need to get a basic digital receiver.
- Progressively convert analogue transmitters to digital, in order to increase the coverage, on a region-by-region basis, beginning with those areas with largest percentage of digital subscribers. Greater than 98% fixed reception DVB-T coverage might ultimately be achieved.

As an alternative to the above, the few remaining analogue viewers unable to receive digital signals could be provided with satellite receivers (assuming that the existing programme services are on the satellite). In this case it may not be necessary to extend the DVB-T services to the full extent of the analogue services which are to be withdrawn.

10.1.3 Example 3*: Forced switch off*

The analogue service is simply switched off or alternatively an announcement is made that the analogue service will be switched off at a given date in the future. Countries where there exists a high penetration of cable and or satellite may particularly consider this approach but there could still be some political problems.

10.2 Simulcast Coverage

Where a country decides to simulcast analogue and digital services, in order to provide continuity of service to all viewers, the result will be a non-optimum use of the spectrum and it will also incur extra costs. Therefore, the simulcast period should be as short as possible.

Where there would be simulcasting of the current analogue services during the transition, full coverage of the terrestrial digital services during the transition will not be possible in many countries because of the need for the power of many of the digital stations to be kept low in order to protect analogue reception. This may lead to a gap in coverage between analogue and digital terrestrial during the migration period and any such gaps can only be made good after the analogue services have been switched off.

10.3 Timescales for Analogue to Digital Switch-Over

At present it is not feasible to establish a common analogue switch off date for all CEPT countries. Nevertheless, national governments can play an important role by giving a clear indication to broadcasters, equipment manufacturers and consumers of a provisional timetable for switch off.

Criteria such as universal coverage and affordability may need to be specified and fulfilled before the analogue switch off process begins. Although universal coverage is desirable, in some countries, it may not be cost-efficient to achieve levels of digital terrestrial coverage comparable to those presently achieved by terrestrial analogue coverage. Universal coverage may therefore need to be understood within a multi-platform delivery.

11 ADDITIONAL USES FOR THE BROADCAST SPECTRUM

Based on the initial estimates for DVB-T, and the existence of other services in many countries, it is difficult to be precise at this time over the amount of spectrum, if any, which might be available for additional services in the broadcasting bands. The various competing requirements will clearly have to be prioritised.

Clearly studies are still going on concerning the frequency plan to be implemented in the all-digital period and the amount of spectrum required. In any case the potential for uses of broadcast spectrum by other services, in a given geographical area, is likely to be constrained until the time scales are known for the close down of analogue television.

Moreover, at the present time the choice of frequencies within the broadcasting bands is not clear as there are some advantages associated with the upper and lower parts of Bands IV and V.

Although potential additional uses of the spectrum do not have a direct impact on preparations for the revision of ST61 it may affect the input requirements of a given administration. In any case it is likely that their will be some convergence of services.

Further information on convergence and additional services and is given in APPENDIX 5.

12 INITIAL CONCLUSIONS

1. In order to make the most efficient use of the available frequency spectrum and to realise the full potential of terrestrial digital television services, a new frequency plan must be developed. This calls for the revision of the European Broadcasting Agreement, Stockholm, 1961.
2. The preparation of the revised plan for Europe is expected to take place at a two-session conference; the first to establish sharing criteria and planning rules, and the second to agree on a plan and the regulatory procedures for the modification of that plan. For the success of the second session it is essential that individual countries consider their requirements and agree them with neighbouring countries during the intersessional period.
3. The re-planning for DVB-T will involve Bands IV and V, plus Band III. T-DAB will also have to be accommodated in Band III.
4. The revised plan for Europe, as agreed at a planning conference, will need to provide a framework in which individual countries can continue to develop their individual and different requirements on an

equitable basis. Nevertheless, the planning concepts will need to be simple such that the overall plan can be maintained with the minimum of resources

5. Given that likely service requirements, timescales and frequency availability will be different in the various European countries, a flexible approach to the planning process is essential. The options available include:
   - conversion of existing analogue assignments (via the CH97 rules);
   - use of existing digital assignments;
   - a completely new plan.

   In practice it seems that a combination of these methods may be required to develop a plan within which countries can develop their individual requirements.

6. In general, within Europe, it can be assumed that the introduction and market penetration of digital transmission techniques will represent a long-term process where analogue and digital transmissions will have to be broadcast in parallel over a significant period of time.

7. Based on currently available information it is unlikely that there will be common time scales for all countries for the transition from analogue only to all-digital. Moreover, the key parameters of the regulatory framework for DVB-T are being defined at the national level with considerable variation between countries as a result of distinct market and cultural conditions.

8. Whilst it is not feasible to establish a common analogue switch off date for all countries, national governments can play an important role by giving a clear indication to broadcasters, equipment manufacturers and consumers, of a provisional timetable for this switch off.

9. It can be expected that the migration to digital services will be on an area-by-area basis.

10. In terms of services to be accommodated the interest in portable reception is increasing and interactive television is important. Furthermore, DVB-T can provide an efficient means to bring multimedia services which are of general interest to all viewers, making DVB-T a key component of the "Information Society" All of this makes it all the more important to provide an in-depth examination of the coverage possibilities.

11. Studies are still going on concerning the frequency plan to be implemented in the all-digital period and the amount of spectrum required. It is still too early to say if parts of the broadcasting bands could be used for additional applications. The potential for uses of broadcast spectrum by other services, in a given geographical area, is likely to be constrained until the time scales are known for the close down of analogue television.

12. The technical criteria of CH97 are still adequate to a great extent. Some additions, refinements and clarifications are needed. These include:
   - criteria for mobile reception; minimum field strength values have been established and speed limitations due to the Doppler effect are indicated. No account is taken of expected improvements achieved by the use of diversity reception.
   - the concept of "pixel coverage"; this concept has been introduced in order to make theoretical coverage calculations for less than full coverage.
   - clarification of protection ratios, a number of inconsistencies between protection ratios for different conditions and system variants have been identified.

APPENDIX 1 : ITU Member States belonging to the EBA

(Based on ITU RR No. S5.14)[9]

CEPT Countries

No	Country Symbol	Country Name
1	ALB	Albania
2	AND	Andorra
3	AUT	Austria
4	AZE	Azerbaijani Republic
5	BEL	Belgium
6	BIH	Bosnia and Herzegovina
7	BUL	Bulgaria
8	CVA	Vatican City State
9	CYP	Cyprus
10	CZE	Czech Republic
11	D	Germany
12	DNK	Denmark
13	E	Spain
14	EST	Estonia
15	F	France
16	FIN	Finland
16	G	United Kingdom of Great Britain and Northern Ireland
18	GRC	Greece
19	HNG	Hungary
20	HOL	The Netherlands
21	HRV	Croatia
22	I	Italy
23	IRL	Ireland
24	ISL	Iceland
25	LIE	Liechtenstein
26	LTU	Lithuania
27	LUX	Luxembourg
28	LVA	Latvia
29	MCO	Monaco
30	MDA	Moldova
31	MKD	The Former Yugoslav Republic of Macedonia
32	MLT	Malta
33	NOR	Norway
34	POL	Poland
35	POR	Portugal
36	ROU	Romania
37	RUS	Russian Federation
38	S	Sweden
39	SMR	San Marino
40	SUI	Switzerland
41	SVK	Slovak Republic
42	SVN	Slovenia
43	TUR	Turkey
44	UKR	Ukraine

Non CEPT Countries

44	ALG	Algeria
45	ARS	Saudi Arabia
46	BLR	Belarus
47	EGY	Egypt
48	IRQ	Iraq
49	ISR	Israel
50	JOR	Jordan
51	LBN	Lebanon
52	LBY	Libya
53	MRC	Morocco
54	SYR	Syria
55	TUN	Tunisia
56	YUG	Yugoslavia

[9] **S5.14** The "European Broadcasting Area" is bounded on the west by the western boundary of Region 1, on the east by the meridian 40° East of Greenwich and on the south by the parallel 30° North so as to include the northern part of Saudi Arabia and that part of those countries bordering the Mediterranean within these limits. In addition, Iraq, Jordan and that part of the territory of Syria, Turkey and Ukraine lying outside the above limits are included in the European Broadcasting Area.

COUNCIL

Document C2001/121-E
29 June 2001
Original: English

GENEVA — 2001 SESSION — (18 – 29 JUNE)

INTERNATIONAL TELECOMMUNICATION UNION

APPENDIX 2 : Agenda for the Revision of Stockholm (1961)

RESOLUTION 1185

(approved at the sixteenth Plenary Meeting)

Regional Radiocommunication Conference for the revision of the European Broadcasting Agreement, Stockholm, 1961, in the Frequency Bands 174-230 MHz and 470-862 MHz [*])

The Council,

considering

a) the proposals contained in the letter of consultation of 17 August 2000 (see letter DM-1163 from the Secretary General) carried out in accordance with the provisions No 310 and 301 of the ITU Convention, concerning the convening of a Regional Radiocommunication Conference (RRC) for the revision of parts of the Regional Agreement for the European Broadcasting Area, Stockholm, 1961 (European Broadcasting Agreement, Stockholm, (1961)),

b) the results of the above consultation contained in letter DM-1173 of 9 October 2000 from the Secretary General;

noting

that a broadcasting Plan for the European Broadcasting Area should take account of existing and planned use in the border areas adjacent to the European Broadcasting Area;

resolves

1. that a RRC for the revision of the European Broadcasting Agreement, Stockholm (1961), in the bands 174-230 MHz and 470-862 MHz will consist of two sessions, separated by about two years;

2. that the first session of the RRC will be held in Geneva, Switzerland, from 10 to 28 May 2004 with the following agenda:

2.1 to produce a report to the second session to include:

   a) the technical basis for the work of the second session of the RRC ;

   b) the necessary bases to facilitate planning exercises prior to the second session of the RRC;

   c) the form in which the requirements of administrations should be submitted,

2.2 to decide upon the final date by which the requirements should be submitted to the ITU by administrations,

2.3 to make a proposal to Council on the duration of the second session of the RRC within the limits of resolves 3,

---

[*] See also Resolution 1180

3. that the second session of the RRC will be held in Geneva, Switzerland, during 2005 for a maximum of five weeks, to revise the Stockholm Agreement (1961) including:

3.1 the preparation, on the basis of proposals from administrations, of the report of the first session of the Conference and taking into consideration the report from the Director of the Radiocommunication Bureau on the intersessional work, of an agreement and an associated frequency plan for terrestrial digital broadcasting in the frequency bands 174-230 MHz and 470-862 MHz, taking account of the following non-exhaustive list of items:

a) planning principles;
b) protection of existing and planned analogue broadcasting stations and mechanisms, including time periods, for the migration from the analogue to the digital broadcasting situation;
c) protection of other existing and planned services in the bands 174-230 MHz and 470-862 MHz;
d) definition of terms to be used in the agreement;
e) propagation characteristics and methods of forecasting field strength values in the VHF and UHF bands;
f) planning criteria (including protection ratios), planning methods and network configurations (e.g. single-frequency networks, multi-frequency networks);
g) inter-service and intra-service sharing and compatibility criteria, including frequency bands adjacent to the frequency bands 174-230 MHz and 470-862 MHz;

3.2 regulatory procedures relating to modifications of and additions to the Plan;

3.3 co-ordination procedures for the transition from analogue to the digital broadcasting situation;

3.4 regulatory procedures pertaining to the sharing of the frequency bands 174-230 MHz and 470-862 MHz between broadcasting and other services to which these frequency bands are also allocated;

4. to establish a Planning Project Team, open to administrations, assisted by the Radiocommunication Bureau to undertake the planning exercises prior to the second session of the RRC,

instructs the Director of the Radiocommunication Bureau

1. to provide assistance, including the preparation and organisation of the RRC;

2. to develop planning tools, with the assistance from the Planning Project Team and the administrations, *inter alia* in order to aid administrations in the preparation of their requirements prior to the second session of the RRC;

3. to make the necessary arrangements for convening meetings of the Planning Project Team and to provide the necessary assistance,

invites the ITU-R Study Groups and the Special Committee on Regulatory and Procedural Matters

to carry out, as a matter of urgency, the relevant technical, operational and regulatory studies and to prepare a report for submission to the first session of the RRC,

instructs the Secretary-General

1. to take the necessary steps for convening the RRC;

2. to bring this Resolution to the attention of all Member States,

invites the Administrations of the European Broadcasting Area and of neighbouring countries

1. to participate actively in the preparatory work for the RRC;

2. to support the Radiocommunication Bureau in the development of the planning tools, *inter alia* by providing available software.

APPENDIX 3 : Information taken from DigiTAG or FM PT24 Members

Country	Number of Multiplexes at launch	Number of multiplexes envisaged in the future	Capacity per Multiplex (Mbit/s)	8/2k	SFN/MFN	Reception objectives	Band III use envisaged & channel bandwidth	DVB-T coverage considered necessary prior to analogue switch-off	Date of revision
BEL	<4	5 - 6		8k	Mainly SFN	Portable Mobile		>90%	12-06-01
CZE	≥2	≥6		8k	SFN & MFN	Fixed Portable Mobile	8 MHz	≥90%	14-06-01
D	Possibly 3 to 4 at launch	6 – 8	13.3	8k	Mainly SFN	Mainly portable Mobile		>90%	30-05-01*
DNK	<4	≥6		8k	MFN & SFN	Portable		>90%	14-11-01
E	5	>6		8k	MFN & SFN			>90%	30-05-01*
F	6			8k	MFN & gap SFN	Fixed Portable in urban areas Mobile	8 MHz	80-90%	30-05-01*
FIN	<4	<4		8k	MFN Gap SFN			80-90%	30-05-01*
G	6	6		2k	MFN	Fixed Portable in urban areas		>90%	30-05-01*
HOL	5	5		8k	SFN & MFN	Portable Mobile		>50%	30-05-01*
HNG	3	6		8k	MFN & SFN				06-10-00
I	>4			8k	SFN & MFN	Fixed Portable Mobile	7 MHz	>90%	30-05-01*
IRL	>6	>6		8k	MFN Gap SFN	Fixed Portable in urban areas	8 MHz	>90%	30-05-01
NOR	<4	4		8k	MFN Gap SFN	Fixed Portable		>90%	30-05-01*

Country	Number of Multiplexes at launch	Number of multiplexes envisaged in the future	Capacity per Multiplex (Mbit/s)	8/2k	SFN/MFN	Reception objectives	Band III use envisaged & channel bandwidth	DVB-T coverage considered necessary prior to analogue switch-off	Date of revision
						Mobile			
POR	4	6		8k	SFN & MFN				06-10-00
S	4	6		8k	MFN & SFN	Fixed Portable Mobile		>90%	14-11-01
SVK	2	6		8k	Mainly SFN	Fixed Portable in urban areas Mobile			14-06-01
SVN	6			8k	MFN & SFN				06-10-00

*Update based on information from the "Summary of Results from DigiTAG Service Models for DTT Questionnaire", December 2000

Note: References to 'multiplex' may need to be interpreted as an equivalent data capacity

APPENDIX 4 : Ideas on migration from various countries

A4.1 Germany

Government position

(Taken from: "Introduction of Digital Broadcasting in Germany, Launch Scenario 2000" BMWi Doc. 481)

As soon as it provides a regular service in each region, DVB-T will need to offer a minimum number of television programme equivalents which is higher than the number of programmes currently transmitted by analogue, in order to achieve public acceptance.

The aim is 12 programme equivalents, with programmes in a picture quality comparable to PAL, and new multimedia services. It must be possible to create bouquets of programmes.

Gradually, the number of programmes offered at the launch is to be capable of expansion to at least 20 television programme equivalents, and a regionalisation of the programmes is to be possible.

Portable indoor reception is to be made possible right from the beginning albeit not necessarily in rural areas (depending on the levels of transmitter power permissible under Chester '97).

For this reason, the Initiative recommends the establishment of single frequency networks right from the beginning.

To a limited extent, mobile reception is possible, but it is not an explicit coverage objective.

Planning objectives

In Germany the long-term aim is to ensure portable indoor reception with a high location probability and possibly mobile reception for the whole population. The all-digital scenario based on a SFN planning for all regions, using an 8 k system; 16 QAM-2/3 is favoured. To secure a high frequency economy and to avoid self-interference problems SFNs with a diameter of 150 km to 200 km are envisaged.

First of all, the regular DVB-T transmissions will start with about three or four multiplexes in big cities and areas with high density of population. Later, it will be extended to the whole country step by step. Within the transition period, of one or two years, the programme distribution of the analogue and the digital services will be in parallel in the areas concerned. After this transition period all analogue distributions will end in these areas. The former analogue frequencies can be applied for extending the digital coverages in the same or in adjacent areas.

The frequency resources for the start will consist of converted analogue channels of high power transmitters and additionally coordinated channels e.g. the channels above 60. Existing sites of high power stations situated in the areas mentioned above will be used as far as possible and added by stations of lower power to generate sufficient field strength necessary for portable indoor reception.

A4.2 United Kingdom

Government position

The Government criteria announced for digital switch-over are two-fold: first, ensuring that 'everyone who currently receives free-to-air analogue channels should be able, after switch-over, to receive these same channels digitally'; second, that 'switching to digital must be an affordable option for the vast majority of people'. The 'full switch-over' (which is thought to mean switching off all analogue transmissions) would only occur when both tests had been met fully.

In setting out the Government's agenda for digital switch-over, the Secretary of State for Culture, Media and Sport has stated that full switch-over could start to happen as early as 2006 and be completed by 2010. In subsequent clarifications from the Department for Culture, Media and Sport (DCMS), the Government's position seems to be that when digital television penetration (which can be interpreted as take-up by the public) reaches 70%, the Department will provide a more detailed timetable for switch-over; when it reaches 95%, a firm date for 'full switch-over' will be confirmed.

Planning studies

The subject of migration processes has been studied within various projects in the UK. It should be stressed, however, that there is currently no complete consensus in the UK on the migration process, which may involve delivery means other than terrestrial.

A high proportion of the UK population (about 70%) relies solely on terrestrial networks for the delivery of television services. During the transition from analogue to digital, it will be important to maintain the current level of service for these viewers. This means that:

a) Coverage of the digital equivalent of the current "free to air" services after the switch-over should be at least as high as the present analogue services;

b) Continuity of service should be maintained as far as possible, so that there is no significant gap in transmission.

The three frequency planning options given in Section 4.2 have been examined with regard to these aims.

For a re-planning option, it was thought that although the coverage aim could be satisfied, it would be very difficult to achieve a smooth transition. This is because changes in channel would require widespread replacement of transmission and reception equipment, which would not be possible without severe disruption and loss of service. It would also be difficult to implement a gradual migration, since assignments in the new digital plan would also have to be compatible with analogue assignments in other areas.

Migration based on the existing digital television plan should allow a smoother transition, but coverage would not be universal.

The Radiocommunications Agency in the UK has a public consultation underway on spectrum planning for digital television. A formal strategy can only be presented following completion of this consultation process later in the Spring of 2002.

In order to expedite this process the describing the UK Government recently published a draft Digital Action Plan which aims to complete the technical transition planning work by the end of 2004.

A4.3 Italy

Government position

The progress of digital terrestrial television in Italy is constrained by the need to clear analogue channels to provide capacity for DTT (Digital Terrestrial Television). The Authority's frequency plan, although primarily produced in 1997 for analogue TV services, allows for four national frequencies to be used for DTT. However, broadcasters currently use all of these for analogue transmissions.

In 1999 the Authority created a DTT National Committee, i.e. a Forum bringing together broadcasters, network operators, industry, universities and R&D institutes. The results of the work, carried out by four study Groups on Service requirements, Frequency planning, Receivers and Planning of the launching phase, are reported in the *White Book* published in September 2000 and submitted by the Authority to the Parliament. In it, the case for DVB MHP was considered as an open standard allowing to overcome the introduction of proprietary solutions which may be used in the short term, i.e. during the experimental phase, because of the unavailability of MHP consumer receivers on the market.

The White Book also calls for licensing of frequencies to network operators and argues for financial incentives for local broadcasters to liberate frequencies. No estimate of either national coverage or number of multiplexes has been released. However, three main broadcasters, RAI, Mediaset and Telepiù, would each like to operate their own national multiplex.

2006 is the date that circulates as analogue switch-off date in the media and in statements by the Authority and the Ministry of Communications, although it does not have force of law. However, some players see this deadline as unrealistic due the densely utilised frequency spectrum in both VHF and UHF bands.

The White Book argues for an immediate introduction of DTT in both VHF and UHF bands, through a large scale experimental phase, without waiting for the implementation of the frequency plan. Instead of using the four national frequencies which are supposed to be available once the plan is fully implemented, DTT would initially be launched on a market driven approach island-by-island where and when a frequency is free ("a macchia di leopardo"), with particular interest to metropolitan areas.

RAI's pilot trials are in progress in Turin (on two UHF channels) and Rome (one VHF channel). Telepiù has recently started up pay TV pilot trials in Palermo and La Spezia.

Planning studies

The DTT National Committee has considered several planning scenarios assuming the delivery of each national service (1 MPX of 5 TV programmes and additional data & multimedia applications) by adopting 1-SFN network (1 frequency needed) or alternatively a 3-SFN network (3 frequencies). The adoption of 4-MFN networks (multi-frequency configuration using 4 frequencies for 1 MPX) was also considered.

The delivery of regional services can be accomplished by adopting 3-SFN as well as MFN network configurations.

A planning exercise has been carried out for the case of 64 QAM (2/3; Tg=1/4; 8K) aiming at evaluating the population coverage in case of the delivery of one national service in fixed reception by roof-top antenna. The use of existing transmitting sites, as foreseen in the 1997 Plan described, has been considered in the DTT introductory phase. The results so far achieved are summarised as follows:

1-SFN. About 87% population coverage by using 306 TX if implemented in Band III -VHF; 391 TX if implemented in Band V – UHF.

3-SFN. About 97% population coverage by using 430 ÷ 460 TX depending on the frequency band;

4-MFN. About 93% population coverage by using 360 ÷ 400 TX depending on the frequency band.

APPENDIX 5 : Convergence and additional services

A5.1 Convergence of services

Looking towards recent developments it is becoming apparent that there are developments in the field of multimedia[10]. This can be seen as part of the convergence process within an integrated hybrid network environment. For instance it has been proposed that DVB-T is particularly suitable for mobile Internet access because DVB-T can have a much higher data capacity (10 - 15 Mbps) than today's "conventional" Internet access to the home. It is considered that very fast web surfing, very fast download of large files (e.g. high resolution pictures or software upgrades) and streamed high quality video/audio can all be offered using the same system and terminal.

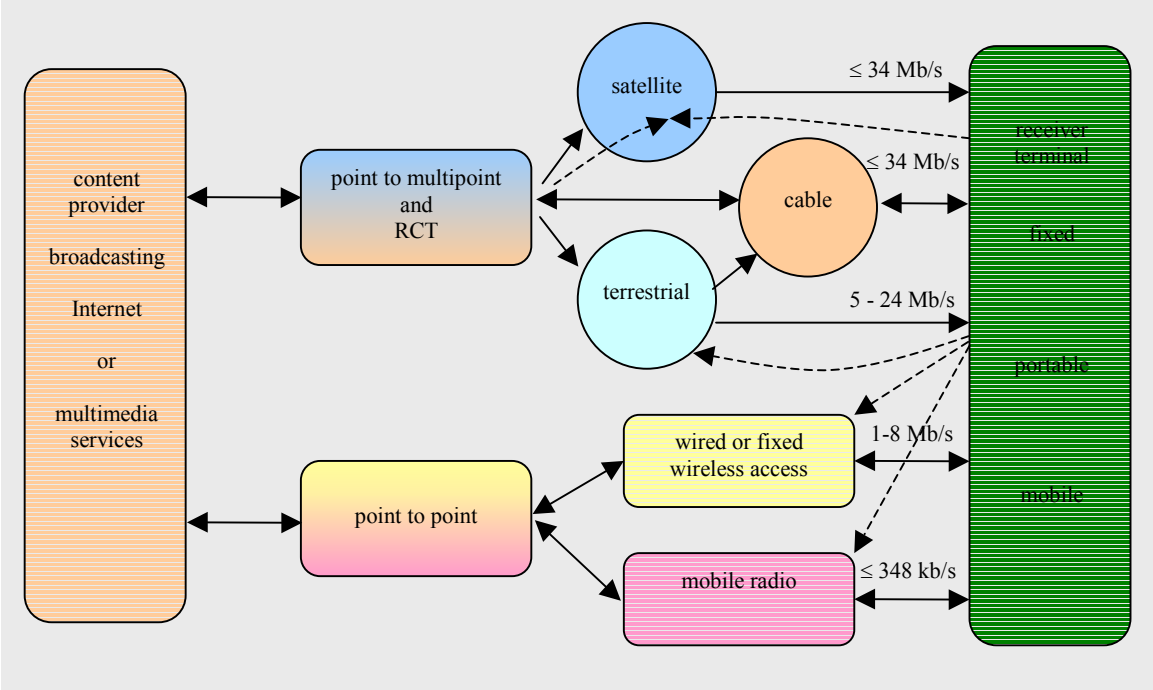
There are two issues to be considered in this respect; firstly, the trade off between the data capacity used for video and the data services using the same multiplex. Secondly, because this is a point-to-multipoint transmission all viewers of a given transmitter receive the same data. Due to the limited availability of spectrum in the downlink direction, fully personalized content to every user of a broadcasting service, in real time, is not possible.

It is therefore probably more appropriate to consider this as 'multicasting' or 'datacasting' a limited form of broadcasting featuring point-to-multipoint topology.

Multicasting can be regarded as complimentary to UMTS services offering non-real time services. The files are stored in the local terminal memory and the user can browse them at any time.

Nevertheless, all of these services can be combined with conventional DVB-T services - television and Internet (or multicast) within the same signal and system. Furthermore, the opportunity for interactivity embraced by DVB-T can provide interaction between the broadcaster/service provider and the viewer. This type of interactivity requires a return link (low capacity channel of 1 kbit/s). For broadcasters planning their bouquets on pay TV and interactive programmes, a return link connection is crucial to their business plan.

An overview of network convergence between broadcast and telecom services is shown below:



Convergence of broadcast and telecom services showing typical bit rates for each

[10] Multimedia can be defined as "services arising from the convergence of computing, communications and established media"

In regard to the above it should also be noted that the ITU are considering the regulatory aspects of Terrestrial Wireless Interactive Multimedia Systems (TWIMS) at WRC-03[11].

A5.2 TWIMS – Terrestrial Wireless Interactive Multimedia Services

Terrestrial Wireless Interactive Multimedia Systems are those systems that allow the delivery of multimedia content, which may include a combination of text, data, graphics, image, animation, voice, sound and video, with which the user may interact, through broadcast services operating in the terrestrial broadcast spectrum. The scope of the content should include multimedia content that is initiated by the broadcaster, initiated by a third party but scheduled via the broadcaster, or initiated by the user via the return channel. The scope of the delivery spectrum should include terrestrial television and terrestrial sound broadcast spectrum. The scope of the system should include delivery from one-to-many, broadcast, and from one-to-one, narrowcast. While this is in general true, multimedia applications delivered by broadcasting services are expected to deliver larger amounts of multimedia data in the downlink direction compared to the amount of data carried from the user in the uplink direction; thus making such broadcast based multimedia applications different from those provided through telecommunications services.

DVB-T can provide an efficient means (via portals) to bring multimedia services of general interest to all viewers. It is a particularly important development as research has indicated that a significant percentage of the general public will never use a computer for Internet access. DVB-T can thus contribute to the development of the "*European Information Society*".

A5.3 Interactive Television

In is clear that the above issues will affect the way we plan networks for the all-digital world -for instance the return path is very important. Whilst the return path might be conveniently provided by GSM or UMTS there might also be the opportunity to provide these services within the broadcast bands. Within the DVB project studies are taking place on the use of technology derived from UMTS, to provide a package return channel DVB-RCT, Return Channel Terrestrial[12], within the broadcasting bands.

However it should be recognised that any spectrum found within the broadcasting bands for such an application would be on a secondary basis to broadcasting. Moreover there are other considerations including:

- The system is intended to operate on a secondary and non-interference basis to broadcasting it has no impact on the revision of the Stockholm Plan;
- There are regulatory issues to be addressed concerning this application which is probably defined as a fixed service
- The broadcasting bands III, IV and V are already used extensively by SAB/SAP services on a secondary basis and this facility will need to be maintained, or even increased.

The practical implementation of the in-band option has been studied by the EU-funded INTERACT[13] project. Further consideration of this may also be found in EBU BPN 024 "The Return Channel for Interactive DVB-T".

In principle Multimedia applications provided by broadcasting services may use a variety of spectrum bands in particular for the uplink channel. However since broadcasting will remain a one-to-many service with peripheral personalized experience, it makes it possible to use the spectrum in a manner where the downlink data from interactive multimedia and datacasting applications may sit together with conventional broadcasting applications and therefore use the same channel.

Using the same spectrum band for the uplink channel could provide some economies due to re-using some of the existing equipment, including the antenna.

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[11] Resolution 737 (WRC-2000) requests a "Review of spectrum and regulatory requirements to facilitate worldwide harmonization of emerging terrestrial wireless interactive multimedia applications". It appears as Agenda item 1.21 for WRC-03 "to consider progress of the ITU R studies concerning the technical and regulatory requirements of terrestrial wireless interactive multimedia applications, in accordance with Resolution 737 [GT PLEN-2/2] (WRC-2000), with a view to facilitating global harmonization".

[12] Details of DVB-RCT will be soon available at http://www.dvb.org/standards/index.html

[13] INTERACT subsequently became iTTi and is now WITNESS at http://www.rte.ie/about/witness/project.html

A5.4 Services Ancillary to Broadcasting and Programme Making

The results of a recent questionnaire on the use of SAB/SAP (Services Ancillary to Broadcasting and Programme Making) in CEPT countries (Doc. CEPT/WGFM (2000) 122) concluded that the broadcasting Bands III, IV and V were heavily used for SAB/SAP applications all over Europe. In particular Radio microphones and Talkback production systems were used.

The results of the questionnaire lead to a consideration of how the frequency requirements for SAB/SAP applications could be solved in future. This will need to be studied as and when the new all-digital plans emerge.

The ERC Reports 88, 89 and 90 on compatibility and sharing analysis between DVB-T and radio microphones, Talkback links, and OB (Outside Broadcast) audio links in Bands IV and V, suggest that there are still opportunities for using Bands IV and V for talkback and radiomicrophones. In the long term the use of these bands for DVB-T will be come more intense and the effect of this on SAB/SAP needs further study.