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An assessment of terrestrial television services within the EBU

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1. Introduction

During 1987/1988, many EBU Member-organizations completed questionnaires which provided information related to the development of terrestrial television coverage within each country.

The analysis of the twenty replies received is presented in this document.

The primary objectives of the questionnaire were:

- to learn of the techniques used by Members for planning their television services;
- to up-date information regarding the coverage achieved; and
- to reveal the extent to which the television spectrum is shared with other users.

The results provide a helpful reference to the techniques used and the results achieved in developed networks and give an indication of the usefulness or otherwise of the CCIR methods and planning criteria.

The questionnaire is included in *Appendix 1* and the list of organizations which sent in completed replies is given in *Appendix 2*.

2. Assessment of service

The great majority of organizations assess coverage using a combination of field-strength prediction, field-strength measurement and reception quality checks.

As may be expected there are some differences in the methods of field-strength prediction used.

Most countries use more detailed techniques as well as the Recommendation 370 [1] curves. It is interesting to note that while most organizations apply the terrain roughness correction factor to Recommendation 370, only four organizations use the terrain angle correction factor of CCIR Report 239 [2]. It may also be noted that the BBC and UKIB do not use CCIR Recommendation 370 curves as part of the method of service area assessment but rely solely on computerised calculations based on a terrain data bank.

In respect of minimum field-strengths:

- most organizations use the CCIR Recommendation 417 [3] values;
- the BBC and UKIB work only to the lower levels identified in CCIR Report 409 [4];
- RTL mentions that these lower values are used at the "limit of coverage";
- RTE uses values lower than Recommendation 417 for UHF;
- Switzerland uses values above those of Recommendation 417.

Of the four organizations expressing dissatisfaction with their present method of service assessment, all identified the inadequacy of present field-strength prediction methods. In answer to questions which sought to identify improvements which could be applied internationally, these organizations indicated a clear need for the use of terrain data banks. In addition, Norway emphasised the importance of picture quality assessment and that field-strength alone is an inadequate substitute.

3. Assessment of interference

The majority of replies reveal that a mixture of field-strength prediction and measurement is used for the assessment of interference to the wanted signal, although in one case it is reported that only picture degradation

testing is employed. CCIR Recommendation 370 is again the most-used source for predictions. The BBC and UKIB rely only on computerised calculations based on a terrain data bank. The TRT underlines the known fact that the present “warm” sea Recommendation 370 curves probably underestimate propagation levels in the Eastern Mediterranean. Terrain roughness is again used to a greater extent than terrain angle correction factor. More detailed methods are used by a slightly smaller number of organizations than in the case of the wanted signal.

Most of the replies indicate that interference checks are made at points selected around the periphery of the service area, although there are some variations in the actual techniques. Most organizations take account of both receiver antenna directivity and polarization discrimination. Only one organization comments unfavourably upon the Recommendation 655 [5] protection ratios.

Some organizations express doubts concerning the calculation of multiple interference. Where this is carried out, the majority uses the simplified multiplication method. As far as the time protection figure is concerned, only the BBC and UKIB aim for the lower figure of 95% for their UHF services, although they report that actual results indicate that most of the areas are protected for a higher percentage of the time. Six of the replies express satisfaction with the means of estimating interference, based on the evidence of actual results.

Fifteen of the replies confirm that delayed images are assessed. In some cases the answers to this particular question clearly relate to the tests which are carried out at a new relay station site to assess the quality of the incoming signal.

4. Presentation of coverage information

All organizations use some form of map presentation, sometimes associated with tabulated information; there is little uniformity between the methods chosen. As these will depend to a considerable extent upon the techniques of prediction and/or measurement, and upon the national requirements, some differences are inevitable.

5. Sharing with non-broadcasting services

5.1. Sharing with non-broadcast services within own country

There is a relatively wide range of sharing between broadcasting and non-broadcast services in Europe. The non-broadcast uses include fixed and mobile services, radio-astronomy (channel 38) and broadcast ancillary services, such as vision links, talkback, programme contributions and radio microphones.

In most cases sharing is realized by geographical separation sometimes made possible by employing a detailed terrain data bank and computerised calculations.

When using frequency separation, the non-broadcast services are located avoiding the vision, colour and sound carriers of the television signal, where the protection ratios are relatively low. In general, as a technical sharing basis, CCIR Recommendation 655 has been used as far as the television service is concerned and there have been few problems in agreeing compatibility parameters with the other service.

As in the case of television to television interference, there are some doubts concerning the validity of multiple interference assessments and also for some protection ratio values.

Restrictions have been required in relation to the permitted power (max. e.r.p = 100 W) to protect the radio astronomy service in channel 38. Filters have sometimes been fitted to solve band edge problems and this has been successful but not always at low cost.

A significant number (40%) of organizations indicate that in future they expect sharing requests for low-power land-mobile stations mainly in Band III and for cordless telephone systems in the UHF bands. Some organizations, who have not yet dealt with such sharing request, consider that they would not have all the information needed. A lack of protection ratios to and from television services, and agreement on the minimum field-strengths to be protected, are identified. Also, the matter of how to deal with the low transmitting antenna heights of interfering transmitters and the low receiving antenna heights of radio microphone receivers remains unclear.

5.2. Sharing with non-broadcast services in another country

The sharing situation is similar to that described in *Section 5.1.* but in addition, land-mobile services in Bands I and III, and-to-point links in Band V (above channel 60) and radio-location facilities are identified. In most cases sharing is realised by geographic separation but in some instances frequency separation is employed.

CCIR Recommendation 655 is used as a technical basis for assessment of interference to the television service. The minimum field-strength for the fixed service of -6 db(μ V/m) to be protected is felt to be unrealistic

but this value is a standard from the Stockholm, 1961 Agreement. Field-strength measurements are not used as a technical basis for agreement.

Assessment of multiple interference is again noted as a significant problem as are lengthy discussions and multilateral meetings. Difficulties are reported in the coordination of network planning above channel 60 in Band V.

Most organizations foresee more sharing requests for fixed, mobile and satellite services and consider that the existing CCIR texts are not entirely satisfactory as a basis for the current requirements for technical assessment and coordination.

6. Network development

6.1. General

Within the EBU, the current situation is that many organizations have found it possible to plan for one network at VHF and three at UHF. There are, however, variations depending on the geographic situation (and thus the amount of interference from neighbours) and the nominal percentage of time for which the network is planned to be protected against interference (the larger the percentage time, the less is the spectrum capacity). A notable exception is RTE which has achieved two networks in the VHF bands by using precision offset and some UHF relay (fill-in) stations.

It is noted that it is common to use VHF relay (or fill-in) stations to supplement a UHF network and to use UHF relay stations to supplement a VHF network.

Different organizations report different degrees of development for their network, ranging from little more than 10% coverage to near 100%. There is a similar spread in the number of networks in operation, ranging from 1 in four countries to 6 in France (although there are differences between the coverages achieved by these 6 networks).

It is noteworthy that 85% of the networks are regarded as “national” and only 15% are termed “regional”, but many organizations note the growing need for regional, local and private networks. Although in some countries, all the networks have the same coverage, it is generally true that the first network in any one country has the highest percentage coverage. The coverage of the first network is more than 98% in the case of 85% of the organizations. However, taking all 46 networks together, only 65% achieve a coverage of more than 98%.

6.2. Completion of the networks

It is noted that 75% of the organizations report that they have completed their main station building programme, but very few of the relay (fill-in) station building programmes are complete. For example, in the UK and in FRG where the networks are already more than 99% complete, it is estimated that several hundred additional relay stations are needed. The percentage of each network which consists of stations with an effective radiated power (e.r.p.) of less than 10 kW is markedly affected by the terrain; for example, in FRG, NOR, SUI and UK more than 90% of the stations have less than 10 kW e.r.p. while in BEL and NL only about 50% of the stations come in this category.

Regarding the amount of spectrum needed for network completion,

- one third of organizations considered that there is enough;
- one third considered that there is almost enough;
- one third considered that there is not enough.

However, such replies need to be considered in association with the views that there is an increasing demand for new networks and that future needs cannot yet be defined.

6.3. Future development

The developments considered range from continued network extension to a complete change in the transmission standard.

About one third of the organizations are planning significant extensions or modifications of their networks, either by increasing the total number of national services or the introduction of regional or local services.

About one third plan to introduce improvements to the sound quality and also to introduce two-channel or stereophonic sound - this is in addition to the improvements already in use or undergoing experimental investiga-

tions in a number of countries. Overall, about two thirds of the organizations consider that the addition of a digital sound system is likely.

On the contrary, only a quarter of the organizations consider that the introduction of a MAC type system into the terrestrial networks is a possibility. A few organizations mentioned items such as:

- higher-level teletext
- digitally assisted television
- video programming system

but there was no uniformity of view in these respects.

One possible development which is viewed with concern by some organizations is that of satellite sound broadcasting sharing the spectrum with UHF television channels. The general view is that this is likely to be rather difficult to achieve within the main part of the UHF spectrum because of the intense usage by television and the foreseen need for additional terrestrial services. However, some organizations thought that it may be possible to achieve sharing in channels above channel 60 because these are not widely used at present (at least, in some countries).

7. Conclusions

The analysis of the questionnaire has revealed that there are no significant differences within any one country in the techniques employed for the assessment of coverage and of interference. There are, however, some differences between countries. These differences can be attributed in part to the varying degree to which some countries have introduced computer techniques employing terrain data banks. It can be concluded that, unless there is uniformity in the methods employed, it is difficult to present a united front in support of the efficient use of the spectrum allocated to broadcasting.

There is a clear need for an initiative aimed at achieving a greater degree of uniformity of assessment of coverage by EBU Members. This could lead to the production of a new report which would substantially modify or replace the existing CCIR Report 228 [6] which is not in use among EBU Members.

A major problem in reaching uniformity of methods is due to the fact that the only internationally-accepted method for predicting field-strength is CCIR Recommendation 370 and its propagation curves, which has been used as part of their technical basis by several planning Conferences. Calculations based on these statistical curves cannot adequately deal with the detail of individual paths, even if account is taken of the improvement factors listed in Recommendation 370 and in Report 329 [7], and the need for a unified terrain data bank based method must be emphasized. As the timescale for the development of a unified terrain data bank based method may be several years, improvements to the CCIR methods must be sought for use during this interim period.

There is very little evidence, with one or two exceptions, that Members have experienced significant difficulties in sharing spectrum with other services, for example with the land-mobile service. However, the increasing requirement for other services to share the broadcasting spectrum is recognized and there is a clear need for agreement to methods suitable for the assessment of sharing arrangements. The EBU and its Members have been involved in preparation work for the Second Session of the African Broadcasting Conference where the inadequacies of existing documentation on sharing criteria have presented some problems.

The EBU should thus continue to study sharing criteria and sharing methods, both of which will be of increasing relevance in all EBU countries.

Appendix 1 Questionnaire relating to the terrestrial television service

To illustrate the scope of the EBU enquiry into the European terrestrial television services, this *Appendix* reproduces the questions which were sent to the EBU Members in Spring 1987.

Part A - Service, interference and presentation of results

Service

1. How is each service area assessed?

- by field-strength measurement

(YES/NO)

- by field-strength prediction (YES/NO)
- by assessment of reception quality (YES/NO)

If more than one method is used, please answer YES in more than one category.

If some other method is used, please specify this:

2. If field-strength prediction is used, which method is used?

- a) CCIR Recommendation 370 (YES/NO)

If the answer is YES, do you also take account of:

- terrain roughness (YES/NO)
- terrain clearance angle (YES/NO)
- attenuation by diffraction (YES/NO)

If the last answer is YES, please give more details:

- b) A more-detailed technique (YES/NO)

If the answer is YES, please give more details:

3. Do you use the minimum field-strength values given in:

- CCIR Recommendation 417 (YES/NO)
- CCIR Report 409 (YES/NO)

If you use some other values, or a combination of CCIR values, please give more details:

4. Do you think that your present method of service assessment is satisfactory? (YES/NO)

If the answer is NO, please give your reasons:

5. Please give details of any improvements to service assessment techniques which you would like to see adopted internationally:

Interference

1. How do you assess interference (other than delayed image)?

- by field-strength measurement (YES/NO)
- by field-strength prediction (YES/NO)

If any other method is used, please give details:

2. If field-strength prediction is used, which method is used?

- a) CCIR Recommendation 370 (YES/NO)

If the answer is YES, do you also take account of:

- terrain roughness (YES/NO)
- terrain clearance angle (YES/NO)
- attenuation by diffraction (YES/NO)

If the last answer is YES, please give more details:

b) A more-detailed technique (YES/NO)

If the answer is YES, please give more details:

3. At what locations do you assess interference levels?

- at the site of the wanted transmitters (YES/NO)

- at selected test locations (YES/NO)

If the last answer is YES, please give details of how these test points are chosen:

If both answers are NO, how do you assess interference?

4. Do you take account of receiving antenna

- directivity (YES/NO)

- polarization discrimination (YES/NO)

5. Are you satisfied that the protection ratios given in CCIR Recommendation AT/II are realistic?

- co-channel (YES/NO)

- adjacent-channel (YES/NO)

- image channel (YES/NO)

6. Do you calculate multiple interference levels? (YES/NO)

- by the simplified multiplication method (YES/NO)

- by the power sum method (YES/NO)

If you use some other method, please give details:

7. For what percentage of time do you aim to achieve protection in the coverage area?

- VHF: 90% 95% 99%

- UHF: 90% 95% 99% (tick one for each band)

8. Do you have any practical experience concerning the validity of your interference assessments?

Please give details:

9. Do you assess delayed image interference ? (YES/NO)

If the answer is YES, how is this done ?

- by picture quality assessment (YES/NO)

- by some other means (YES/NO)

Please give further details:

Presentation of results

1. Which results do you attempt to present?

- service (that is, neglecting interference) (YES/NO)

- coverage (that is, including interference) (YES/NO)

2. Are your results presented:
- on a map showing contours (YES/NO)

If the answer is YES, please give details of the type of contours used:

- on a map with tabulated information (YES/NO)

If the answer is YES please give details of the type of information included (for example, population numbers, programme information, etc.):

- solely as tabulated information (YES/NO)

If the answer is YES, please give details:

Part B - Network development

1. What is the population coverage of each of your present terrestrial networks? Please give answers in terms of total population. Coverage for different regions should be combined and expressed in national terms.

Please indicate the type of each network (national, regional, cable, local).

What percentage of the population is served

- off-air? %
- by cable? %

2. How many transmitter are there in each e.r.p. category, for each network?

Categories:

	≤ e.r.p.	<10 W	
10	≤ e.r.p.	<100 W	
0.1	≤ e.r.p.	<1 kW	VHF and UHF
1	≤ e.r.p.	<10 kW	
10	≤ e.r.p.	<100 kW	
100	≤ e.r.p.	<1000 kW	
1000	≤ e.r.p.		UHF only

3. Is each network complete for
- main stations ? (YES/NO)
- relay stations ? (YES/NO)

4. Please give an estimate of how many more transmitters are needed for each network.

5. Do you consider that you have access to enough spectrum for each of the required extensions?

- enough
- almost enough (tick one)
- not enough

6. What developments do you foresee for your present terrestrial networks, assuming that the vision carrier spacings are retained ?

7. Do you regard a change of transmission standard in the present European terrestrial networks as:
- digital sound system (LIKELY/UNLIKELY/IMPRACTICABLE)
- MAC type system (LIKELY/UNLIKELY/IMPRACTICABLE)
- any other system (LIKELY/UNLIKELY/IMPRACTICABLE)
(please specify)

Please give your reasons for your views:

8. Please give any consequence which you think might result from sharing at UHF between terrestrial television and any satellite broadcasting.

Part C - Sharing with non-broadcast services within your country

1. Are there any non-broadcast services operating at present within the frequency bands which you use for broadcasting ? (YES/NO)

If the answer is YES, please specify which services:

and indicate whether sharing is achieved by means of

- geographical separation (YES/NO)
- frequency separation (YES/NO)

Please provide any details on these last points:

If the answer to Question 1 is YES, then please answer the remaining questions in Part C.

2. What technical bases have been used? (YES/NO)
- protection ratio values

Please give the source of the values used, and the values themselves:

- field-strength measurements (YES/NO)

Please supply details:

3. Were there problems in agreeing these parameters with the other service? (YES/NO)

If the answer is YES, please give details of any difficulties:

4. Has the process of sharing required any modification of your broadcasting installations, e.g. reduced power, special filters ? (YES/NO)

If the answer is YES, please specify any technical modifications needed to permit satisfactory sharing:

5. Has it been an expensive process ? (YES/NO)

Please specify which party in the sharing process had to bear the costs and whether these were large:

6. Has it been technically successful ? (YES/NO)

Please give the reasons why the modifications did not lead to a satisfactory technical solution:

7. Are there likely to be requests for sharing in the future? (YES/NO)

Please indicate what additional requests for sharing you expect to receive:

8. If you have not so far dealt with such a request, do you think that you have all the information you need to examine the case? (YES/NO)

Please indicate what information you think you may lack:

9. Do you think adequate information exists within the CCIR texts to deal with sharing in the bands allocated to broadcasting ? (YES/NO)

Please indicate any particular deficiencies which you have identified in the CCIR texts:

Part D - Sharing with non-broadcast services in another country (Same questions as Part C)

Appendix 2

List of organizations which replied to the questionnaire

Austria	Österreichischer Rundfunk (ORF)
Belgium	Belgische Radio en Televisie (BRT) Radio-Télévision Belge de la Communauté française (RTBF)
Cyprus	Cyprus Broadcasting Corporation (CyBC)
Denmark	Danmarks Radio (DR)
Finland	Oy. Yleisradio AB (YLE)
France	Télédiffusion de France (TDF)
Germany FR	Arbeitsgemeinschaft der öffentlichrechtlichen Rundfunkanstalten der Bundesrepublik Deutschland (ARD) Zweites Deutsches Fernsehen (ZDF)
Greece	Elliniki Radiophonia Tileorassi (ERT)
Ireland	Radio Telefis Eireann (RTE)
Italy	RAI - Radiotelevisione Italiana (RAI)
Luxembourg	Radio-Télé-Luxembourg (RTL)
Netherlands	Nederlandse Omroepprogramma Stichting (NOS)
Norway	PTT
Spain	Radiotelevisión Española (RTVE)
Sweden	Sveriges Radio AB (SR)
Switzerland	PTT
Turkey	Türkiye Radyo - Televizyon Kurumu (TRT)
United Kingdom	British Broadcasting Corporation (BBC) Independent Broadcasting Authority (UKIB)

Bibliography

- [1] CCIR Recommendation 300:
- [2] CCIR Report 239:
- [3] ITU-R Recommendation BT.417-4: **Minimum field strengths for which protection may be sought in planning a television service.**
- [4] CCIR Report 409: **Boundaries of the television service area in rural districts having a low population density**
- [5] ITU-R Recommendation BT.655-2: **Radio-frequency protection ratios for AM vestigial sideband television systems.**
- [6] CCIR Report 228:
- [7] CCIR Report 329: