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

SAP/SAB (INCL. ENG/OB) SPECTRUM USE AND FUTURE REQUIREMENTS

Lisbon, February 2002

EXECUTIVE SUMMARY

Purpose of the report

This report considers the current and future spectrum demand by the various applications in the Services Ancillary to Programme making and Services Ancillary to Broadcasting (SAP/SAB). This also includes the video links, traditionally referred to as ENG/OB.

The report then reviews the frequency bands currently identified for SAP/SAB applications and considers the suitability of these frequency bands to satisfy the identified demand. It also considers the other measures that might be necessary to improve pan-European harmonisation in SAP/SAB use of these bands.

The overall purpose of the report is the provision of factual basis for ultimate revision and extension of the ERC Recommendation 25-10, which would describe the frequency bands for various SAP/SAB applications and conditions of their use.

The report does not specifically address the SAP/SAB service links, such as Talk-back, remote control of audio/video sets, etc.

Content of the report

Section 1 of the report describes the definitions and principal applications of SAP/SAB and ENG/OB.

Section 2 analyses current and future demand by different sectors of SAP/SAB activities, such as theatres, studios, news gathering, sports, etc. This is then summarised in section 3 into overall picture of SAP/SAB spectrum demand.

Section 4 discusses the likely impact of digital technologies on SAP/SAB developments and resulting changes in spectrum demand or usage conditions (different channel bandwidths, proximity of channels, etc.).

Section 5 provides the detailed inventory of frequency bands identified for video and audio SAP/SAB links and suggests some further actions to ensure continued operations of SAP/SAB.

Section 6 contains a brief discussion on the licensing of SAP/SAB and provides recommendations towards the harmonised and simplified form for SAP/SAB applications.

Section 7 contains overall conclusions, which are also reproduced below in this executive summary.

Annexes of this report contain detailed information on frequency bands used for video SAP/SAB links in different European countries (Annex 1) and summary of responses of CEPT Administrations to the questionnaire on introduction of radio microphones in the band 1785-1800 MHz (Annex 2).

Overall conclusions of the report

Amongst the many findings of this report, the following appear to be the most significant overall conclusions:

(1) It is suggested that CEPT adopts a unified and logically inter-linked set of definitions of various applications and technologies in the SAP/SAB area, as described in Fig. 3 of section 1 of the report;

(2) It is shown that while the actual demand for SAP/SAB spectrum varies significantly between different countries, different programme makers and different events, the overall trend is that of steady increase of SAP/SAB demand in most of the sectors. Administrations are invited to base their forecasts of the near/long-term demand for different SAP/SAB applications on the information provided in Tables 4 and 5, section 3 of the report;

(3) At the time of writing this report, the actual impact of digital technologies on the future of SAP/SAB was not entirely clear, as digital SAP/SAB equipment was only about to be tested or in the conception phase. Even the potential benefits of digital technologies were not yet fully apparent to the industry, in particular for radio microphone applications;

(4) However, based on the theoretical simulations and some of early tests, the report shows that the introduction of digital technologies could mean higher spectral efficiency of SAP/SAB equipment. This might be achievable through the reduction of channel bandwidth for video links and easing of intermodulation constraints (hence more dense co-location) for radio microphones. For details refer to section 4;

(5) Overall consideration of frequency bands for SAP/SAB applications has proved that SAP/SAB use is highly divergent and irregular across various CEPT countries. Because of this, only limited harmonisation may be achievable. Recognising the impracticality of exclusive allocations the concept of tuning ranges should be pursued as the main means of harmonising SAP/SAB spectrum use;

(6) In reviewing frequency bands for video SAP/SAB links, the preferred sub-bands were identified where possible. These (if available in particular country) should be used as a first choice option in assigning frequencies for SAP/SAB, in particular for occasional/temporary use;

(7) The potential interest in identifying the frequency band 2700-2900 MHz for one type of SAP/SAB applications – digital cordless cameras with 0 dBW output power was confirmed. This would significantly ease the pressure on the SAP/SAB bands below 2500 MHz, which could then be better exploited for high mobility SAP/SAB applications. However conditions for use of the band 2700-2900 MHz by cordless cameras, if proved possible at all, are to be established by the FM PT 31, taking account in particular of the outcome of relevant SE PT 34 studies;

(8) Consideration of frequency bands for audio SAP/SAB applications, notably radio microphones, showed that the main interest of SAP/SAB industry is currently concentrating on the band 470-862 MHz, which should remain a vital tuning range of SAP/SAB operations for the foreseeable future. Therefore some solutions should be further considered for ensuring continued co-existence of SAP/SAB with primary broadcasting services in the band, in particular during and after their conversion to DVB-T. One of such already exploitable solutions is extension of switching range of radiomicrophones beyond that of currently marketed equipment (3-6 UHF TV channels);

(9) The band 1785-1800 MHz is likely to make a large contribution to satisfying spectrum demand for radio microphones, in particular as a long term solution for truly pan-European operations (touring shows, etc.). This would help to relieve the pressure for SAP/SAB use in the band 470-862 MHz;

(10) The model application form for SAP/SAB licence applications should be promoted. The existing CEPT proposal for such a form in Annex 4 of the ERC Recommendation 25-10 should be used as the basis, but updated during the revision of REC 25-10 so that it contains more information and is better suited for electronic submissions and administrative handling.

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1 SAP/SAB AND ENG/OB APPLICATIONS

1.1 Definitions of SAP/SAB and ENG/OB

Within the CEPT, definitions for ENG and OB were agreed some time ago and are set out in the ERC Report 38. However, originally they referred only to video reporting services. Later it became obvious that ENG/OB definitions should also accommodate the sound reporting applications. Therefore the ERC Report 42 proposed additional amendments to those definitions. Trying to combine all those various references into an overall picture, the following definition of ENG/OB may be proposed:

ENG: Electronic News Gathering (ENG) is the collection of video and/or sound material without the use of film or tape recorder, using small, often hand-held, electronic cameras and/or microphones with radio links to the news room and/or to the portable tape or other recorders.

OB: Outside broadcasting (OB) is the temporary provision of programme making facilities at the location of on-going news, sport or other events, lasting from a few hours to several weeks. Outside Broadcasts are generally planned in advance, but it is often necessary to accommodate short notice changes of venue or unforeseen requirements. Video and/or sound reporting radio links (channels) might be required for mobile links, portable links and cordless cameras or microphones at the OB location. Additionally, video and/or sound reporting radio links may be required as part of a temporary point to point connection between the OB vehicle and the studio.

It can be seen that the definitions of ENG and OB are not mutually exclusive. Certain operations could equally well reside in either or both categories. Therefore, to avoid confusion, it has been a long practice within the CEPT to consider all types of such operations under the combined term "ENG/OB". It is also understood that ENG/OB refers to terrestrial radiocommunication services, as opposed to SNG/OB term, which refers to similar applications but over the satellite radiocommunication channels.

For better understanding of differences between ENG and OB, below Figs. 1 and 2 show typical operational set-ups for those two scenarios of broadcasting activities.

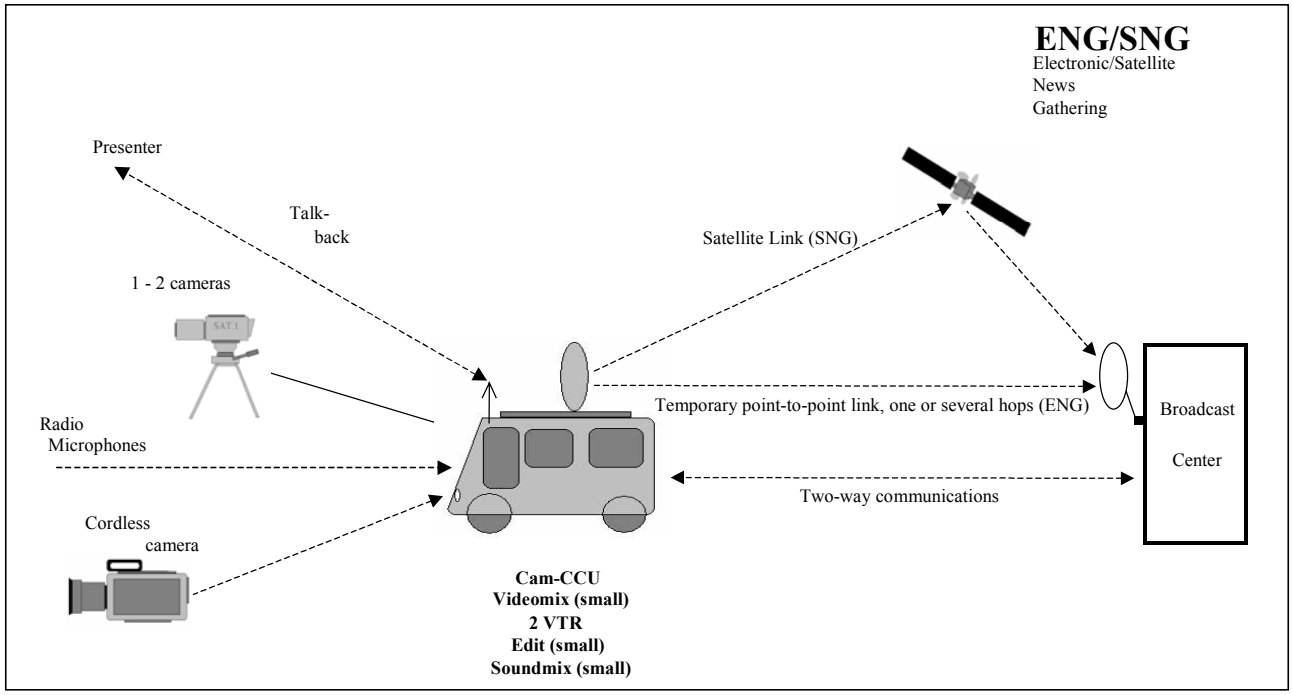


Figure 1 : Typical set-up of ENG operations

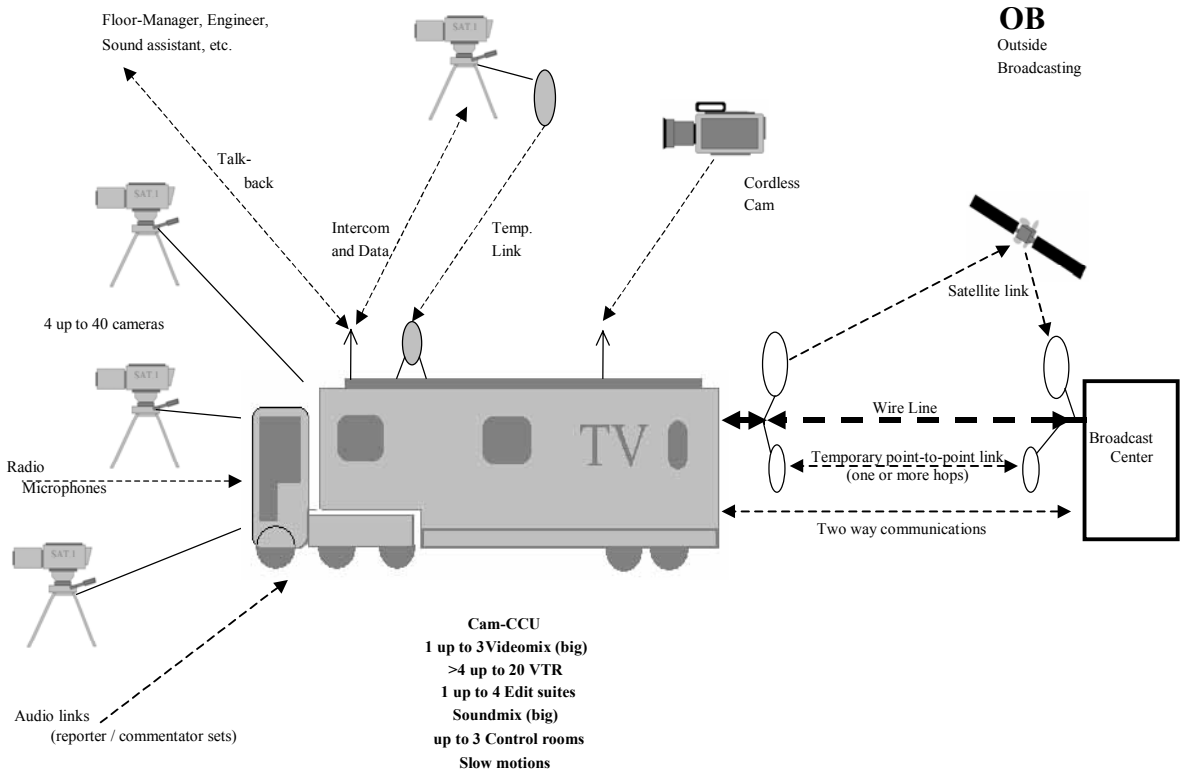


Figure 2 : Typical set-up of OB operations

The definitions of SAP/SAB are set out as follows:

SAP: Services Ancillary to Programme making (SAP) support the activities carried out in the making of "programmes", such as film making, advertisements, corporate videos, concerts, theatre and similar activities not initially meant for broadcasting to general public.

SAB: Services Ancillary to Broadcasting (SAB) support the activities of broadcast service companies carried out in the production of their programme material.

Services Ancillary to Broadcasting (SAB) were originally just those required by public broadcasting companies in the preparation of programme material, while Services Ancillary to Programme making (SAP) covered programme making by independent companies along with the commercials, theatre shows, concerts and sporting events. While there are some differences in the nature of these two businesses, their spectrum requirements are almost identical.

Similarly to ENG/OB, it may be seen that the definitions of SAP and SAB are not necessarily mutually exclusive. Therefore they are also often used together as "SAP/SAB" to refer generally to the whole variety of services to transmit sound and video material over the radio links.

However, it is important to note that in such broad understanding, the SAP/SAB services include both ENG/OB and SNG/OB applications, but also the service links that may be used in the production of programmes, such as talk-back or personal monitoring of sound-track, telecommand, telecontrol and similar applications. Assuming all of the above definitions and comments, the following part of the section gives detailed presentation of different applications possible within the above categories and links between them.

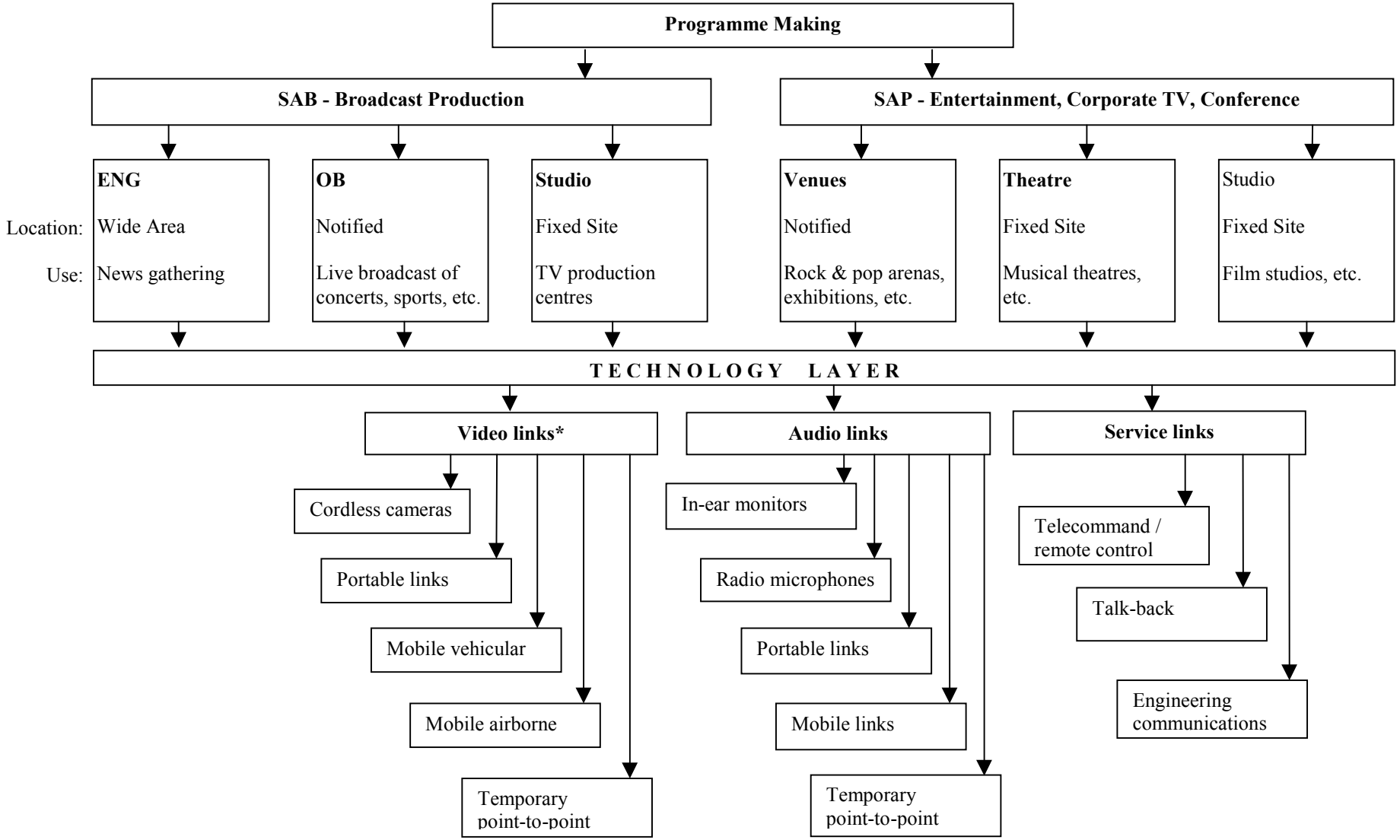
For more detailed description of various applications used for providing video and audio links of this category, please refer to ERC Reports 38 and 42.

1.2 Overall picture of SAP/SAB world of applications

As mentioned before, the SAP/SAB definitions imply more business-oriented classification of programme making facilities. The technical view then adds another dimension to that picture because many SAP and SAB users use the same technology for their applications. Therefore, the following picture in Fig. 3 describes this two-layered structure of the whole world of SAP and SAB, including ENG/OB applications.

The following definitions are assumed in describing the technology layer of various SAP/SAB applications:

Radiomicrophone	Handheld or body worn microphone with integrated or body worn transmitter.
In-ear monitor	Body-worn miniature receiver with earpieces for personal monitoring of single or dual channel sound track.
Portable audio link	Body worn transmitter used with one or more microphones, with a longer operating range capabilities than that of radiomicrophones.
Mobile audio link	Audio transmission system employing radio transmitter mounted in/on motorcycles, pedal cycles, cars, racing cars, boats, etc. One or both link terminals may be used while moving.
Temporary point-to-point audio link	Temporary link between two points (e.g. part of a link between an OB site and a studio), used for carrying broadcast quality audio or for carrying service (voice) signals. Link terminals are mounted on tripods, temporary platforms, purpose built vehicles or hydraulic hoists. Two-way links are often required.
Cordless camera	Handheld or otherwise mounted camera with integrated transmitter, power pack and antenna for carrying broadcast-quality video together with sound signals over short-ranges.
Portable video link	Handheld camera with separate body-worn transmitter, power pack and antenna.
Mobile airborne video link	Video transmission system employing radio transmitter mounted on helicopters or other airships.
Mobile vehicular video link	Video transmission system employing radio transmitter mounted in/on motorcycles, pedal cycles, cars, racing cars or boats. One or both link terminals may be used while moving.
Temporary point-to-point video links	Temporary link between two points (e.g. part of a link between an OB site and a studio), used for carrying broadcast quality video/audio signals. Link terminals are mounted on tripods, temporary platforms, purpose built vehicles or hydraulic hoists. Two-way links are often required.
Talk-back	For communicating the instructions of the director instantly to all those concerned in making the programme; these include presenters, interviewers, cameramen, sound operators, lighting operators and engineers. A number of talk-back channels may be in simultaneous use to cover those different activities. Talk-back usually employs constant transmission.
Telecommand/remote control	Radio links for the remote control of cameras and other programme making equipment and for signalling.



*Note: video links often incorporate audio circuits for sound programme transmission.

Figure 3 : Overall picture of SAP/SAB user sectors and applications

1.3 Distinction between the radiomicrophones and In Ear Monitors (IEM)

Radio microphones normally use wide band frequency modulation to achieve the necessary audio performance for professional use. For the majority of applications the transmitted signal requires a channel bandwidth of up to 200 kHz.

IEM equipment is used by stage and studio performers to receive personal fold back (monitoring) of the performance. This can be just their own voice or a complex mix of sources. The bandwidth requirement of professional IEM equipment is up to 300 kHz.

The comparison of different specifications and operational requirements of radiomicrophones and IEM is given below in Table 1.

Characteristics	**Radio Microphones**	**IEM (In ear monitors)**
Application	Voice (Speech, Song), Music instruments	Voice or mixed feedback to stage
Transmitter		
Placement of a transmitter	Body worn or handheld	Fixed Base
Power source	Battery	AC Mains
Transmitter RF-Output power	<30 mW	50 mW
Transmitter audio input	Microphone level	Line level
Receiver		
Placement of a receiver	Fixed/Camera mounted	Body worn
Power Source	AC mains/Battery	Battery
Receiver audio output	Line level	Earphone
Receiver type	Single or diversity	Single
General		
Battery/power pack operation time	>4 - 8 h	
Audio frequency response	≤80 to ≥15.000 Hz	
Audio mode	Mono	MPX-Stereo
RF frequency ranges	TV Bands III/IV/V, 1.8 GHz	TV bands III/IV/V, 1.8 GHz (*note 1*)
Signal to noise ratio (optimal/possible)	>100/119 dB	>60/110 dB
Modulation	FM wideband	
RF peak deviation (AF = 1 kHz)	±50 kHz	
RF bandwidth	≤200 kHz	≤300 kHz
Useable equipment/channel (ΔRF = 8 MHz)	>12	6…8

Note 1: IEM may be also used in 863-865 MHz if complying with EN 301 357

Table 1 : Comparison of Radiomicrophones and In Ear Monitors

It is important to note these differences when assigning operating frequencies to IEM, as opposed to radio microphones.

2 CURRENT AND FUTURE DEMAND FOR SAP/SAB SPECTRUM

The content of this section is largely based on the results of the study “The demand for programme making and special events spectrum”, made in the UK in 1999 and used here with kind permission of the Radiocommunications Agency, UK. Some demand figures for audio reporting links are based on a study conducted in France by ART in 2000.

2.1 SAP/SAB sectors addressed

Discussion of SAP/SAB spectrum demand is divided into several sub-sections, characterising several distinctive sectors of programme making activities, along with the principles depicted at the business layer in Fig. 3. These sectors are:

- theatres and touring shows;
- studio production;
- television news gathering;
- sound broadcast;
- casual sport events and similar outside broadcasts;
- special events (i.e. large outside broadcasts).

The scope of each sector development may vary from country to country, therefore the aggregate figures of expected SAP/SAB spectrum demand may be adjusted accordingly for each specific country.

All of those sectors are poised to see growth in the future. The latest trends in society towards expanding consumption of TV programming and other (multimedia) entertainment will require an increasing radiocommunications infrastructure to support the additional programme making. This includes the expansion of television with digital, cable and satellite, and the future introduction of interactive TV, but also covers the Internet, which, as it goes broadband, will increasingly include sound and video programming.

It should be also noted that EU has enacted legislative requirements to produce a greater percentage of broadcast material within the community.

Other society trends that may have a significant impact on the development of different SAP/SAB sectors include changes in programming style for TV, changes in coverage style and priorities for TV sport, changes in musical theatre and other sorts of theatre, changes in production budgets and staffing levels, etc. SAP/SAB is very dynamic as producers continually seek new experiences for audiences, with consequential changes in demand for spectrum. Such requests need to be considered against the benefits and needs of other services and other SAP/SAB applications.

Technical trends and changes, which may be relevant for changing demand for SAP/SAB spectrum, include:

- the introduction of digital video links, for both point-to-point and mobile links;
- the introduction of digital radio microphones;
- the introduction of narrowband technology for talkback;
- possibilities to use in programme contribution public networks, like TETRA, GSM, UMTS, etc.

2.2 Peak vs. aggregate demand

SAP/SAB use in most cases may be characterised as having a high degree of locality, as it is normally confined to the limits of specific locality, where programme making takes place, or even to limits of a single building, like theatre, TV studio, etc. Therefore the demand for SAP/SAB radio spectrum normally occurs in parallel. For example if events in two cities have a demand for spectrum, the total demand for spectrum is equal to the larger of the two demands.

Similarly, if events on different days each have a demand for spectrum, the overall demand for spectrum is again equal to the larger of the two demands, as spectrum used for one purpose on one day can be re-used for another purpose on another day.

Demand measured in this way is *peak* demand and is the correct measure to use to determine whether current spectrum assignments are sufficient. An alternative measure is *aggregate* demand, where spectrum demands are added together even where spectrum can be re-used. This measure might be used to predict the total income from spectrum licence fees, for example. Attempts to predict aggregate demand would require quite different methods than used in this study.

Throughout this whole report any discussion of spectrum demand assumes reference to peak demand. Expressed in such way, spectrum demand may be characterised by simply considering the most heavy users of radio spectrum (e.g. in major conurbations) and assuming that the smaller users (e.g. regional users) will be able to re-use the same spectrum well within the total amount designated as a peak demand.

To illustrate this schematically, a graph can be drawn of spectrum demand against time and place. The horizontal axis represents different times and/or places, although there is no sense of an increase in either time or place when moving to the right – it merely represents *different* times and/or places. The vertical axis represents spectrum demand. Example in Fig. 4 shows this with two rectangles, one representing schematically the way demand might arise for outside broadcasts, the other doing the same for TV news.

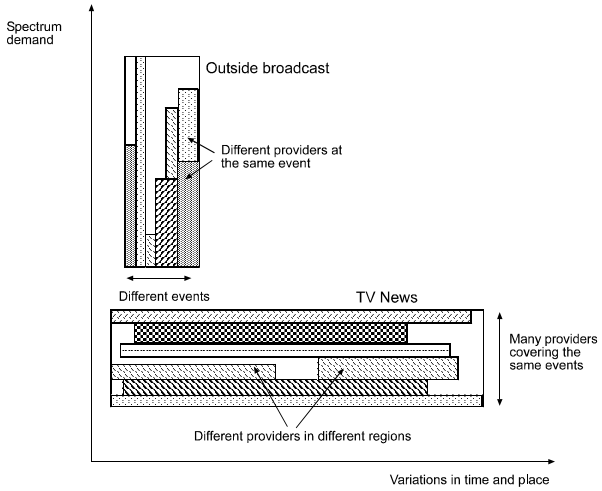


Figure 4 : Illustration of how demand arises in different SAP/SAB sectors

Spectrum can be re-used at different outside broadcast events, so each event has a different rectangle, and the rectangles are placed side-by-side. Demand at a single outside broadcast event is quite high so the height of each rectangle is large, but the demand is localised in time and space so the width of each rectangle is small. Where two or more broadcasters visit the same event, their rectangles have to be stacked on top of each other as they cannot use the same spectrum. Similar principles apply to demand from theatres and studios.

However for ENG applications, each broadcaster usually has to have its own spectrum, which it can use anywhere in time and space (within certain limits). This is because broadcasters need to be able to go anywhere at any time without booking frequencies first. Each broadcaster has relatively few frequencies, so the rectangles have small height, but can use those frequencies over a wide range of times and places, so the rectangles are wide.

Different broadcasters need to be able to visit the same event at the same time, so the rectangles representing different broadcasters have to be stacked on top of each other to obtain the overall demand for the sector. If two broadcasters operate in two sufficiently separated regions, they can share spectrum, so their rectangles can appear side-by-side.

Therefore the whole of the SAP/SAB use may be illustrated as shown in Fig. 5. Each sector has its own rectangle, representing its demand.

Demand from ENG users has to be added to demand from the other sectors as these sectors require a ‘go anywhere’ capability (in time and within a geographical region), so they have allocations, which are separate from all other users. The same spectrum cannot (for example) be used by a theatre and for newsgathering, as the news gatherers require the capability to use spectrum at the same time and place as the theatre. However, as spectrum can normally be re-used between theatres, studios and outside broadcasts, so their rectangles are separated horizontally rather than stacked vertically.

The total demand for SAP/SAB spectrum is therefore equal to the sum of the demands for TV news, radio and the largest of theatres, studios and outside broadcasts.

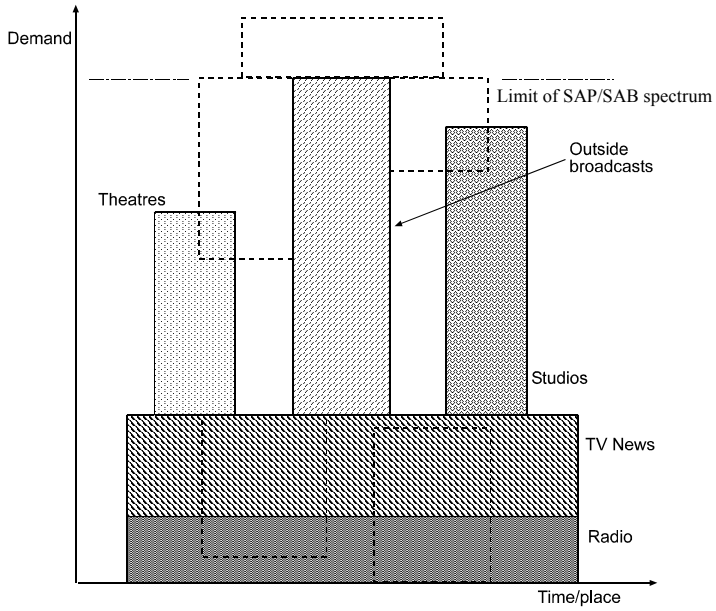


Figure 5 : Combination of spectrum demand in different SAP/SAB sectors

In fact, outside broadcast demand can be so heavy that spectrum is sometimes borrowed from the other sectors, and/or from outside the SAP/SAB allocations. This is shown by the additional dotted rectangles, which represent how outside broadcast might intrude on other radio services' spectrum.

2.3 Demand for theatres and touring shows

Theatres, concert venues and other auditoria of all sizes, both amateur and professional, use radio microphones and to a lesser extent, in-ear monitoring systems and talkback. Applications include drama, musical theatre, rock concerts, corporate events and amateur uses (for example for drama, concerts and shows, and in churches).

Spectrum demand is heaviest for large-scale, professional productions, and for touring musicals and rock concerts, and it is these areas on which the following discussion concentrates. Typically, this kind of usage will be most prominent in the locations with highest density of professional theatres, like the West End in London, UK.

Studies show that currently the heavy peak spectrum demand for a single theatre production may be as high as 45-55 wide band channels (radio microphones and in-ear monitors) and 5-10 narrow band channels for talkback and similar communications. Latest analysis shows that these figures of demand in theatres are not expected to grow significantly over the coming years, due to certain physical limits of manageability of that many signals.

Analysis of typical requirements for the touring shows, e.g. rock & pop concerts, suggests that for such touring productions channel demand may be in the order of 20-40 wide band channels, in a mixed active (60%) and standby (40%) assignment. One particular example considered in detail showed, that radiomicrophones would take around 25% of the channels, while the rest would be divided almost equally by in-ear monitors and instrument (guitar) pick-ups.

It may be further noted that in theatres the demand for in ear monitors is insignificant and not likely to increase. However the situation is the opposite for rock & pop and similar concerts, where demand for in ear monitors in terms of a number of necessary channels prevail over demand for radio microphones. This implies, that the same aforementioned maximum of 45-55 wide band channels may satisfy the needs of both theatres and concerts, but divided in appropriate proportions for different applications (radiomicrophones vs. in ear monitors), as required by specific profile of necessary sound support.

Much of SAP/SAB operations had been short range and able to share spectrum with other services on a geographical basis. This may not always prove to be the case in the future and some reassessment of the balance between frequency reuse and area coverage may be required.

2.4 Demand for studio production

Studios use radio for talkback, microphones, in-ear monitors for presenters, and (potentially, but not at present) cordless cameras. The reason for using radio is to give freedom of movement within the studio.

The studies made in the UK show that currently spectrum demand by studio productions might be as high as 10-15 wide bandwidth channels (radiomicrophones and in-ear monitors) and 5-10 narrow band channels (talkback) for a single large studio. These figures should be increased up to 50-100 wide band and 30-70 narrow band channels for large studio buildings, incorporating number of studios under one roof.

It is further foreseen that within the next 10 years the demand for the wide band radio channels in a studios will approximately double, requiring around 20 channels per studio, or up to some 200 per large studio building. These figures are based on estimates for big studio productions e.g. BBC studios in the UK, etc.

It may be noted that substantial over-provision of microphones and frequencies is common in studio buildings. Typically every studio will have its own microphones and frequencies, with some spares to be used as 'top-up', rather than having fewer frequencies with a pool system relying on not all studios being operative at any one time. This shows that the demand for spectrum may be significantly reduced if a spectrum management discipline could be imposed on the management of radio equipment at the large studio buildings.

One trend may be currently noticed of transferring more and more of traditional studio work out to locations. This might move the desired number and type of channels towards the requirements described in section 2.7.

2.5 Demand for TV news (ENG)

TV news providers use radio links in order to provide rapid response coverage of developing news stories. Therefore video links as well as talkback and radio microphones are used in the production of live and recorded news reports 'from the scene'.

Terrestrial radio links, known under the term of ENG, consist of one or more microwave links that feed video and audio signals directly from the news location to broadcaster's network or studio. ENG links are only one of a number of options used to transfer live or recorded material from location to the studio or network, others including:

- SNG (Satellite News Gathering) refers to the use of satellite links to achieve the same thing;
- fibre optic links can be used where a location has a fibre termination;
- store-and-forward over public telecommunications lines can be used for non-live inserts;
- similarly non-live inserts can be recorded on tape and carried by motorbike or otherwise to the studio.

Each ENG operator (news provider) requires its own exclusive spectrum, for which it requires round-the-clock access over the designated area; there is no scope for event by event co-ordination as the time taken to respond to a news event is too small.

ENG operators normally operate a number of trucks, which can be quickly despatched to a location where a news event is taking place. The truck contains all the facilities required to cover the story and transmit the signal back to the studio or network for (where necessary/appropriate) further production, editing and/or transmission.

It is estimated that all together ENG operators providing news coverage in the area covering major conurbations with high density of news events (typically capital and other big cities, like London, etc.) may require allocation of up to:

- 25-50 talkback narrowband channels;
- 15-30 wideband channels for radiomicrophones;
- 5-10 channels for various video links.

The UK study suggests that predictions of future demand for ENG users would depend heavily on the success of digital technology as a major means of video transmission. If the digital technology does not deliver the promised advantages, hence making no significant impact on the sector, then over the next 10 years increase in spectrum demand for ENG operations would see a modest grow. However if the digital technology delivers on the promised advantages of resilience, quality and ruggedness, then it could mean not only replacing analogue links with digital, but also an overall boost to use of video coverage. So, for major conurbations (like London, etc.) forecasts of future demand for those two scenarios may look like shown in Table 2.

Type of links	Channels demand within 10 years if digital is not a success	Channels demand within 10 years if digital is a success
Talkback narrow band	30-60	30-60
Wide band radiomicrophones	25-50	25-50
Analogue point-to-point video links	5-10	0
Digital point-to-point video links	1-5	10-15
Cordless cameras	1-5	10-15

Table 2 : Two scenarios of forecasted future demand by ENG operations

It is obvious from these figures that if digital technology proves to be successful, then an increase of demand for video links in the longer term may outweigh the gains in spectral efficiency obtained through using narrower channels for digital links.

2.6 Demand for sound broadcasters

Local and national sound broadcast stations use SAP/SAB services for newsgathering, traffic reporting, sports reporting, and other applications. Talkback, radio microphones and audio links are the key services used. However not all stations make significant use of SAP/SAB, in most cases news provision is bought in from specialist news agencies or similar providers.

Therefore SAP/SAB demand for sound broadcast stations is quite modest, e.g. even for such major conurbation as London area, the total demand is some 10 audio links, 5 wide band channels for radiomicrophones and 5 narrow band channels for talk-back communications.

Prediction of demand over the next 10 years indicate that the number of channels for audio links and for radiomicrophones may approximately double, totalling to 15-20 audio link channels and 5-10 radiomicrophones channels.

2.7 Demand for casual sport events and similar outside broadcasts

All forms of SAP/SAB applications are used heavily for sports and other outside broadcasts. Such events are here divided into two sectors. This section covers routine outside broadcasts, the sort of events, which occur week in, week out up and down the country. Although co-ordination is needed, difficulties rarely arise and no special planning of frequencies is required. Frequencies do not have to be 'borrowed' from other uses to cover events in this section.

The following section (2.8 'Major Events') deals with major events, which require detailed and specialised planning, sometimes on-the-ground co-ordination, and sometimes 'borrowing' of frequencies from other uses. The distinction should be emphasised that there are many more events in this section than the following one. Therefore it would not be desirable to have to expend the same planning effort that goes into the large events on the events in this section, unless there were clear rewards in terms of spectral efficiency.

It might be estimated that the current spectrum demand for a general sport event (such as a single football match, etc.), per single broadcaster covering that event, could be around:

- 5-10 wide band channels for radiomicrophones;
- 1 wide band channel for audio link;
- around 10 narrow band channels for talkback;
- 1-2 point-to-point video links (2-4 channels if stand-by/duplex are required);
- 1-5 video links by cordless cameras.

However it should be obvious, that if there are more than one broadcaster covering the same event or if several events occur near-by, then the above estimates should be multiplied appropriately. Demand may also increase if for topography or other reasons it might become necessary to duplicate some of the links, or use repeaters, etc.

The UK study suggested that forecasts of future spectrum demand for sports and OB sector would depend on future take up of digital technology for video transmissions, as it would be for the above described case of TV news gathering. So Table 3 below shows two scenarios of possible future demand for sports and other outside broadcasts per single event/broadcaster. Demand for sound reporting point-to-point links is derived from the results of a study carried out in France by the ART in year 2000.

Type of links	Channels demand within 10 years if digital is not a success	Channels demand within 10 years if digital is a success
Talkback narrow band	10-15	10-15
Wide band radiomicrophones	10-15	10-15
Audio point to point links	2-5	2-5
Analogue point-to-point video links	1-2	0
Digital point-to-point video links	1-2	3-5
Mobile and/or cordless cameras	5-8	8-10

Table 3 : Two scenarios of forecasted future demand for coverage of daily sports and other routine OB

By comparing forecasts in tables 2 and 3 it may be seen that the TV news (ENG) would be more resonant to the success of digital technologies, than the outside broadcasts. This probably may be explained by the fact that outside broadcasts are normally more stationary in their operations, so the need for radio links is not as demanding as for fully mobile ENG operations.

2.8 Demand for coverage of major events

Some of the events covered by the outside broadcasts are extraordinary in terms of the attention they attract, their size, large geographical scales, etc. Some examples of such special events are:

- major large scale sporting events, like Marathons, Cycle Races, etc.;
- major national celebrations, royal weddings and funerals, etc.

The pictures given in Figs. 6-7 below show a typical case of channel demand for video and audio links respectively, by the visiting ENG/OB team covering one of major sporting events.

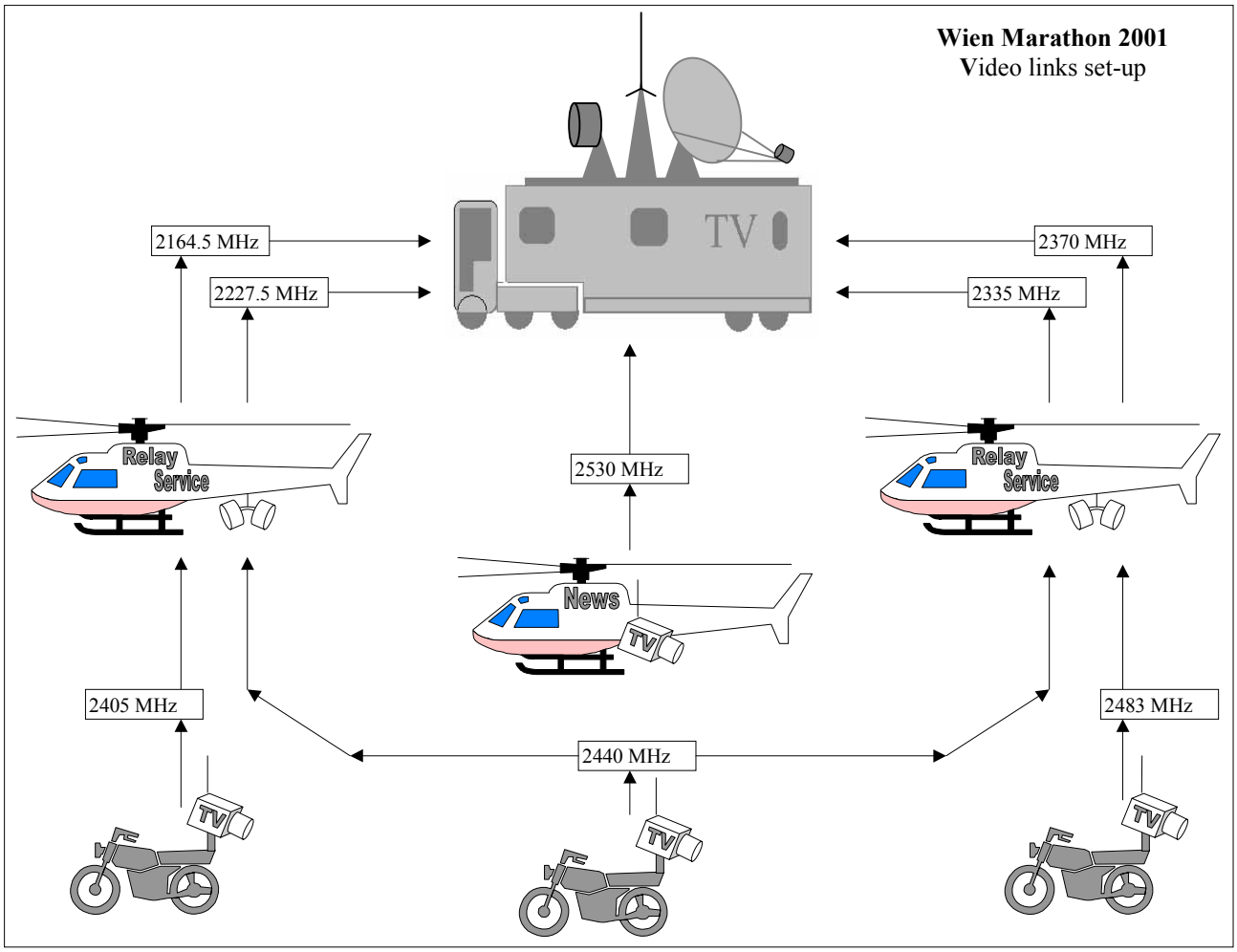


Figure 6 : Real case of ENG/OB demand for video channels to cover Vienna Marathon, 2001 (Courtesy: NOB)

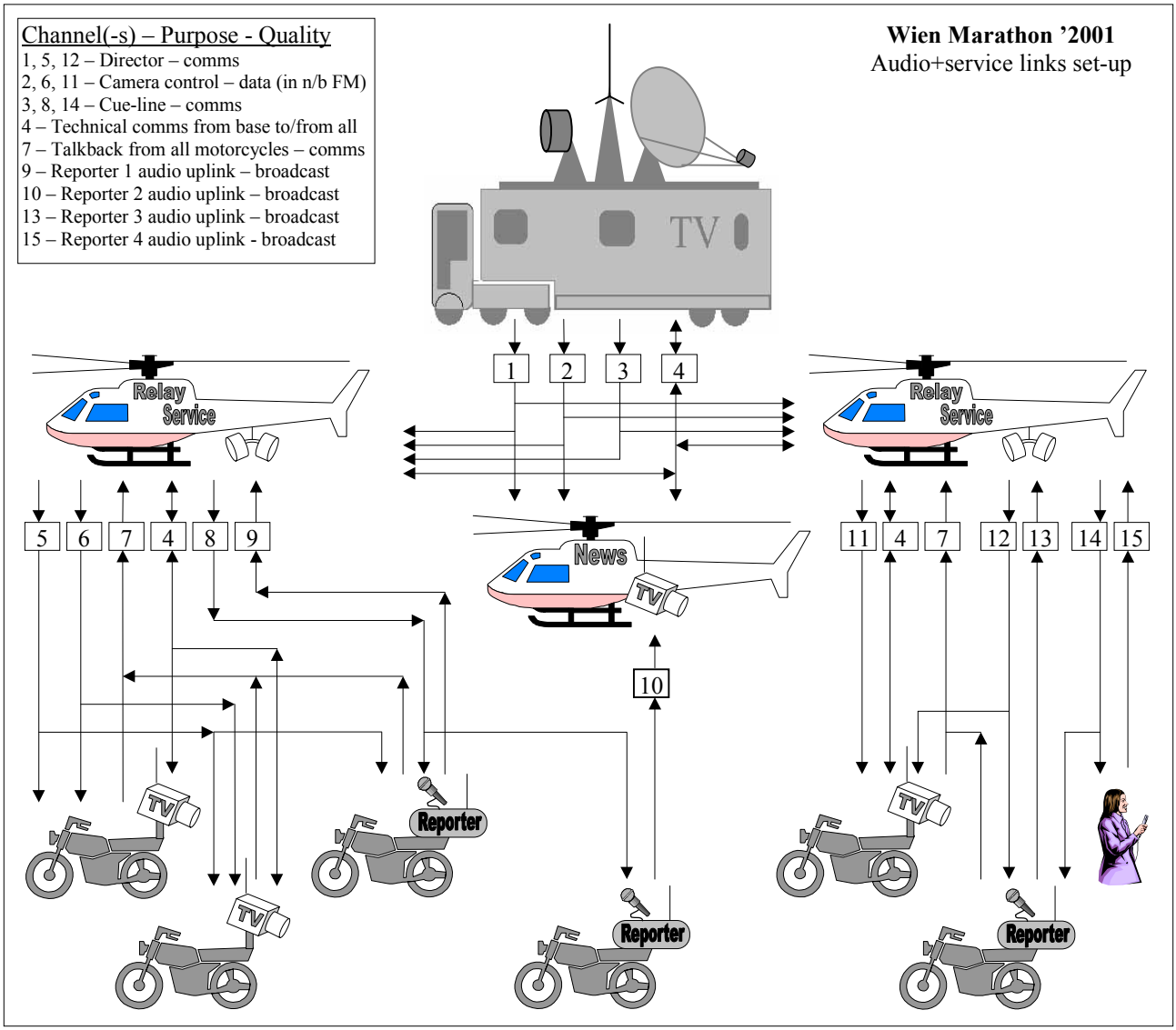


Figure 7 : Real case of ENG/OB demand for audio and service link channels to cover Vienna Marathon, 2001 (Courtesy: NOB)

Such events are the points of greatest demand for SAP/SAB spectrum. However, because of their rarity it seems inappropriate to dimension national SAP/SAB allocations to cope with their demand. Rather, in preparing for such events, spectrum may be borrowed from other users of radio spectrum on a case by case basis.

There can be no question of predicting demand for a 'typical' event, and there would be no virtue in doing so in order to obtain a band plan, as these events can not always be accommodated by a standard band plan, only by a specific plan for each event.

In that respect, it may be also noted that these "non-standard" solutions for accommodating such additional demand would be more easy to achieve if SAP/SAB equipment would generally have wider tuning ranges. Therefore manufacturers should be encouraged to produce equipment with widest technically feasible tuning ranges, focused on covering whole (but if possible also going beyond) of the tuning ranges identified by CEPT.

In general, the broadcasters covering these events are the same as those covering the events described in previous section 2.7, and the drivers and trends are mostly the same, although there are some variations since:

- nearly all the events considered here are 'high profile', so many more broadcasters will be attracted to cover them, hence significantly increasing demand for spectrum at one site;
- broadcasters are aware that SAP/SAB resources might be tight at such major events, so they would be prepared to adhere to the more strict spectrum use discipline and having to co-operate and/or accept less spectrum than they would like;

Assuming all this, this report does not attempt to evaluate possible spectrum demand for this kind of events, as it would have to be satisfied on a case by case basis, based on national arrangements existing for such cases. Instead, the tables in following section indicate just the order of possible demand figures, based on experience from some of "typical" yearly recurring events, such as Vienna, Berlin Marathons, Tour de France, European Grand Prix, etc.

3 SUMMARY OF SERVICE REQUIREMENTS OF VIDEO AND AUDIO SAP/SAB APPLICATIONS

Based on the classification of SAP/SAB equipment in section 1 and considerations in section 2, it becomes possible to summarise and compare the service requirements of the various SAP/SAB sectors for different kinds of technical applications employed. These applications are further differentiated by scenarios in which the equipment might be used (mobility, airborne use) and their related operational parameters, such as range, antenna height, antenna directivity, etc. Such different operational requirements suggest preference for different frequency bands.

Table 4 summarises the service requirements for video SAP/SAB links, and Table 5 summarises the service requirements of audio SAP/SAB links.

Only those SAP/SAB usage sectors are reflected in Tables 4 and 5, which are likely to cause most significant and lasting peak demand. For video links these are the news-gathering (ENG), daily sport coverage or similar routine OB and some of recurring (usually annual) special events, such as major marathons, races and similar events (Berlin, London, Wien Marathons, Tour de France, etc.).

For audio links the activity areas reflected are the news gathering (ENG), daily sports and similar routine OB, theatres and touring shows, and the major recurring events as already mentioned for video links (including major stage shows, such as Eurovision Song Contest).

Apparently all such daily or recurring demand usually requires a long term solution to satisfy, however it may be required to a full extent only at a few locations across the nation.

Estimates of future demand for video links in Table 4 are based on the assumption that digital technology becomes a success, as described in sections 2.5 and 2.7. This also implies that the necessary channel raster in the future may be decreased from current typical 20 MHz to 10 MHz for cordless cameras, portable and mobile video links.

Today temporary point-to-point video links are accommodated either in SAP/SAB bands alongside the mobile SAP/SAB applications, or in the traditional fixed bands (such as 7 GHz or 8 GHz bands). Accordingly they follow either a typical 20 MHz raster in SAP/SAB bands or 28 MHz channel raster in fixed bands. Advancement of digital technology in SAP/SAB applications for these temporary point-to-point links could lead to a transfer to either a 10 MHz (or even 8 MHz because of less stringent size limitations) raster in SAP/SAB bands, or to a 14 MHz raster in fixed bands, see section 4.1 for details.

Because of the wide variety of SAP/SAB, both in terms of number of applications, types of events covered and extent of SAP/SAB use across different European nations, it was not possible to obtain any definite (averaged) figures of estimated channel demand, which would be valid for any CEPT country. Instead, the figures shown below in Tables 4 and 5 are either based on available estimates from the above mentioned national studies or provide the best-attempt estimates, derived from the practical experiences reported to the FM PT 41.

Therefore the estimates in Tables 4 and 5 should be used with caution and seen as indicative figures, giving order of demand, rather than its precise values.

Type of Link	Typical Range	Radio Link Path	Recommended Tuning Ranges	Channel requirement estimates for different activity sectors/events		
				ENG, for major urban area	Casual OB, e.g. football match[2]	OB at major annual events[3]
Cordless Camera	<500 m	Usually clear line of sight, but might be susceptible to multipath impairment	2-2.5 or 2.7-2.9 GHz[4] 10.0-10.68 GHz 21.2-24.5 GHz 47.2-50.2 GHz	**Now:** (2…5) x 20 MHz ch. **In 10 years:** (10…15) x 10 MHz ch.	**Now:** (1…5) x 20 MHz ch. **In 10 years:** (8…10) x 10 MHz ch.	**Now:** (5…10) x 20 MHz ch. **In 10 years:** (10…20) x 10 MHz ch.
Portable Link	<2 km	Normally, but not always clear line of sight.	2-2.5 GHz 10.0-10.68 GHz			
Mobile Airborne	< 50 km	Normally, but not always clear line of sight.	2-2.5 GHz 3.4-3.6 GHz			
Mobile Vehicular	< 10 km	Often obstructed and susceptible to multipath impairment.	2-2.5 GHz 3.4-3.6 GHz			
Temporary Point-to-point links	< 80km per hop	Usually clear line of sight for OB, but often obstructed for ENG use.	7 GHz, 8 GHz bands 10.0-10.68 GHz 21.2-24.5 GHz	**Now:** (2…5) x 20/28 MHz **In 10 years:** (10…15) x 8/10 MHz	**Now:** (1…2) x 20/28 MHz **In 10 years:** (3…5) x 14/28 MHz	**Now:** (2…5) x 20/28 MHz **In 10 years:** (10…15) x 14/28 MHz

Table 4 : Classification and service requirements of video SAP/SAB links[1]

Type of Link	Typical Range	Recommended Tuning Ranges	Channel requirement estimates for different activity sectors/events							
			TV/radio news (ENG), major urban area		Casual OB, e.g. football match [2]		Theatres and touring shows		OB at major annual event [3]	
			Now	In 10 years	Now	In 10 years	Now	In 10 years	Now	In 10 years
In-ear monitors	<100 m	174-216 MHz 470-862 MHz 1785-1800 MHz	10…15 ch.	15…30 ch.	1…5 ch.	5…10 ch.	45…55 ch.	45…55 ch.	20…80 ch.	20…80 ch.
Professional radio micro-phones	<100 m									
Portable audio links	<2 km	VHF/UHF bands [5]	3…5 ch.	5…10 ch.	1…5 ch.	5…10 ch.	2…5 ch.	5…10 ch.	10…20 ch.	10…20 ch.
Mobile (incl. airborne) audio links	<20 (50) km	VHF/UHF bands [5]	3…5 ch.	5…10 ch.	3…5 ch.	5…10 ch.	Not applicable		5…10 ch.	5…10 ch.
Temporary Point-to-point links	<50 km per hop	VHF/UHF bands [5]	1…5 ch.	3…5 ch.	1…3 ch.	2…5 ch.	Not applicable		5…10 ch.	5…10 ch.

Table 5 : Classification and service requirements of audio SAP/SAB links [1]

Note[1]: for further technical characteristics (powers, antenna gains, etc.) refer to ERC Report 38 (video links) or ERC Report 42 (audio links)
Note[2]: Channel estimates for casual OB operations are given per routine event/single broadcaster
Note[3]: Major annual event means typical recurring special event, like annual marathons, races, major stage shows (Eurovision Song Contest), etc.
Note[4]: The final decision awaits results of sharing studies in the band 2.7-2.9 GHz
Note[5]: Depending on application scenario, channel width and required transmitter power, portable, mobile and temporary point-to-point audio links may be accommodated either in SAP/SAB bands or in other VHF/UHF bands, including the Private Mobile Radio (PMR) bands

4 IMPACT OF DIGITAL TECHNOLOGIES

4.1 Video links

By the time of writing this report there was already commercially available equipment for digital video transmissions in SAP/SAB applications. Digital technology promises a lot of advantages to the SAP/SAB industry, such as improved and constant quality of transmitted picture, high robustness, flexible operation modes, decreased size, additional services and effects, etc. So if digital equipment delivers on those promises, then it might be expected that the digital would soon dominate the landscape of SAP/SAB services and applications.

The most popular digital modulation scheme used today is expected to offer advantages over analogue links in terms of quality, resilience and range, especially in cluttered environments. However digital links have two drawbacks: they introduce a delay in the transmitted signal, and there is no visible warning of when the link is about to go down (in contrast to the situation with analogue links, which will show increased interference in the picture before the link goes down).
In addition, some users have indicated concerns over the range of digital links; whilst others expect digital links to have a 10 dB advantage in a link budget over the analogue links currently in use.

This section discusses what impact the introduction of digital technologies will or might have on the spectrum management decisions and solutions for SAP/SAB spectrum.

4.1.1 Channel bandwidth of digital radio cameras

Current studies suggest that the typical digital radio camera will employ the DVB-T transmission standard with COFDM modulation. This would give an advantage of using the same technology as for the mass-market delivery, thus helping to drive down the price of cordless cameras.

DVB-T standard was developed so that transmissions would fit into now standard lattice of terrestrial analogue TV transmissions in the VHF/UHF bands, employing 8 MHz channel raster.

However studies reported to FM PT 41 have demonstrated that employing DVB-T signals for ENG/OB applications would normally require the higher channel bandwidth of 10 MHz. This is caused by the inability to use bulky filtering in the cordless cameras and hence necessity to ensure multi-camera operation in adjacent channels.

It was concluded that the digital video transmissions within the portable and mobile SAP/SAB applications, such as cordless cameras, should be accommodated in the 10 MHz width channel raster. This also allows the combining of two channels within the 20 MHz raster (currently used by analogue wireless cameras) when higher quality transmission is required.

If digital cordless cameras were to operate within TV Bands IV&V, they would have to fit within the existing 8 MHz TV channel raster without causing adjacent channel interference.

Digital temporary point-to-point video links, operated in traditional fixed bands (e.g. 7 GHz or 8 GHz band) should be capable of supporting the channel raster of fixed links, usually following the pattern 7/14/28 MHz. If such links would be deployed alongside the aforementioned mobile SAP/SAB applications, then in future they should be capable of operating either in the 10 MHz raster, or in the 8 MHz raster, where lesser restrictions to filtering allow.

4.1.2 Limits on operational frequency

Analysis of performance of DVB-T transmissions in the mobile environment suggests, that the COFDM modulation used in DVB-T is highly susceptible to the effects of Doppler shift of frequency in the reflected multipath signals. This has an adverse effect of limiting the maximum speed of relative displacement of transmitting and receiving terminals.

The studies reported to the FM PT 41 suggested the following figures of maximum speeds of operation of DVB-T terminals for the vehicular mobile environment, as shown in Table 6 below.

Mode of operation (COFDM 2K) and frequency	**0 dB echo**	**Rural environment**	**Urban environment**
2.5 GHz			
16-QAM r=1/2	121 km/h	65 km/h	82 km/h
64-QAM r=1/2	91 km/h	35 km/h	52 km/h
3.5 GHz			
16-QAM r=1/2	86 km/h	46 km/h	59 km/h
64-QAM r=1/2	65 km/h	25 km/h	37 km/h

Table 6 : Maximum limits of operational speed for vehicular mobile DVB-T wireless cameras

The figures in Table 6 imply that the frequency of 3.5 GHz should be regarded as the practical limit for most typical ENG/OB uses of vehicle mounted wireless cameras.

4.2 Radio microphones

By the time of writing this report, there was still large uncertainty with regard to the future prospects of digital technology for professional radio microphones. Few models of consumer digital radio microphones had been produced and tested in ISM bands (2.4 GHz), however they were unsatisfactory for professional use because of audio delay and poor sound quality. Professional digital radio microphones in the band 1785-1800 MHz and in the TV Bands IV&V were yet to be developed.

Therefore it was decided to consider this issue from two different perspectives, resulting in two following sub-sections. First, the potential benefits of digital technology for radio microphone applications are considered from the theoretical point of view. Then, expectations of some of the current radio microphone manufacturers are summarised, based on the results of a questionnaire. A third sub-section summarises this analysis by providing comparison of expected spectral efficiency of digital vs. conventional analogue radio microphones.

4.2.1 Analytical study of digital radio microphones

The studies reported to the FM PT 41 did suggest several assumptions, which might provide the basic specifications for considering the potential advantages of digital technologies for radio microphones. Among these were the following:

- The audio coding may be similar to that of existing NICAM-728 standard. Therefore assumed “mono-NICAM” configuration would require bit rate of 384 Kb/s;
- The necessity of channel coding (FEC=1/2) would increase the transmission bit rate to 768 Kb/s;
- It was assumed that the basic modulation could be 25% root-raised cosine QPSK. If greater multipath tolerance were required, modulation like QPSK-COFDM could be used, yielding similar conclusions in terms of necessary bandwidth.

The above assumptions would mean that a theoretically estimated necessary spectral bandwidth of the digital radio microphones is 480 kHz, suggesting the potential channel spacing of 500 kHz.

The estimated channel width of 500 kHz is larger than the 200 kHz currently used by analogue radio microphones. However, the same study analysed the impacts of non-linear amplification and reverse intermodulation in the transmission sections of simulated digital radio microphones. These simulations produced evidence, supporting the conclusion, that adjacent channel operation of digital radio microphones might be feasible, as opposed to the limitations imposed by intermodulation on analogue radiomicrophones.

This would mean that although requiring higher bandwidth, the digital radio microphones may be potentially more spectrum efficient.

4.2.2 Digital radio microphones developments

In order to gather information on practical developments and future prospects of digital radiomicrophones, a questionnaire was developed in FM PT 41 and sent to radio microphone manufacturers in the summer of 2001. The responses from 10 manufacturers could be summarised as follows:

- the problem of noticeable audio delay, resulting from digital signal processing, is seen as a major limiting factor to the up-take of digital technology;
- however, all manufacturers announced their commitment to manufacture digital radio microphones, somewhere between now and year 2003;
- 80% of manufacturers aim at producing digital microphones for the TV Bands IV&V, 80% - for the band 1800 MHz;
- manufacturers expect that between 8-15 digital radio microphones could be co-located within the sub-band of 8 MHz;
- manufacturers expect that the switching and tuning ranges of digital radio microphones will remain essentially the same as of contemporary analogue radio microphones, that is 15-24 MHz (3 TV channels) and 50-100 MHz respectively.

Essentially all this means that currently the industry seems to be cautiously positive regarding the prospects of digital technologies, being sure that developments lie with the digital technology, but being not sure what exactly benefits it would bring.

After completion of the questionnaire exercise some further statements were received by the FM PT 41, providing further evidence that the radio microphones manufacturers might be able to expand the switching range of their future products beyond currently commercially available range of 3-6 UHF TV channels.

4.2.3 Performance comparison of digital vs. analogue radio microphones

From the limited information available by the time of writing this report, it was not possible to make a reliable estimate as to the performance characteristics and co-existence capabilities of future digital radio microphones. Therefore Table 7 below compares the performance of contemporary analogue radio microphones with analytically predicted as well as manufacturers' estimated performance of future digital radio microphones.

Type of radio microphones	**Number of microphones used simultaneously at one location within a**			
	Single 8 MHz block in Bands IV&V	**Contiguous 2x8 MHz block**	**2x8 MHz blocks, separated by 8 MHz**	**Band 1785.7-1799.4 MHz**
Typical analogue today (200 kHz)	8…10	11	16	10 (estimate)
High performance analogue today (200 kHz)	10…12	-	-	-
Theoretically simulated digital (500 kHz)	16	32	32	27
Currently envisioned by manufacturers digital	7…15	Note(1)	Note(1)	8…25

Table 7 : Performance comparison of future digital vs. contemporary analogue radio microphones

Note(1): although manufacturers in their reply to the questionnaire did not specify the numbers, majority expressed preference for contiguously allocated channels for future digital radiomicrophones, as opposed to non-contiguous spectrum

It becomes clear from the data given in Table 7, that even if digital radio microphones would require larger channel width, they are still likely to provide much higher (2…3 times) spectral efficiency because of better co-existence features (more dense co-location).

5 INVENTORY OF FREQUENCY BANDS

5.1 Frequency bands for video links

This section contains an inventory of candidate bands for video SAP/SAB links. It lists those bands identified for ENG/OB in ECA (ERC Report 25, February 1998 edition) and ERC REC 25-10 (1995 edition). The inventory is intended to provide details for each of the bands: current CEPT provisions (DEC/REC), national usage, reasoning and conclusions regarding possibilities of future (harmonised) use by video SAP/SAB links.

The bands listed in the document address mostly the bands, which are intended for use by cordless cameras and different mobile video SAP/SAB links. It is assumed that the majority of temporary fixed point-to-point ENG/OB connections are often accommodated in the "traditional" fixed services' bands, utilising the same channelling arrangements. For example, such fixed services' bands, where temporary point-to-point links are often located, include bands around 5.9 GHz, 7.5 GHz, 8 GHz, etc.

The information on nationally used frequency bands is used in this section, as was collected by the FM PT 41 in mid 2001. It is reproduced in full in Annex 1 of this report.

Two distinctive terms are used in this section to describe different proposed status of band identification for use by video SAP/SAB links:

- *Tuning range* – means identification of the frequency band, from where CEPT countries may assign specific sub-bands or particular frequencies for video SAP/SAB links subject to availability, actual demand and sharing arrangements with primary services using those bands. Ideally, SAP/SAB equipment should be capable of being re-tuned within the whole of tuning range and even beyond, to be suitable for operation in different countries;

- *Preferred sub-band* – a sub-band within the tuning range, where higher prospects of pan-European usage of video SAP/SAB links may be expected. These sub-bands are identified as either those, which are most widely used for SAP/SAB today, or as occupying certain gaps in spectrum use by primary services, such as separation gaps between the "go-return" duplex legs in fixed service channelling arrangements, etc. If SAP/SAB equipment is not capable of covering the whole tuning range, then it should be capable of operating at least within the preferred sub-band to ensure the best opportunity for international use.

5.1.1 Frequency bands 2025-2110/2200-2290 & 2290-2500 MHz

Current CEPT background

The bands 2025-2110/2200-2290 MHz are foreseen by the ECA to be used primarily for fixed links, space science services and mobile systems. Footnote EU16A clarifies that mobile service is limited to tactical radio relay links and ENG/OB applications.

The NJFA and ERC Response to DSI Phase III identify the sub-bands 2025-2070/2200-2245 MHz as the harmonised 2x45 MHz solution for near/cross-border operation of military TRRL. See also ECA footnote EU2.

Within the band 2290-2400 MHz ECA foresees mobile systems, the band 2400-2483.5 MHz is designated as ISM band, also used for SRDs, etc. The band 2483.5-2500 MHz is designated as fixed, mobile, mobile-satellite, ISM band.

Although until now ECA did not directly foresee ENG/OB use in the band 2290-2500 MHz, such use was recommended by the ERC REC 25-10. The FM PT 41 proposed to extend it downwards until 2290 MHz and treat it together with the above bands 2025-2110/2200-2290 MHz.

Current national usage within CEPT

These frequency bands today are already widely used across CEPT for video SAP/SAB links. Total of 16 from 18 countries providing information (89 %) indicated that they do allow various video links in some parts of this frequency range. In terms of specific sub-bands, certain majority (70%) would allow SAP/SAB in the middle of the band, around 2.2-2.4 GHz, while respectively 40% and 45% of countries would allow such use in the lower (2-2.2 GHz) or upper (2.4-2.5 GHz) parts of this range. See Annex 1 for details.

Future use by video SAP/SAB links

Likely extended use by video SAP/SAB links on a shared basis with other services.

It should be noted that the ISM band 2400-2483.5 MHz becomes increasingly difficult to share between video links vs. SRDs, especially Radio LANs, including Bluetooth. However some further possibilities to maintain SAP/SAB use in this band should be investigated further. E.g. the use of digital modulation technologies with the narrowed channel bandwidth and low power (10 mW) by future video SAP/SAB applications could improve sharing possibilities.

The bands 2025-2110/2200-2400 MHz today are widely used for governmental purposes in many European countries, in particular for TRRL below 2300 MHz and aeronautical telemetry between 2300-2400 MHz. However these bands provide potential for video SAP/SAB links, as it may be seen that SAP/SAB access to this band is allowed in many countries under various arrangements.

Category of video SAP/SAB links

Primarily mobile vehicular and airborne video links, but also including portable video links. Cordless cameras may have to be accommodated in this band too, unless replacement band at 2.7-2.9 GHz is made available for that kind of SAP/SAB links.

Prospects of harmonisation and preferred sub-bands

It is suggested that the bands 2025-2110 and 2200-2500 MHz are combined together and identified as a single tuning range for video ENG/OB links. It is assumed that this corresponds well with the expected minimum tuning range of 500 MHz for equipment designed for this band.

5.1.2 Frequency band 2500-2690 MHz

Current CEPT background

The band 2500-2690 MHz has been identified by WRC-2000 for satellite and terrestrial components of UMTS/IMT-2000. The conditions and time-scales for UMTS access to this band are currently being developed within ECC PT 1.

ECA does not directly foresee ENG/OB use in this band; however such use was recommended by the ERC REC 25-10 in the band 2300-2600 MHz.

Current national usage within CEPT

Of 16 countries providing information for this band, only 4 (25%) indicated on-going use of video SAP/SAB links in this band. Further 5 (30%) indicated that currently video SAP/SAB links are allowed, but in the future the band should be freed for other use, notably as an UMTS extension band. Remaining 7 countries indicated no SAP/SAB use in this band.

Future use by video SAP/SAB links

The band 2500-2690 MHz is intended for sole UMTS use in the longer term. However this band might continue to be used for video SAP/SAB applications in the short term, presumably until 2005-2007.

Category of video SAP/SAB links

Primarily mobile vehicular and airborne video links.

Prospects of harmonisation and preferred sub-bands

No, given the expected future deployment of UMTS.

5.1.3 Candidate frequency band 2700-3400 MHz

This band is currently considered as a candidate for accommodating some SAP/SAB requirements, in particular within the sub-band 2700-2900 MHz. However such identification for video SAP/SAB links should await results of ongoing sharing studies in SE PT 34 and review of the whole band 2700-3400 MHz by the FM PT 31.

Having considered the progress of sharing studies, FM PT 41 at its October 2001 meeting, decided to restrict candidate SAP/SAB applications for introduction in the band 2700-2900 MHz to digital cordless cameras only. The operational requirements, based on the data in ERC Report 38 but adjusted for expected digital scenario, are given below in Table 8.

Additional operating and licensing conditions, e.g. co-ordination requirements, exclusion zones around radars or other measures for protection of aeronautical radionavigation, are to be established based on the results of sharing studies and realistic possibilities of enforcing such conditions.

Type of Link	Typical Tx antenna characteristics			Maximum EIRP (dBW)	Typical Environment
	Height (agl)	Directivity	Gain (dBi)		
Digital Cordless Cameras (see definition in Section 1 of the report)	2 m	Omni-directional in HRP	5	0	Indoor, Outdoor (e.g. within sports stadium)

Table 8 : Parameters of digital cordless cameras considered for operation in the candidate band 2700-2900 MHz

It was assumed that the current choice for modulation would be the DVB-T standard, however later developments of proprietary modulation schemes may be considered once and if they become known. Unfortunately, this would also require re-visiting the assumptions made when conducting the sharing studies. However it may be possible to associate the sharing study results with some essential requirements in terms of modulation parameters, compliance with which would assume validity of the original sharing study with the different system.

Such proposed restriction of potential SAP/SAB use to only one application would provide only partly solution to congestion in use of spectrum available to video SAP/SAB links. However, if cordless cameras may be used on certain conditions in the band 2700-2900 MHz, this would at least release pressure on the other bands (notably in the range 2-2.5 GHz), which then may be to a larger extent used for high mobility (terrestrial and airborne) video SAP/SAB links.

Given that the sharing concerns are resolved satisfactorily, then the band 2700-2900 MHz could become a good candidate for harmonised use by cordless cameras, because of existing similar use of the band by incumbent services across Europe.

5.1.4 Frequency band 3400-3600 MHz

Current CEPT background

The ECA foresees this band to be used primarily for fixed links and fixed wireless access applications. However footnote EU 17A allows ENG/OB use under the mobile allocation. This is further specified in the Notes column as being for occasional co-ordinated ENG/OB links.

The ERC REC 13-04 identifies the band 3400-3600 MHz as one of the bands, preferred for FWA applications.

Current national usage within CEPT

While in many countries this band is earmarked or used for services other than SAP/SAB, notably for FWA, at least 5 out of 16 responding countries (some 30%) do allow video SAP/SAB links in this band. Usually it is for occasional SAP/SAB use on a co-ordinated basis.

Future use by video SAP/SAB links

Some possibilities of continued SAP/SAB use exist under national sharing arrangements or case-by-case co-ordination procedures.

Category of video SAP/SAB links

Mobile vehicular and airborne video links.

Prospects of harmonisation and preferred sub-bands

The band might be kept as a tuning range for video SAP/SAB links, and such use may in particular utilise the spectrum gaps in and around the FWA channelling plan. Until FWA is better developed, wider use of this band by video SAP/SAB links may take place.

5.1.5 Frequency band 4400-5000 MHz

Current CEPT background

This band is identified by the ECA as a harmonised military band for fixed and mobile systems. The sub-band 4990-5000 MHz is also foreseen for Radio Astronomy measurements. However Notes column allows occasional use of co-ordinated ENG/OB links.

See also ECA footnotes EU2 (for sub-band 4400-4500 MHz) and footnotes EU20 & EU27, which address issues of civil-military sharing.

Current national usage within CEPT

In most CEPT countries this band is reserved for sole military use. However at least 6 out of 17 providing the data (35%) indicated that they do allow occasional SAP/SAB use in this band.

Future use by video SAP/SAB links

Some possibilities of continued SAP/SAB use exist under national sharing arrangements or case-by-case co-ordination procedures.

Category of video SAP/SAB links

Tests performed in Austria of video SAP/SAB links in this band (ORF, 2001) concluded that this band is suitable for fixed or low mobility video link applications, such as temporary point-to-point links, portable links or cordless cameras.

Prospects of harmonisation and preferred sub-bands

No.

5.1.6 Frequency band 5250-5850 MHz

Current CEPT background

The various sub-bands of this band are foreseen by the ECA to be used for different applications, including radiolocation, radionavigation, satellite services. Furthermore, ERC DEC(99)23 designates the bands 5150-5350 MHz and 5470-5725 MHz for HIPERLANs.

However, ECA footnote EU22 stipulates that the band 5250-5850 MHz will be studied to identify possibilities to accommodate ENG/OB, specifically wireless cameras.

Current national usage within CEPT

Of 16 countries providing information, only 3 (20%) indicated possibilities for using video SAP/SAB links.

Future use by video SAP/SAB links

Currently uncertain, future of the band will be re-considered at the WRC-03.

The band may be difficult to share with other services, allowed by Radio Regulations, in particular with HIPERLAN in the future. However, possibilities to use HIPERLAN technology for ENG/OB links might be investigated.

The ISM part of the band, namely 5725-5850 MHz might be increasingly difficult to share with incumbent ISM equipment and with possible future increasing use of SRDs in this sub-band.

Category of video SAP/SAB links

Cordless cameras and portable video links.

Prospects of harmonisation and preferred sub-bands

No.

5.1.7 Frequency band 10.0-10.68 GHz

Current CEPT background

The various sub-bands of this band are foreseen by the ECA to be used for different applications, such us FWA; radars in the parts below 10.5 GHz; sensors and passive applications. ENG/OB use is envisaged across the entire band. RR footnotes S5.149 and S5.482 apply in the band 10.6-10.68 GHz to protect operation of passive services.

The ERC REC 13-04 identifies the band 10.15-10.30/10.50-10.65 GHz as one of the bands, preferred for FWA applications.

Current national usage within CEPT

This band is widely used by video SAP/SAB links in Europe. Of 18 countries, only 2 indicated no SAP/SAB use in this band. Of 16 positively responding countries, 12 would allow video SAP/SAB links in the middle part of the band (around 10.3-10.5 GHz), 10 in the upper parts (10.5-10.68 GHz) and 6 in the lower parts (10-10.15 GHz).

Future use by video SAP/SAB links

Likely continued use of video SAP/SAB links on a shared basis with other services, e.g. utilising separation gaps between go-return duplex parts within FWA deployment scenarios, non-radar parts, etc.

Category of video SAP/SAB links

Temporary point-to-point video links, portable video links and cordless cameras.

Prospects of harmonisation and preferred sub-bands

The whole band 10.00-10.68 GHz might be identified as a tuning range for video SAP/SAB links.

The sub-band of 10.3-10.45 GHz may be identified as a preferred sub-band for video SAP/SAB links.

5.1.8 Frequency band 21.20-24.50 GHz

Current CEPT background

The various sub-bands of this band are identified by the ECA to be used for different applications, such us fixed links, passive services, RA observations and radars. There are no foreseen plans in Europe for operation of passive services in parts of this band.

ECA currently allows ENG/OB use across the entire band, except within the sub-band 21.4-22.0 GHz, reserved by ECA for wide-band high definition television. The latter sub-band is also considered for BSS/HDFSS applications.

ERC Recommendation T/R 13-02 established the channel raster for fixed services in this range, inter alia recommending to deploy fixed unidirectional links, such as used for ENG/OB, in the sub-bands 22.6-23.0 GHz, and 24.25-24.5 GHz. In such deployment, unidirectional links would not overlap with the duplex channelling raster of conventional bi-directional permanent fixed links.

Current national usage within CEPT

This is another band in major use for video SAP/SAB links in Europe. Only 2 of 20 responding countries indicated no SAP/SAB use in this band. Of 18 positively responding countries, 12 would allow video SAP/SAB links in the lower parts of the range (in particular within 21.2-21.4 GHz), 9 in the middle parts (22.6-23 GHz) and 6 in the upper parts (24.25-24.5 GHz), while actual ranges vary much greater.

Future use by video SAP/SAB links

Good prospects, likely increase of SAP/SAB usage.

Category of video SAP/SAB links

Cordless cameras and temporary point-to-point video links.

Prospects of harmonisation and preferred sub-bands

The whole band should be kept as a tuning range for video SAP/SAB links.

The sub-bands 21.2-21.4 GHz, 22.6-23.0 GHz and 24.25-24.5 GHz may be identified as the preferred sub-bands for video SAP/SAB links.

5.1.9 Frequency band 47.20-50.20 GHz

Current CEPT background

This band is foreseen by the ECA to be used for different applications, such us fixed links, fixed-satellite services, broadcasting satellite feeder links, also for RA observations. The bands 47.2-47.5/47.9-48.2 GHz are designated for HAPS and sharing with this service may require caution.

ENG/OB use is envisaged by the ECA across the entire band.

Current national usage within CEPT

This band seems being not currently demanded for SAP/SAB use in most CEPT countries. Of 16 countries providing data, 6 indicated that video SAP/SAB would be allowed, and only one (UK) indicated practical use. Other countries indicated no attitude towards video SAP/SAB links in this band.

Future use by video SAP/SAB links

Unclear, as interest for SAP/SAB in this band is not yet mature. It might be expected that the SAP/SAB designations in the 21.2-24.5 GHz band should be filled first, before attention turns to the 48 GHz band.

Category of video SAP/SAB links

Cordless cameras and temporary point-to-point video links are potential applications in this band.

Prospects of harmonisation and preferred sub-bands

Good prospects of harmonisation may be seen in this band and its identification as a tuning range for SAP/SAB links should be kept. Further developments in this band would depend on actual requirements for video SAP/SAB links in this range.

5.1.10 Conclusions

From analysis given in the previous subsections it appears, that because of unlikely and, in principle, unnecessary exclusivity of spectrum for video SAP/SAB links and its highly divergent use across various CEPT countries, the harmonisation of specific sub-bands is achievable only to certain extent.

Instead, the tuning ranges should be pursued as a major and practical level of harmonising SAP/SAB spectrum. Such harmonised tuning ranges would allow sufficient level of flexibility to Administrations in managing different levels of national demand for SAP/SAB applications, while giving opportunity to manufacturers to achieve sufficient economies of scale, when producing equipment tuneable over the entire identified range.

In case the full tuning range in each band is not initially practicable due to equipment constraints, preferred sub-bands have been identified, where possible, as a best compromise. Consequently, it is recommended that Administrations should consider the preferred sub-bands as the first choice, in particular for temporary used assignments.

5.2 Frequency bands for audio links and radio microphones

This section contains an inventory of frequency bands identified for audio SAP/SAB links in general, in particular for radio microphones.

It should be noted, that portable, mobile and temporary point-to-point audio links may be accommodated either in the SAP/SAB bands described in this section, or in other VHF/UHF bands, including PMR bands. This would depend on particular application scenario, channel width and required transmitter power. It should be noted that identification of harmonised sub-bands for these audio links is not achievable.

The material of this section further develops that contained in the final report from the FM PT 27, filed as WG FM document FM(98)67, May 1998.

5.2.1 Frequency band 174 - 216 MHz (TV Band III)

This band is identified by the CEPT Recommendation 70-03 as a tuning range for radio microphones. This band is still used for TV transmissions (TV Band III) in many European countries, restricting the wide spread of radio microphones. In some countries, this band is also increasingly used for land mobile services. At least 10 CEPT Administrations indicated that they do not allow radio microphones in this band, but in many other countries a large number of radio microphones are in operation.

It also seems that manufacturers focus their future plans on higher bands. In replies to the questionnaire on prospects of digital radio microphones, few manufacturers indicated their wish to produce professional digital radio microphones in the band 174-216 MHz.

However, taking into account a large amount of existing equipment, this band should be identified as a tuning range for audio SAP/SAB applications for the time being.

5.2.2 Frequency band 470 - 862 MHz (TV Bands IV & V)

TV bands IV&V are identified as a tuning range for professional radio microphones in CEPT Recommendation 70-03 and currently seem to accommodate the majority of national requirements for professional radio microphones. Only some 5 CEPT countries indicated that they do not allow radio microphones in this band.

Other categories of audio SAP/SAB links envisaged in this band are in-ear monitors and portable audio links.

To ensure continued and reliable long term operation of radio microphones and other audio SAP/SAB links in this band it was deemed necessary to answer two major problems, associated mostly with future plans of conversion from analogue to digital TV:

- Identify possibilities and means of ensuring continued use of SAP/SAB in TV Bands IV&V after the introduction of digital TV, and in particular during analogue-digital simulcasting period;
- Develop solutions for more uniform access to the band for cross-border operations, like touring shows, etc.

Working towards solution of these problems, FM PT 27 had previously initiated some of necessary sharing studies, which were carried out in the SE PT 27 and now published as ERC Reports 88-90.

Details from manufacturers collected by the FM PT 27 suggested that it would be impracticable to produce one piece of multi-channel equipment, which would be capable of switching across the whole of TV bands IV&V, at that time the practical switching was only across some 3 TV channels. However at the time of writing this report, the switching range of radio microphones on the market already reached up to 6 TV channels, that is some 48 MHz.

FM PT 41 received further indications that this switching range may be extended up to some 100 MHz in the future, subject to actual demand from users. This extension of switching range may be seen as very important contributing factor towards improved co-existence between broadcasting services and SAP/SAB.

Replies to the questionnaire on future prospects of digital radio microphones showed that most of the manufacturers intend producing digital radio microphones for the band 470-862 MHz.

Assuming all these developments and high interest between manufacturers in exploiting the band 470-862 MHz for current and future SAP/SAB applications, this band should be seen as the vital contributor to satisfying long term demand for audio SAP/SAB applications.

However solutions for ensuring continued co-existence of SAP/SAB with broadcasting after and during introduction of digital TV should be further considered by CEPT, in close collaboration with the SAP/SAB industry. Further extension of switching range of equipment is one of these solutions, which already now may be explored to a larger extent.

5.2.3 Frequency band 1785-1800 MHz

After much searching by the Project Team FM PT 27 the band 1785-1800 MHz was identified as a candidate for harmonised allocation for future (digital) radio microphones. This band is positioned between GSM–1800, operating in the lower adjacent band 1710-1785 MHz and TFTS allocation in the upper adjacent band at 1800-1805 MHz.

Consequent compatibility studies, conducted by SE PT27, showed that a guard band at each end of the new band would be necessary in those countries using GSM-1800 and TFTS. The usable band for radio microphones was therefore effectively limited to 1785.7-1799.4 MHz, to protect GSM-1800 operations at the lower band edge and radio microphones from the airborne transmission leg of TFTS at the upper band edge. A licensing procedure was also established in some countries to protect the TFTS ground stations' receive facility, as well as to ensure protection of in-band radio relay operations.

The above identification was ultimately confirmed through the provisions of CEPT Recommendation 70-03. The relevant technical characteristics and measurement procedures are described in the ETSI standard EN 301 840 (digital radio microphones) and EN 300 422 (analogue radio microphones).

However this band still presents a challenge to manufacturers of professional radio microphones in designing and developing new equipment to the common harmonised standard. At the same time, it also provides marketing and use opportunities across most of Europe. In order to gather actual information on the level of implementation of this band for radio microphones, the FM PT 41 has collected data from CEPT Administrations by means of specially developed for this purpose questionnaire, in October 2001. Responses from 23 CEPT administrations were received and only 2 of those indicated substantial restrictions to introduction of radiomicrophones in the band.

More detailed review of responses has shown the general positive attitude of CEPT Administrations to the radiomicrophones in this band and wide degree of acceptance of relevant provisions of CEPT Recommendation 70-03 and EN 301 840. Summary of those responses is reproduced in Annex 2 to this report.

This positive attitude from CEPT Administrations was echoed by the radio microphone manufacturers, majority of whom in their replies to the aforementioned questionnaire on prospects of digital radiomicrophones, indicated that they intend to produce digital radio microphones for this band.

If all these expectations become true and the band 1785-1800 MHz becomes to a large extent used for radio microphones, this would provide a significant part of long-term solution for ensuring continued and uniform pan-European use of radio microphones.

5.2.4 Conclusions

The wide variety of audio SAP/SAB links, in particular radio microphones, are deployed in the tuning ranges identified for audio SAP/SAB in general and radio microphones in particular.

Of these tuning ranges, the band 174-216 MHz seems to be losing its importance for future SAP/SAB applications, but because of large base of existing equipment, its identification as SAP/SAB tuning range should be maintained for the time being.

The band 470-862 MHz appears as the vital tuning range for audio SAP/SAB applications, where most of existing and future SAP/SAB use is concentrating. Even with future exploitation of the 1800 MHz band for radio microphones, the pressure on the band 470-862 MHz is not likely to decrease significantly, as the band 1785-1800 MHz will satisfy only part of the overall SAP/SAB demand in the UHF range. Therefore identification of the band 470-862 MHz as a tuning range for audio SAP/SAB applications should be reinforced. In particular, some further measures for ensuring long-term co-existence with TV transmissions during and after conversion to DVB-T should be considered. One of such measures - widening of switching range of equipment, already seems technically feasible.

The band 1785-1800 MHz is another solution for long-term uniform use by radio microphones, most CEPT Administrations have already declared their commitment to allow radio microphones to this band. When equipment becomes available for this band, it is likely to satisfy a significant portion of overall demand for audio SAP/SAB applications, such as radio microphones and IEM.

Provisioning of frequencies for portable, mobile and temporary point-to-point audio SAP/SAB links will continuously demand flexible approach, requiring accommodation of higher power links in VHF/UHF ranges, including PMR bands.

6 LICENSING CONSIDERATIONS

Licensing of the SAP/SAB equipment and users demands specific attention by Administrations and should differ from the licensing regime of other radiocommunications services. This is because of the typically sporadic pattern of use of SAP/SAB equipment, requiring either some forms of general authorisations or setting up of individual temporary licensing with short application processing times.

Different administrations address these problems differently and solutions range from general authorisation (blanket licence) to outsourcing of SAP/SAB licensing functions to specialised companies, providing user tailored licensing services at short notices.

However at least one case requiring certain degree of harmonisation is the licensing of visiting foreign ENG/OB teams at short notice. In case a host Administration does require individual licences and either does not recognise a licence issued in country of origin of ENG/OB team or frequencies have to be co-ordinated, then some simplified procedures would be beneficial.

One solution is promotion of harmonised form for SAP/SAB applications. The current model SAP/SAB application form in Annex 4 of ERC/REC 25-10 may be used as a basis and should be updated during the planned revision of ERC/REC 25-10. This update should aim at producing more informative fields and making application form better suited for electronic submissions and administrative handling.

7 OVERALL CONCLUSIONS OF THE REPORT

Amongst the many findings of this report, the following appear to be the most significant overall conclusions:

(1) It is suggested that CEPT adopts a unified and logically inter-linked set of definitions of various applications and technologies in the SAP/SAB area, as described in Fig. 3 of section 1 of the report;

(2) It is shown that while the actual demand for SAP/SAB spectrum varies significantly between different countries, different programme makers and different events, the overall trend is that of steady increase of SAP/SAB demand in most of the sectors. Administrations are invited to base their forecasts of the near/long-term demand for different SAP/SAB applications on the information provided in Tables 4 and 5, section 3 of the report;

(3) At the time of writing this report, the actual impact of digital technologies on the future of SAP/SAB was not entirely clear, as digital SAP/SAB equipment was only about to be tested or in the conception phase. Even the potential benefits of digital technologies were not yet fully apparent to the industry, in particular for radio microphone applications;

(4) However, based on the theoretical simulations and some of early tests, the report shows that the introduction of digital technologies could mean higher spectral efficiency of SAP/SAB equipment. This might be achievable through the reduction of channel bandwidth for video links and easing of intermodulation constraints (hence more dense co-location) for radio microphones. For details refer to section 4;

(5) Overall consideration of frequency bands for SAP/SAB applications has proved that SAP/SAB use is highly divergent and irregular across various CEPT countries. Because of this, only limited harmonisation may be achievable. Recognising the impracticality of exclusive allocations the concept of tuning ranges should be pursued as the main means of harmonising SAP/SAB spectrum use;

(6) In reviewing frequency bands for video SAP/SAB links, the preferred sub-bands were identified where possible. These (if available in particular country) should be used as a first choice option in assigning frequencies for SAP/SAB, in particular for occasional/temporary use;

(7) The potential interest in identifying the frequency band 2700-2900 MHz for one type of SAP/SAB applications – digital cordless cameras with 0 dBW output power was confirmed. This would significantly ease the pressure on the SAP/SAB bands below 2500 MHz, which could then be better exploited for high mobility SAP/SAB applications. However conditions for use of the band 2700-2900 MHz by cordless cameras, if proved possible at all, are to be established by the FM PT 31, taking account in particular of the outcome of relevant SE PT 34 studies;

(8) Consideration of frequency bands for audio SAP/SAB applications, notably radio microphones, showed that the main interest of SAP/SAB industry is currently concentrating on the band 470-862 MHz, which should remain a vital tuning range of SAP/SAB operations for the foreseeable future. Therefore some solutions should be further considered for ensuring continued co-existence of SAP/SAB with primary broadcasting services in the band, in particular during and after their conversion to DVB-T. One of such already exploitable solutions is extension of switching range of radiomicrophones beyond that of currently marketed equipment (3-6 UHF TV channels);

(9) The band 1785-1800 MHz is likely to make a large contribution to satisfying spectrum demand for radio microphones, in particular as a long term solution for truly pan-European operations (touring shows, etc.). This would help to relieve the pressure for SAP/SAB use in the band 470-862 MHz;

(10) The model application form for SAP/SAB licence applications should be promoted. The existing CEPT proposal for such a form in Annex 4 of the ERC Recommendation 25-10 should be used as the basis, but updated during the revision of REC 25-10 so that it contains more information and is better suited for electronic submissions and administrative handling.

ANNEX 1
NATIONAL USAGE OF BANDS FOR VIDEO SAP/SAB LINKS WITHIN CEPT COUNTRIES AT JUNE 2001

The following tables provide information on nationally used frequencies for video SAP/SAB links, as valid for June 2001. Most of this information was reported by relevant Administrations to the FM PT 41, some additional data was extracted from the ERO study on Fixed Service use, September 2001. The information from this annex was used in discussions on inventory of frequency bands, given in Section 5.1 of the report.

Information on national use of the band 1785-1800 MHz by radio microphones is given in the following Annex 2, information on use of the bands 174-216 MHz and 470-862 MHz by radio microphones may be found in information annexes of the ERC Recommendation 70-03.

2025-2110/2200-2500 MHz

Country	National use of ENG/OB	Use statistics	Remarks
Albania	No		
Austria	Future ENG/OB in 2070-2110 MHz; 3 channels in 2245-2399 MHz		
Czech Republic	3 channels between 2300-2400 MHz		
Denmark	5 channels within 2310-2394 MHz for wireless cameras	5 licences	
Estonia	No		
Finland	4 channels in 2300-2400 MHz	8 licences	
France	6x10 MHz for digital links in 2000-2500 MHz. Additional 2x10 MHz in Paris area. Occasional access to 2200-2290 MHz. 22 MHz channel at 2470 MHz for analogue G-A&G-G links, shared with military (not to be used after 1/1/2005) or 2x10 MHz channels at 2465&2475 MHz.	320 temporary*	Agreement with space operation services
Germany	3 channels in 2.32-2.40 GHz 5 channels in 2.4-2.4835 GHz	80 licences	NPNI basis in ISM band
Italy	ENG/OB allowed in 1900-2025, 2040-2110, 2120-2300 and 2483.5-2500 MHz		
Latvia	In 2.3-2.4 GHz		
Lithuania	7 channels in 2300-2500 MHz for portable links and cordless cameras		
The Netherlands	10x25 MHz channels for ENG/OB		Future sharing with TRRL in parts of 2025-2290 MHz
Norway	2025-2110 MHz for p-mp fixed and mobile video ENG/OB links, 2200-2290 MHz – for mobile video ENG/OB links 2337-2393 MHz for mobile video links		
Portugal	12 channels in 2300-2480 MHz		
Slovak Republic	ENG/OB allowed in 1880-2110 MHz		
Slovenia	8x25 MHz channels	20 licences	
Switzerland	Cordless cameras, down to 1350 MHz		
UK	2390-2500 MHz on a shared basis	6 permanent 400 temporary**	

Notes:

*In France number of temporary licences issued between Oct-1999 and Sept-2000, 99% of licences are for less than 48 hours duration

**In UK number of temporary licences issued in 12 months period prior to end of March 2001, 99% of licences are for less than 6 days duration

2500-2690 MHz

Country	National use of ENG/OB	Use statistics	Remarks
Albania	No		
Austria	No		
Czech Republic	No		
Denmark	10 channels within 2520-2670 MHz	20 licences	UMTS in future
Estonia	No		
Finland	1 channel centred at 2586 MHz	4 licences	No new licences
France	22 MHz channel at 2510 MHz for G-A&G-G use, shared with military (not to be used after 1/1/2005)	460 temporary*	
Germany	No		
Italy	In the bands 2500-2520 & 2667-2690 MHz		
Lithuania	No		
The Netherlands	Currently 5 x 25 MHz channels		Licensing FWA, UMTS after 2007
Norway	No		
Portugal	10 channels across the band		UMTS in future
Slovenia	Future digital ENG/OB		Shared with FS
Switzerland	Portable/mobile ENG in 2520-2670 MHz		
UK	2500-2690 MHz on a shared basis	24 permanent 511 temporary**	UMTS in future

Notes:
*In France number of temporary licences issued between Oct-1999 and Sept-2000, 99% of licences are for less than 48 hours duration
**In UK number of temporary licences issued in 12 months period prior to end of March 2001, 99% of licences are for less than 6 days duration

3400-3600 MHz

Country	National use of ENG/OB	Use statistics	Remarks
Albania	Co-ordinated occasional use		
Austria	No		FWA planned
Czech Republic	No		
Denmark	No		
Estonia	No		
Finland	No		FWA in use
France	2 exclusive 10 MHz channels for digital ENG/OB centred at 3405 & 3600 MHz	100 temporary*	FWA in use
Germany	No		FWA in use
Italy	No		
Lithuania	Co-ordinated occasional use		
The Netherlands	No		Only FS/FWA
Norway	no		FWA in use
Portugal	no		FWA in use
Slovenia	No		FWA planned
Switzerland	Mobile ENG/OB may access 3410-3600 MHz on a co-ordinated basis with FWA		FWA in use
UK	3400-3420 MHz and 3500-3600 MHz for ENG/OB on a shared basis with military	No permanent 1250 temporary**	Some FWA plans

Notes:
*In France number of temporary licences issued between Oct-1999 and Sept-2000, 99% of licences are for less than 48 hours duration
**In UK number of temporary licences issued in 12 months period prior to end of March 2001, 99% of licences are for less than 6 days duration

4400-5000 MHz

Country	National use of ENG/OB	Use statistics	Remarks
Albania	Co-ordinated occasional use		
Austria	4 channels in 4404-4516 MHz 4 channels in 4716-4828 MHz	Future use	In agreement with military
Czech Republic	No		
Denmark	No		
Estonia	No		
Finland	Occasional ENG/OB links		In future - FS
France	No		ENG opposed
Germany	No		ENG opposed
Italy	No		
Lithuania	6x20 MHz channels in some regions, subject to prior co-ordination		
Luxembourg	Co-ordinated occasional use		
The Netherlands	Possible		Sharing with military
Norway	No		governmental
Portugal	No		governmental
Slovenia	No		governmental
Switzerland	No		ENG opposed
UK	No		

5250-5850 MHz (EU22)

Country	National use of ENG/OB	Use statistics	Remarks
Albania	No		
Austria	No		
Czech Republic	No		
Denmark	No		
Estonia	No		
Finland	No		
France	No		ENG not opposed
Germany	No		ENG opposed
Italy	No		
Lithuania	No		
The Netherlands	Temp. p-p video links in 5725-5850 MHz	7 x 25 MHz ch.	
Norway	no		
Portugal	no		
Slovenia	Possible future digital ENG/OB		
Switzerland	no		
UK	5 channels in 5472-5588 5 channels in 5682.5-5815	2 permanent 448 temporary*	Some geographi-cal restrictions

Notes:
*In UK number of temporary licences issued in 12 months period prior to end of March 2001, 99% of licences are for less than 10 days duration

10.00-10.68 GHz

Country	National use of ENG/OB	Use statistics	Remarks
Albania	ENG/OB allowed		
Austria	15 channels in 10.0-10.2 GHz		
Czech Republic	4 channels in 10.4-10.65 GHz		
Denmark	5 channels in 10.5-10.65 GHz	3 licences	Plans for FWA
Estonia	No		
Finland	5 channels in 10.0-10.15 GHz 1 channel centred at 10.427 GHz	22 licences 1 licence	
France	No		
Germany	25 channels in 10.4-10.68 GHz		
Italy	In 10.45-10.80 GHz		
Latvia	In 10-10.15 GHz		
Lithuania	7 channels in 10.3-10.5 MHz		
Luxembourg	Used for ENG/OB		
The Netherlands	In 10.35-10.68 GHz		Sharing with temp. fixed links
Norway	In 10.3-10.5/10.562-10.702 GHz		Used by NRK
Portugal	6 channels in 10.5-10.68 GHz		Plans ENG/OB in 10.0-10.45 GHz
Slovak Republic	Temporary point-to-point in 10.3-10.5 GHz		
Slovenia	ENG/OB possible in 10.3-10.45 GHz		
Switzerland	ENG/OB allowed in the whole band		
UK	In 10.3-10.36 GHz, shared with military	No permanent 2118 temporary*	Plans for FWA

Notes:
*In UK number of temporary licences issued in 12 months period prior to end of March 2001, 99% of licences are for less than 3 days duration

21.20-24.50 GHz

Country	National use of ENG/OB	Use statistics	Remarks
Albania	In 21.2-21.4, 22-23.6, 24-24.5 GHz		
Austria	8 channels in 21.2-21.623 GHz		
Belgium	In 21.2-22 & 22.6-23 GHz		
Czech Republic	4 channels in 22.6-22.7 GHz		
Denmark	7 channels in 21.2-21.4 GHz	4 licences	temporary links
Estonia	In 21.2-21.4 GHz		
Finland	In 21.2-21.4 GHz & 22.6-23 GHz		
France	22 channels in 21.4-23.5 GHz 8 channels in 24.25-24.5 GHz		
Germany	26 channels in 21.20-21.95 GHz	17 licences	
Hungary	In 21.2-21.4 & 22.6-23 & 24.25-24.5 GHz		
Italy	In 21.2-22.3 & 22.768-23.338 GHz		
Latvia	In 21.2-21.4 GHz		
Lithuania	6 channels in 21.2-21.3 and 6 channels in 24.25-24.4 GHz		
Luxembourg	In 21.2-21.4 GHz		
The Netherlands	In 22.6-23 GHz		Sharing with FS
Norway	No		Some bands free
Portugal	No		
Slovenia	Possible		
Switzerland	p-p ENG/OB: 22.6-23.0/24.25-24.5 GHz; cordless cameras across the band		
UK	In 24.25-24.50 GHz		not used so far

47.20-50.20 GHz

Country	National use of ENG/OB	Use statistics	Remarks
Albania	Possible		
Austria	No info		
Czech Republic	No info		
Denmark	No info		
Estonia	In 47.2-48.5 GHz		
Finland	Possible		Except HAPS bands
France	No info		
Germany	No info		
Italy	No info		
Lithuania	Possible		
The Netherlands	No info		
Norway	No info		
Portugal	No info		
Slovenia	Possible		
Switzerland	Cordless cameras allowed across band		
UK	48.0-48.4 GHz for ENG/OB (100 MHz channels)	1 temporary*	Limited use short-range cameras

Notes:
*In UK number of temporary licences issued in 12 months period prior to end of Mar'01

ANNEX 2
SUMMARY OF RESPONSES TO QUESTIONNAIRE ON INTRODUCTION OF DIGITAL RADIO MICROPHONES IN THE BAND 1785-1800 MHZ

The attached table presents a short summary of responses of CEPT Administrations to the questionnaire on prospects of introduction and attached regulatory regime for radio microphones in the band 1785-1800 MHz (actual limits of 1785.7-1799.4 MHz are set by necessary guard bands at the edges of the band).

The questionnaire was distributed and replies collected in October 2001.

Country	RM allowed	Restrictions other than in CEPT/ETSI regulations	Licensing basis for RM	Regulations followed		
				CEPT 70-03	EN 301 840	Other
Austria	Yes	No	General licence	Yes	Yes	
Belgium	Yes	No	No licence	Yes	Yes	
Bulgaria	Yes	No	No licence	Yes		
Croatia	Yes	No	Spectrum block		Yes	
Denmark	No (1)					
Estonia	No (2)				Yes	
Finland	Yes	No	Individual licence(3)	Yes	Yes	EN 300 422
France	Yes (4)	No	General licence (4)	Yes	Yes	EN 300 422
Germany	Yes	No	Individual licence (3)	Yes	Yes	
Italy	No (5)					
Latvia	Yes	No	Individual licence	Yes	Yes	
Lithuania	Yes	No	Individual licence	Yes	Yes	
Luxembourg	Yes (6)	No	No licence	Yes		
Monaco	Yes	No	Individual licence (3)	Yes	Yes	
Norway	Yes	No	No licence			EN 300 422
Poland	Yes	No	No licence	Yes	Yes	
Portugal	No (7)	No				
Slovak Republic	No (8)					
Sweden	Yes	Yes (9)	Individual licence	Yes	Yes	
Switzerland	Yes (10)	No	Individual licence	Yes		
The Netherlands	Yes	No	No licence from 2002	Yes	Yes	
Turkey	Yes	No	No licence	Yes		
UK	Yes	Yes (11)	Individual licence	Yes	Yes	

Notes:
(1) Denmark: currently radiomicrophones are not granted access to this band simply because there were no such requests. If and when such interest is identified, a national radio interface would be issued, radiomicrophones would be allowed on the licence exempt basis. Rec 70-03 and EN 301 840 would be followed;
(2) Estonia: currently this frequency band is not allocated for radiomicrophones. Market demand is under study;
(3) Licence per radiomicrophone, but giving access to the whole band;
(4) France: regulation for radio microphones in the 1800 MHz is being prepared, to be published by ART by mid 2002. It foresees normally a class licence, however individual licensing may be used for special events. Terms of class licence would be based on Rec. 70-03;
(5) Italy: the frequency band is heavily used for military applications;
(6) Luxembourg: the band is for shared civil/military use;
(7) Portugal: future plans for the band are under study;
(8) Slovak Republic: the band is used for one way radio distribution of signals to radio broadcasting stations;
(9) Sweden: geographical sharing with military;
(10) Switzerland: the band is currently not yet designated for radio microphones, but Administration may do so once the necessary harmonisation measures are confirmed by CEPT through a Recommendation or Decision. Max erp 100 mW;
(11) UK: co-ordination with Home Office in 1790-1798 MHz.