REPORT ITU-R BS.2105*

Information relating to the HF broadcasting service

(2007)

Radiocommunication Working Party 6E has received a number of input documents providing information on the HF broadcasting service. Although these documents have been taken into account in the revision of the draft CPM text for WRC-07 Agenda item 1.13 it was felt that they contained a lot of valuable information which may of use in the future. Consequently, the contents of these documents have been used to create a preliminary draft New Report.

Table 1 shows the spectrum allocated in Region 1 to the broadcasting service from 30 March 2009 in the range 4-10 MHz. Note that the amount of spectrum allocated in other regions, and the percentage, is different.

TABLE 1

Spectrum allocated to the broadcasting service in the range 4-10 MHz

Broadcasting service	
Exclusive allocations (kHz)	**Co-primary allocations (kHz)**
5 900-5 950; 5 950-6 200; 7 200-7 300; 7 300-7 400 7 400-7 450; 9 400-9 500; 9 500-9 900	4 750-4 850(T); 4 850-4 995(T); 5 005-5 060(T)

Exclusive (kHz)		**Co-primary (kHz)**	
1 050	17.50%	300	5%

Co-primary (kHz)		
300	5%	FIXED, AERONAUTICAL MOBILE (OR), LAND MOBILE

Annex 1 provides an analysis of an Asia-Pacific Broadcasting Union (ABU) survey on broadcasting service requirements, Annex 2 provides an analysis of a European Broadcasting Union (EBU) questionnaire on future requirements for HF broadcasting, and Annex 3 provides revised HF broadcasting statistics.

* Considering the position of Syria on behalf of the Aran States (Saudi Arabia, Bahrain, Djibouti, Egypt, United Arab Emirates, Jordan, Kuwait, Lebanon, Morocco, Mauritania, Qatar, Syrian Arab Republic and Tunisia) with regard to the work on WRC-07 Agenda item 1.13, Syria continues to object to the content of this Report.

Annex 1

Results of ABU survey on broadcasting requirements

Need for additional spectrum

The need for additional spectrum for the broadcasting service has been clearly established, based on the data provided by the regional coordination groups operating, and established, the provisions of Article 12 of the Radio Regulations. An independent ABU survey among its shortwave broadcasters, amounting to around half the world's shortwave broadcasters, clearly established the need for additional spectrum to the tune of 20%. A cumulative total of 3 360 kHz is available for consideration under Resolution 544 (WRC-03), which would give considerable scope to satisfy the main point of the agenda item.

Spectrum congestion and monetary loss

The current congestion in the HF broadcasting bands results in severe co-channel and/adjacent channel interference among the broadcasting services, making these either totally unintelligible to the listeners or quite impaired in quality. Administrations incur substantive expenses on these services in terms of programme (content) production, transmission operations and in transmitting the services through high power shortwave transmitters. The transmitting infrastructural facilities needed are quite extensive and include vast antenna fields, together with complicated antenna changing operations. The electric supply charges are also huge amounts. However, because of the interference situation, the entire effort and the funds expended become a dead loss as no service is rendered[1].

This factor alone emphasizes the need for additional spectrum to be allocated to the broadcasting service.

Broadcasting considerations

Allocation to broadcasting service and transition

1) ABU strongly approves of and supports the case for extra broadcasting spectrum as indicated in Resolution 544 (WRC-03). The ABU encourages administrations to satisfy this need while recognizing the need for adequate spectrum of other potentially affected services in the range 4-10 MHz and innovative ways and approaches to address that issue outside of normal strategies, e.g., more efficient and dynamic sharing between fixed and mobile services, more intelligent use of spectrum in a hierarchical security system where risk assessment decides spectrum use for security.

2) ABU supports adequate compensation to the spectrum loss to other services as a result of satisfying Resolution 544 (WRC-03).

3) A sufficiently long transition period will be a pivotal factor to help management of that transition by administrations.

4) ABU supports the approach that an adequate transition mechanism be set up by WRC-07 in a new resolution to meet this need, e.g., addressing the problem right now but with a solution that gets implemented slowly but definitively.

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[1] To get an idea of the loss involved, considering an average cost of transmission to be USD 2 000 per hour. Out of the 12 000 h of transmissions every day, currently about 33% are facing interference. This amounts to a cumulative loss of about USD 2 890 800 000 (2 000 x 12 000 x 0.33 x 365) suffered by the administrations.

5) ABU's view is that after implementation of the necessary extra spectrum for the Broadcasting Service, administrations will have little need for scheduling broadcasting transmissions outside the procedures for RR Article 12 in the bands below 10 MHz or in the Tropical bands. Administrations may need to generally discourage such activity.

6) ABU supports the view of some administrations that additional frequency allocation is described in the Resolution 544 (WRC-03) and only broadcasting service should be given more frequency spectrum in the bands 4-10 MHz.

7) ABU does not favour revisiting the 7 MHz area in relation to the amateur service.

8) ABU does not consider the "No change" method as satisfying this agenda item.

Sharing of spectrum

1) Exclusion of the bands associated with RR Appendices 25, 26, 27 and 17 Part B leads to a situation where the discussions are mainly focussed on the fixed, land mobile and broadcasting services and partly to the maritime service. This narrowing of the agenda item makes make full alignment for the services very difficult. Full alignment however is possible but extremely difficult and therefore not envisaged as a viable option in the short to medium term.

2) The HF frequency range, including below 10 MHz is of critical importance to defence radio communication services and their respective users. Therefore, unconstrained access to the existing spectrum resources allocated to the fixed and mobile services between 4 MHz and 10 MHz will remain an essential requirement for administrations. Current and future operational capabilities require higher data rates and will result in the need for additional HF spectrum under certain scenarios of usage.

3) Some administrations are considering sharing scenarios to the fixed- and mobile services to provide additional bands from which to select the most suitable frequency, particularly when using adaptive control techniques. This will positively mitigate the concerns of some of the users of fixed and mobile services, although mobile services will argue that such mitigation may not be enough. The WRC is encouraged to take a more realistic and pragmatic view.

4) Such sharing arrangement may be implemented by the introduction of digital technology, adaptive control techniques for the fixed – land mobile – and maritime mobile services offering dynamic frequency selection, and the application of appropriate assignment rules.

5) ABU supports the need for increased sharing between services in the HF bands as the only way to satisfy many conflicting requirements simultaneously.

6) Spectrum sharing between the broadcasting service and other services in the bands is not generally feasible. Time sharing of the frequency channels is not a practicable proposition and needs to be ruled out, however where it can work, it could be considered further based on the needs of both services involved.

7) Some administrations believe that, prior to any changes to the HF channel plans, actual usage, coordination, and deployment of HF systems by the existing services should be taken into account for each service's requirements along with the technical solutions.

8) Many factors have emerged during the preparations for WRC-07, some of them having a strong degree of consensus. ABU acknowledges the role of adaptive systems in achieving most effective and flexible way of operating within limited spectrum resources. Widespread adoption of such strategies will pave the way for identifying additional spectrum (250/800 kHz) needed for the broadcasting service.

9) Some administrations intend to promote the sharing scenario in portions of the new Appendix 17 bands between the fixed- land mobile and maritime mobile services in order

to realize extra spectrum for the broadcasting service. This may be fully examined and supported by all interested administrations.

10) While some administrations take a negative view of other administrations' broadcasting into their territories, it should be clearly borne in mind that this agenda item deals with spectrum issues and spectrum is needed for each administration to do its own broadcasting as well, so that aspect is very important for all administrations with any view.

Annex 2

Analysis of results from a European Broadcasting Union (EBU) questionnaire on the future requirements for HF broadcasting

1 Background

The Agenda for the International Telecommunication Union (ITU) World Radio Conference to be held in 2007 (WRC-07) includes an item (1.13) dealing with, among other things, consideration of additional spectrum for the broadcasting service in the range 4-10 MHz. Broadcasting statistics derived from the operational database created by the informal coordination groups under RR Article 12 confirm the need for additional spectrum to reduce the level of congestion. However, these are just for previous and current broadcasting seasons. To complete the justification for additional spectrum, a forecast of HF broadcasting requirements is needed for the mid- and long-term future (10 years or more). A questionnaire, shown in Appendix 3 to this Annex, was designed by the EBU to enable an initial response on the justification for additional HF spectrum.

Alongside existing analogue services, one of the issues for the mid- to longer term future is the impact the use of digital modulation techniques will have on spectrum requirements. The recommended digital system for the HF bands is Digital Radio Mondiale (DRM). Transmissions using DRM were officially launched on 16th June 2003 to coincide with WRC-03. In February 2006, more than 600 DRM transmitting hours per day are on air.

It is recognized that providing a realistic forecast for 5 years or more is very difficult. However, providing the "best guess" forecast will be very helpful in determining spectrum needs for the HF broadcasting service into the future.

2 Results of the analysis

Appendix 1 to this Annex provides the detailed analysis of the replies to the Questionnaire based upon 26 replies from which the following main features may be extracted:

A) Future plans regarding HF frequency requirements (Q.6)

For the next 10 years

– More than 55% of the respondents anticipate increasing their HF requirements.

– About 27% of the respondents anticipate having the same HF requirements.

– 8 % of the respondents anticipate reducing their HF requirements.

– The remaining respondents cannot anticipate.

For the next 15 years

– More than 31% of the respondents anticipate increasing their HF requirements.
– About 23% of the respondents anticipate having the same HF requirements.
– 4% of the respondents anticipate reducing their HF requirements.
– The remaining respondents cannot anticipate.

Partial conclusion

HF spectrum occupancy is unlikely to decrease in the coming 10 to 15 years.

B) Usage of digital modulation (DRM) in the HF bands (Q.7)

More than 60% of the respondents are planning to use DRM in HF in the coming 10 to 15 years.

C) Target areas and service periods (Q.8)

Europe

More than 60% of the respondents will target Europe during breakfast, driving and evening-times.

However, there will be a high number of transmissions all day long.

Africa

More than 50% of the respondents will target Africa during morning and evening-times.

Middle-East

About 50% of the respondents will target Middle-East during morning and evening-times.

Asia

More than 50% of the respondents will target Asia during morning and evening-times.

Americas

About 50% of the respondents will target Americas during morning and evening-times.

Oceania

More than 20% of the respondents will target Oceania during evening-times.

Partial conclusion

Peak time broadcasting in most targets is forecast to be morning and evening.

Appropriate transmissions will require, in general, the usage of the bands located in the 4-10 MHz HF spectrum.

D) Co-program and co-timed DRM and Analogue transmissions (Q.9)

During a transition period, (5 to 10 years) broadcasters will not give up analogue transmissions and may transmit to some targets in analogue and DRM.

After a transition period (beyond 10 years), broadcasters will mainly use DRM.

Partial conclusion

DRM will be progressively introduced and will not replace very quickly the analogue transmissions.

Appendix 2 to this Annex provides the list of organizations having responded and those from which replies were still awaited at the date of issuing the presentReport[2].

3 Overall conclusion

From the EBU Questionnaire it is recognized that providing a realistic forecast for 5 years or more is very difficult, however it may be concluded from the results:

– HF broadcasting will still be used in the next 10 to 15 years.

– HF spectrum occupancy is unlikely to decrease in the next 10 to 15 years.

– DRM will progressively replace analogue transmissions.

– Peak-times, such as morning and evening-times and also continuous transmissions to relatively small regional targets, such as Europe, will require the operation of HF frequencies in the 4-10 MHz bands.

Appendix 1
to Annex 1

Summary results

Questionnaire on future requirements for HF broadcasting organizations replying

Q.1 Name of Organization	Q.2 FMO	Q.3 Organization	Q.4 HF bands for broadcasting	Q.5 type of broadcasting
Austrian Broadcasting Services	ORS	SP(1)	Yes	International
Bulgarian National Radio	BUL	PSB(2)	Yes	International, National and Local
Odasiljaci I Veze d.o.o.	HRT	SP	Yes	International
Radio Prague	TCH	PSB	Yes	International
Télédiffusion de France (TDF)	TDF	SP	Yes	International, National and Local
Radio France Internationale (RFI)	TDF	PSB	Yes	International
Arbeitsgemeinschaft des öffentlich-rechtlichen Rundfunkanstalten des Bundesrepublik Deutschland (ARD)/Institut für Rundfunktechnik (IRT)	DWL	PSB	Yes	International

[2] A new release of this analysis will be issued to include further replies on the Questionnaire.

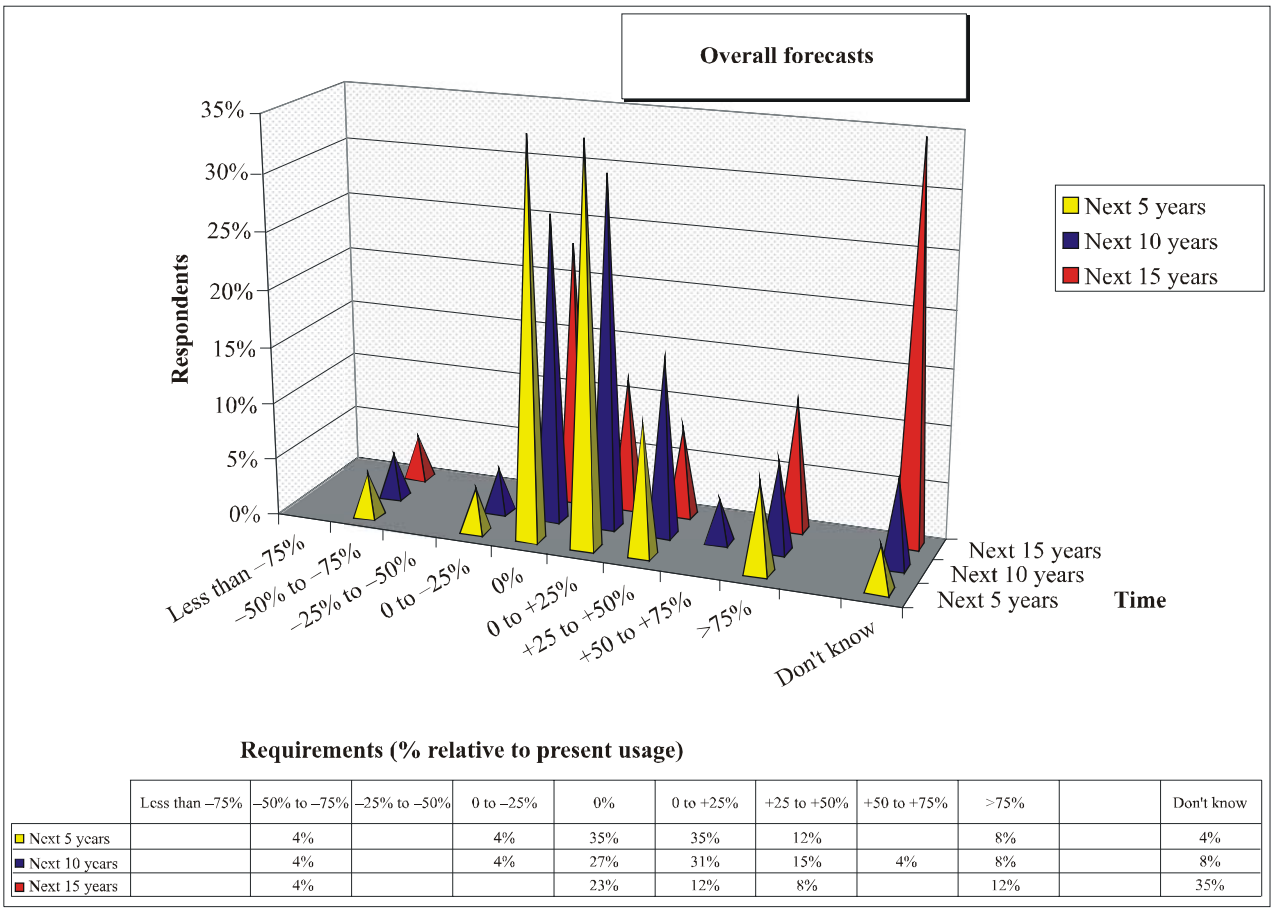
Q.1 Name of Organization	Q.2 FMO	Q.3 Organization	Q.4 HF bands for broadcasting	Q.5 type of broadcasting
Deutsche Welle	DWL	PSB	Yes	International
Hellenic Radio (ERA)	ERA	PSB	Yes	International
Hungarian Radio	HNG	PSB	Yes	International
Jordanian Radio and Television	JRT	PSB	Yes	International
Radio Netherlands	RNW	PSB	Yes	International
Radiodifusão Portuguesa	RDP	PSB	Yes	International, National and Local
Societatea Romana de Radiodifuziune	ROU	PSB	Yes	International, National and Local
Sentech LTD	SNT	SP	Yes	International, National and Local
Radio Nacional de España	REE	PSB	Yes	International
Turkish Radio-Television Corporation	TRT	PSB	Yes	International, National
Emirates Media Inc.	EMI	PSB	Yes	International
VT Merlin Communications	MER	SP	Yes	International
BBC World Service	MER	PSB	Yes	International
Broadcasting, Radio-communications & TV	RRT	SP	Yes	International
Trans World Radio – Asia, Guam	FCC	CB[3]	Yes	International
Family Stations, Inc.	FCC	RB[4]	Yes	International
Adventist World Radio	AWR	PB[5]	Yes	International
Radio Miami International	FCC	CB	Yes	International
Vatican Radio	VAT	PSB	Yes	International

[1] SP: Service Provider
[2] PSB: Public Service Broadcaster
[3] CB: Commercial Broadcaster
[4] RB: Religious Broadcaster
[5] PB: Private Broadcaster

Q.6 If you use or are considering using the HF bands, what are your future plans regarding HF frequency requirements compared to current usage? If you are considering changing your current usage, can you also please estimate the extent of change in HF spectrum usage if possible?

The results are shown hereafter using two different presentations.

Presentation 1

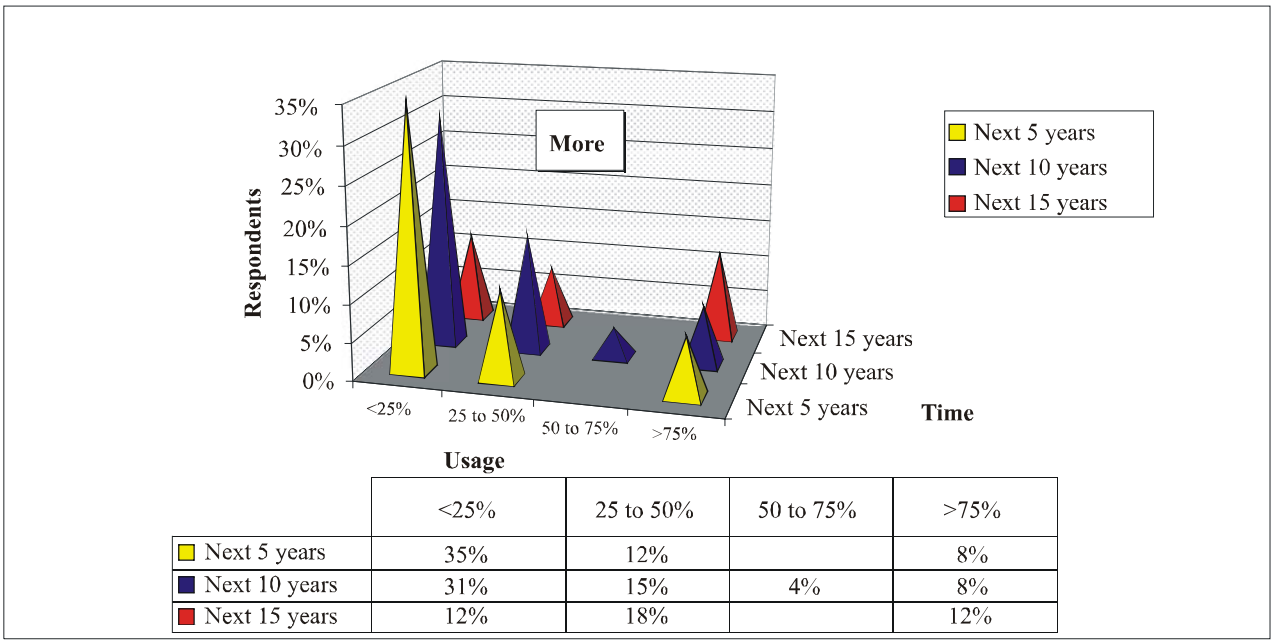


Requirements (% relative to present usage)

	Less than –75%	–50% to –75%	–25% to –50%	0 to –25%	0%	0 to +25%	+25 to +50%	+50 to +75%	>75%		Don't know
Next 5 years		4%		4%	35%	35%	12%		8%		4%
Next 10 years		4%		4%	27%	31%	15%	4%	8%		8%
Next 15 years		4%			23%	12%	8%		12%		35%

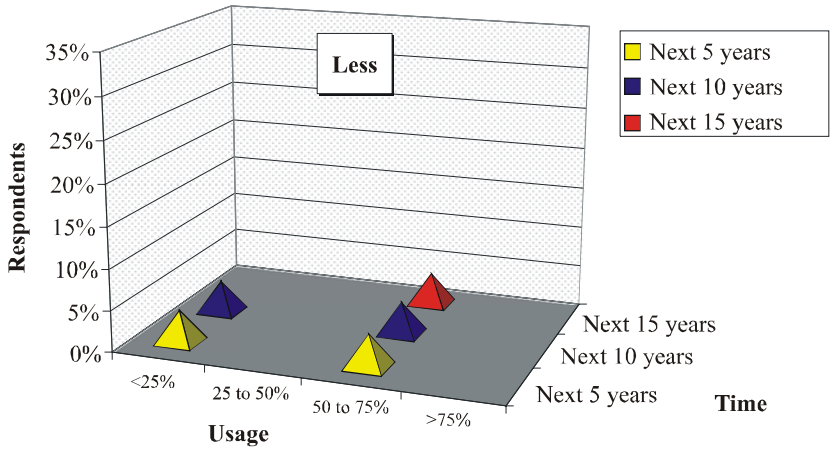
Rap 2105-pres01

Presentation 2

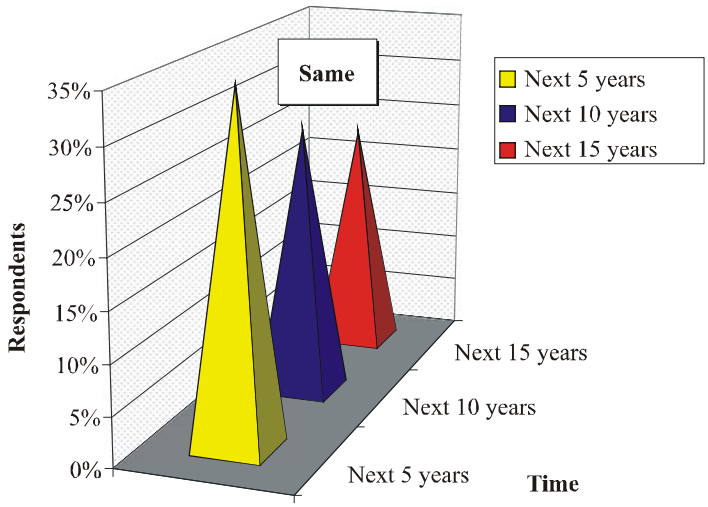


	<25%	25 to 50%	50 to 75%	>75%
Next 5 years	35%	12%		8%
Next 10 years	31%	15%	4%	8%
Next 15 years	12%	18%		12%

Rap 2105-pres02

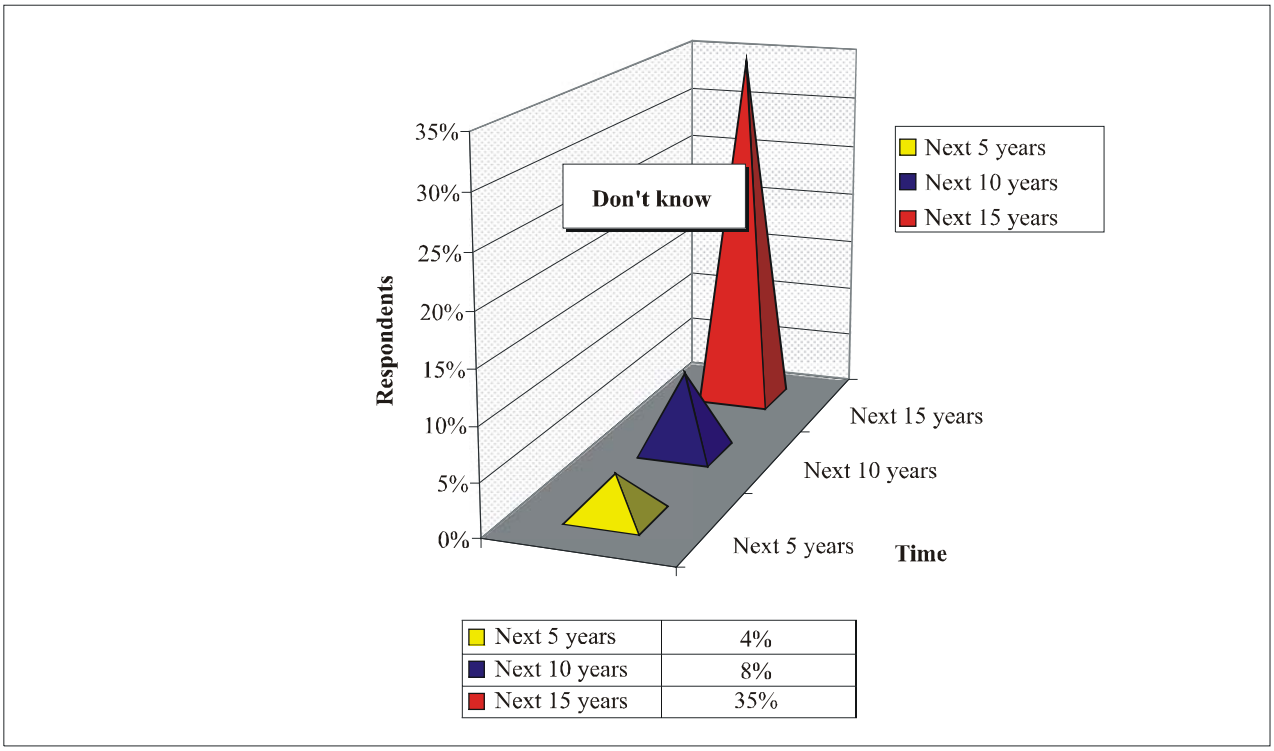


	<25%	25 to 50%	50 to 75%	>75%
Next 5 years	4%		4%	
Next 10 years	4%		4%	
Next 15 years			4%	



Next 5 years	35%
Next 10 years	27%
Next 15 years	23%

Rap 2105-pres03



Next 5 years	4%
Next 10 years	8%
Next 15 years	35%

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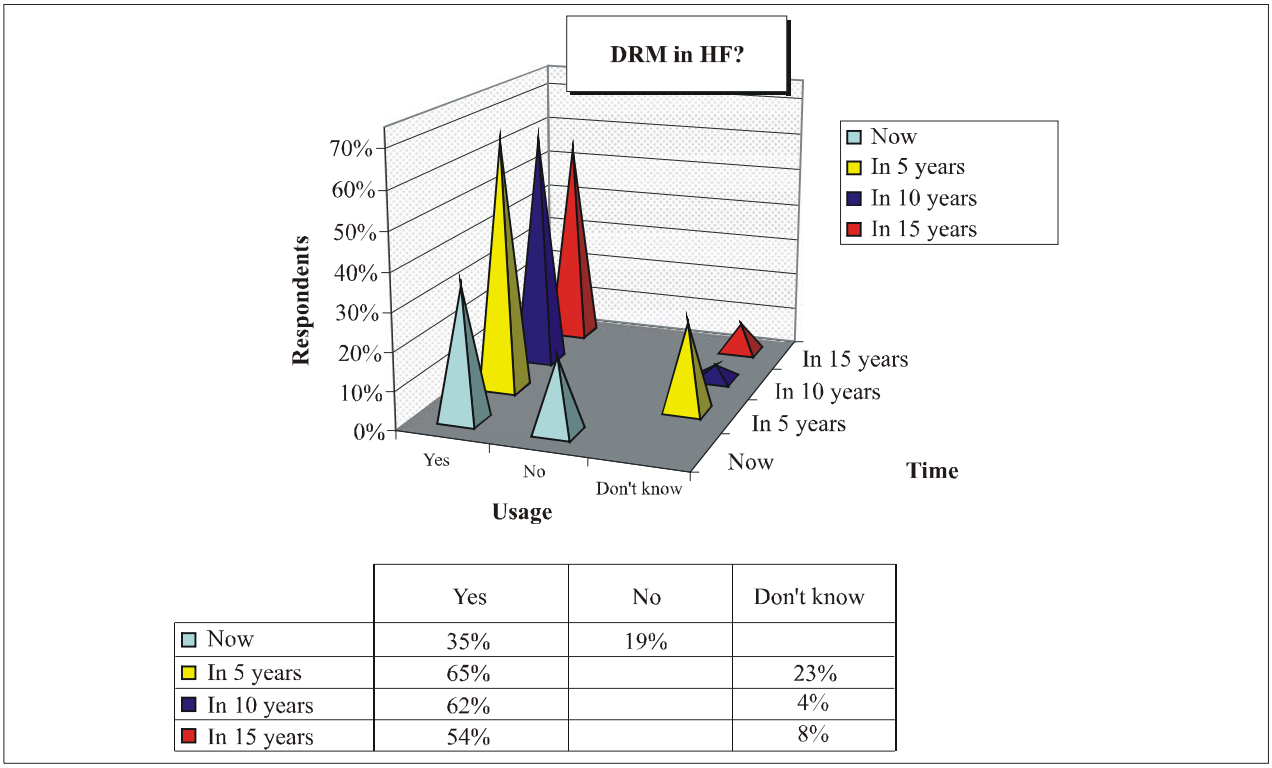
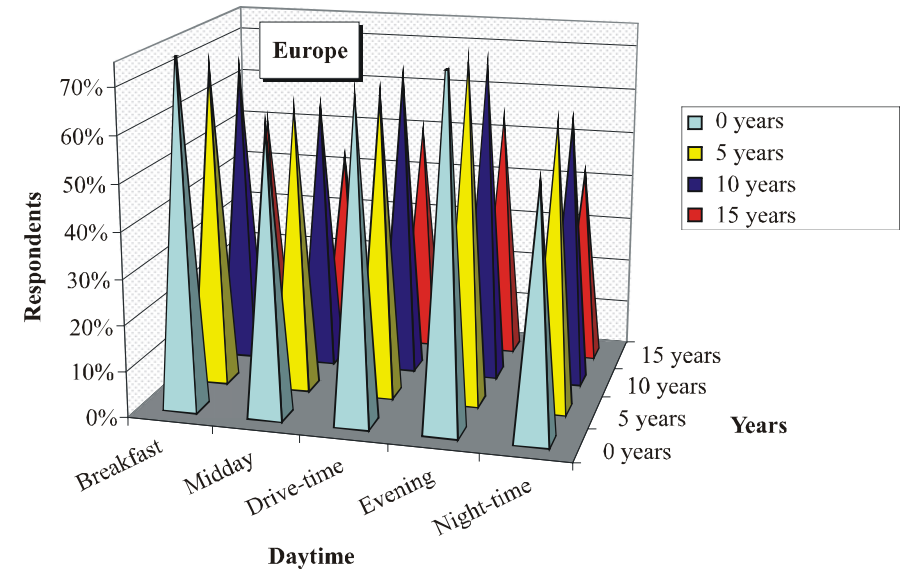
Q.7 Do you use or are you planning to use digital modulation (i.e. DRM) in the HF bands?

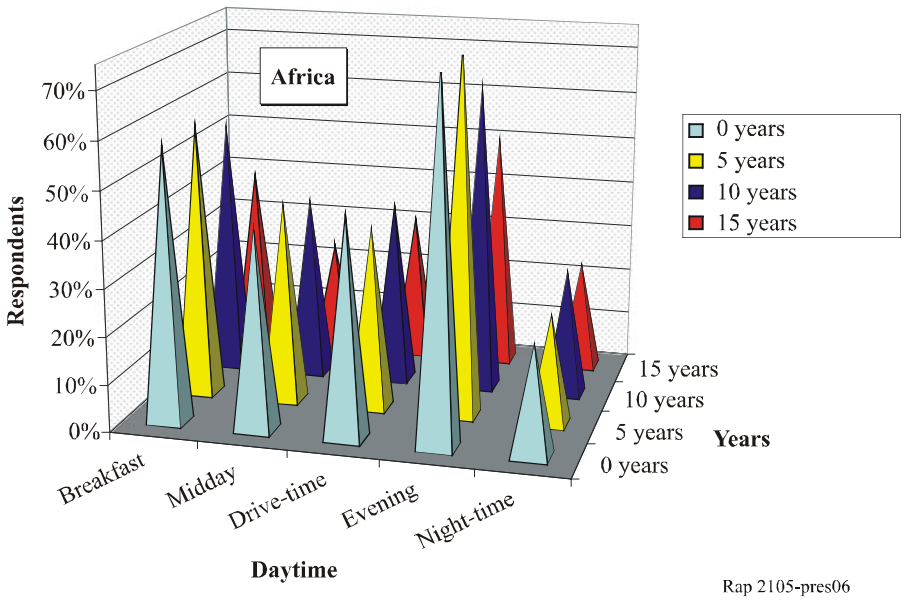


	Yes	No	Don't know
Now	35%	19%	
In 5 years	65%		23%
In 10 years	62%		4%
In 15 years	54%		8%

Rap 2105-pres05

Q.8 What are or will be your target service area(s) and service periods? (Tick all that apply)





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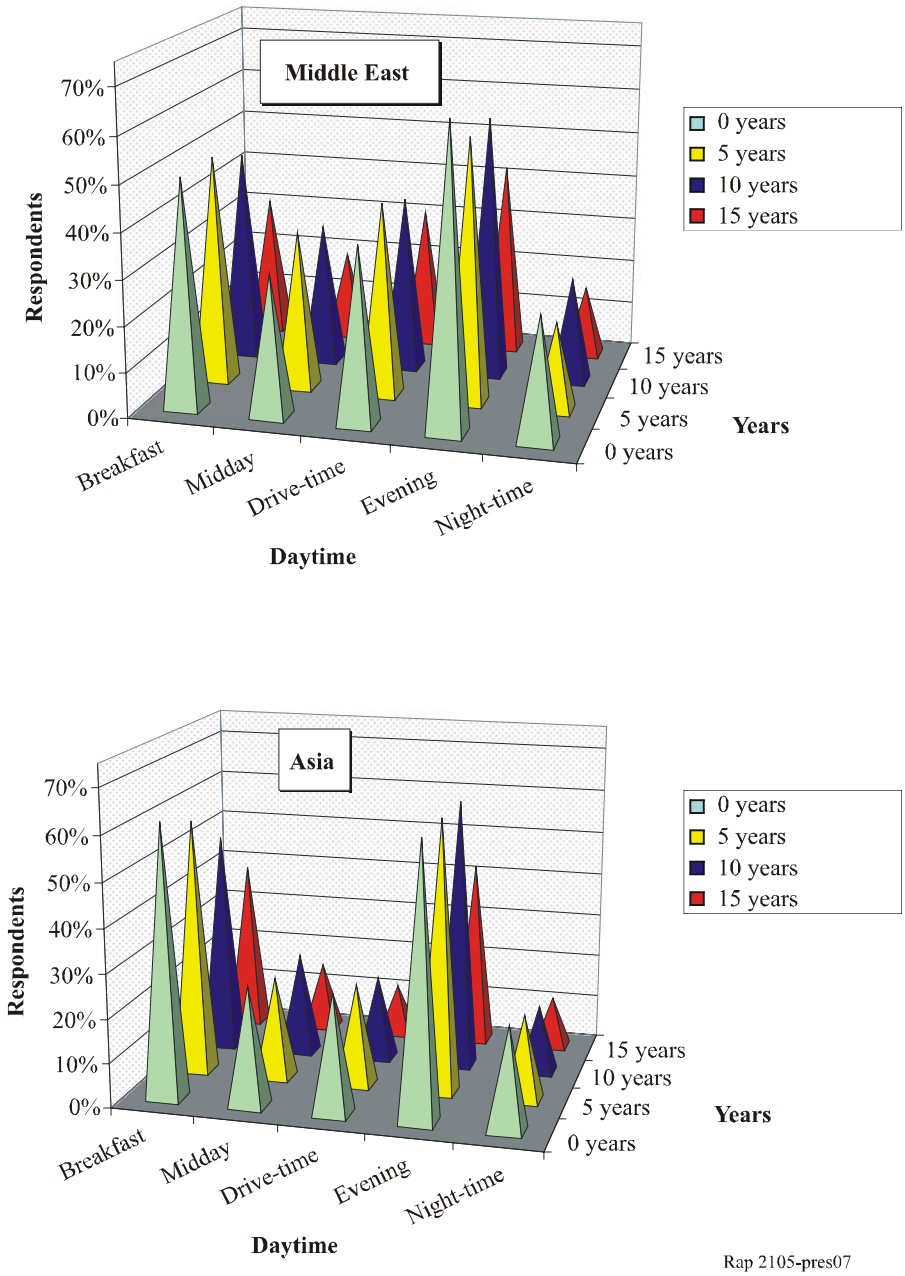
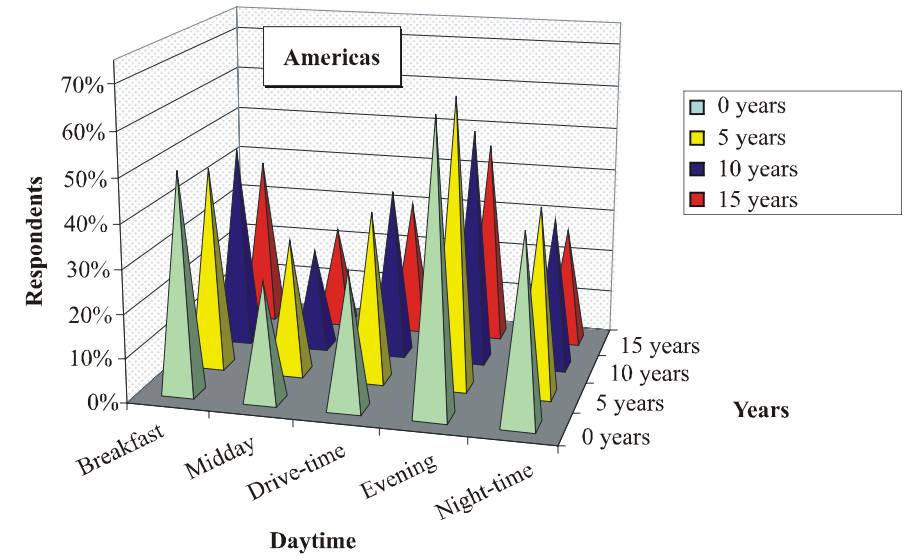
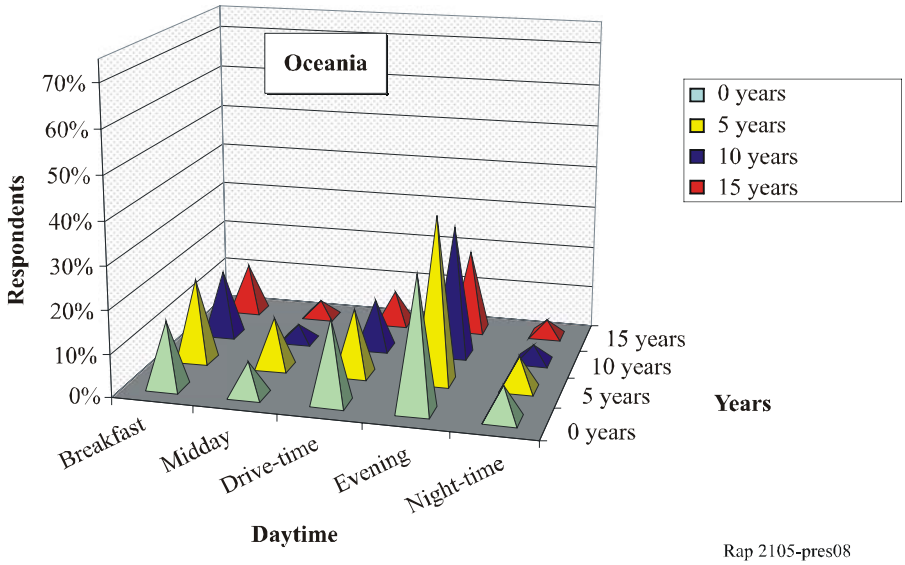

Middle East
Respondents
70%
60%
50%
40%
30%
20%
10%
0%
Breakfast
Midday
Drive-time
Evening
Night-time
Daytime
0 years
5 years
10 years
15 years
Years
Asia
Rap 2105-pres07





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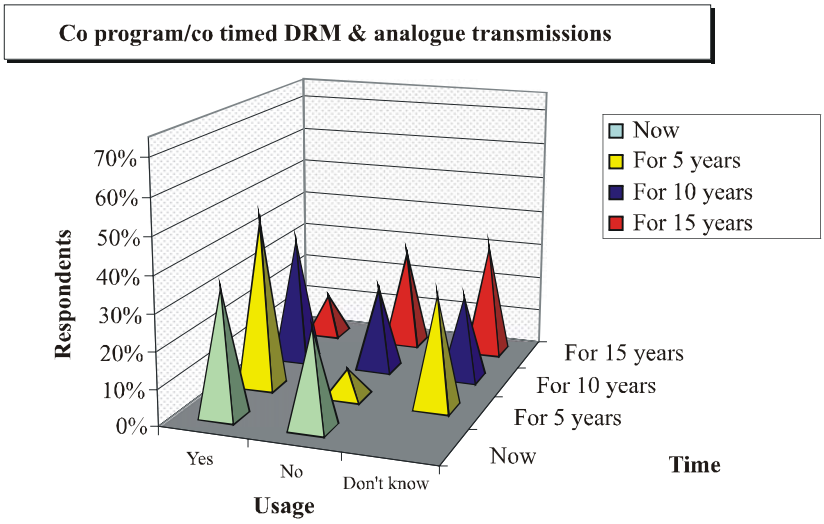
Q.9 If you intend to transmit to a given target area at a given time using digital modulation, are you planning to transmit the same programme using analogue modulation on a different frequency?



	Yes	No	Don't know
Now	35%	27%	
For 5 years	46%	8%	31%
For 10 years	35%	23%	23%
For 15 years	12%	27%	31%

Rap 2105-pres09

Appendix 2
to Annex 1

Questionnaire distribution

(Updated: 28 February 2006)

	Have responded	Replies awaited from
1	Adventist World Radio	ABU (Asia Pacific Broadc. Union)
2	Arbeitsgemeinschaft des öffentlich-rechtlichen Rundfunkanstalten des Bundesrepublik Deutschland (ARD)/Institut für Rundfunktechnik (IRT)	All India Radio (AIR)
3	Austrian Broadcasting Services	ASBU (Arab States Broadc. Union)
4	BBC World Service	Broadcasting Center Europe (BCE)/ Radio & Télé Lëtzebuerg (RTL)
5	Broadcasting, Radio-Com & TV	Deutschland Radio
6	Bulgarian National Radio	DIGITA
7	Deutsche Welle	Deutsche Telekom (DTK)/T-Systems
8	Emirates Media Inc.	Egyptian Radio and Television Union (ERTU)
9	Hellenic Radio (ERA)	Federal Communications Commission (FCC)

	Have responded	Replies awaited from
10	Family Stations, Inc.	HCJB GLOBAL
11	Hungarian Radio	Israel Broadcasting Authority (IBA)
12	Jordanian Radio and Television	Islamic Republic of Iran Broadcasting (IRIB)
13	Odasiljaci I Veze d.o.o.	Korean Broadcasting System (KBS)
14	Radio Miami International	Lithuanian Radio and Television Center (LRTC)
15	Radio Nacional de España	Media Corp
16	Radio Netherlands	Japan Broadcasting Corporation (NHK)
17	Radiodifusão Portuguesa	Netherlands Broadcasting Transmission Company (NOZEMA)
18	Radio Prague	Norvegian Posts and Telecommunications Authority (NPT)
19	Radio France Internationale (RFI)	Pakistan Broadcasting Corporation (PBC)
20	Sentech Ltd,	Public Enterprise Macedonian Broadcasting (PEMB)
21	Societatea Romana de Radio	Polskie Radio
22	Télédiffusion de France (TDF)	Radio Sweden International
23	Trans World Radio – Asia	Qatar Radio & Television Corporation (QRC)
24	Türkiye Radyo ve Televizyon (TRT)	Radio Australia
25	Vatican Radio	Radio Tirana
26	VT Merlin Communications	Radiodiffusion Algérienne
		Radiotelevisione Italiana (RAI)
		Radio Canada International (RCI)
		Radio-Télévision Belge Francophone (RTBF)
		Radio Télévision du Maroc (RTM)
		Russian Television and Radio Broadcasting Network (RTRN)
		Radio Veritas Asia (RVA)
		Saudi Radio
		Télédiffusion d'Algérie (TDA)
		Voice of America (VOA)/International Broadcasting Boara (IBB)
		Voice of Vietnam
		Voice of Malasya (VOM)
		Voice of Russia (VOR)
		Flemish Radio and Television Network (VRT)
		WBU (World Broadc. Unions)

Appendix 3
to Annex 1

Questionnaire on future requirements for HF broadcasting

The Agenda for the International Telecommunication Union (ITU) World Radio Conference to be held in 2007 (WRC-07) includes an item (1.13) dealing with, among other things, consideration of additional spectrum for the broadcasting service in the range 4-10 MHz. Broadcasting statistics derived from the operational database created by the informal coordination groups under RR Article 12 confirm the need for additional spectrum to reduce the level of congestion. However, these are just for previous and current broadcasting seasons. To complete the justification for additional spectrum, a forecast of HF broadcasting requirements is needed for the mid- and long-term future (10 years or more). This questionnaire is designed to provide an initial response to this missing information.

Alongside existing analogue services, one of the issues for the mid- to longer term future is the impact the use of digital modulation techniques will have on spectrum requirements. The recommended digital system for the HF bands is Digital Radio Mondiale (DRM). Transmissions using DRM were officially launched on 16 June 2003 to coincide with WRC-03. Commercial receivers for DRM were presented at IFA – Berlin in September 2005, from at least three manufacturers. In addition the prices are becoming very reasonable.

It is recognized that providing a realistic forecast for 5 years or more into the future is very difficult, however, providing the “best guess” forecast will be very helpful in determining spectrum needs for the HF broadcasting service into the future.

Questionnaire on High Frequency Broadcasting Requirements

1. Name of your organization? _____

2. Country? _____

3. Frequency Management Organization (FMO) Code? (if applicable) _____

(FMO code is used in the application of Article 12 procedures and can be found at:-

http://www.itu.int/ITU-R/terrestrial/broadcast/hf/refdata/reftables/fmorg.txt

4. What best describes your organization?

- **a.** Commercial broadcaster ☐
- **b.** Public Service broadcaster ☐
- **c.** Service provider ☐
- **d.** Other ☐

Please specify _____

5. Do you use the HF bands (3-30 MHz) for broadcasting?

- **a.** Yes ☐
- **b.** Considering ☐
- **c.** No ☐ If "No", then go directly to question 11

6. If you use or are planning to use the HF bands, what type of broadcasting do you do?

- **a.** International ☐
- **b.** National ☐
- **c.** Local (e.g. 26 MHz) ☐

7. If you use or are considering using the HF bands, what are your future plans regarding HF frequency requirements compared to current usage? If you are considering changing your current usage, can you also please estimate the extent of change in HF spectrum usage if possible.

a.

		Next 5-years			
		<25%	**25-50%**	**50-75%**	**>75%**
More	☐	☐	☐	☐	☐
Less	☐	☐	☐	☐	☐
Same	☐				
Don't Know	☐				

b.

		Next 10-years			
		<25%	**25-50%**	**50-75%**	**>75%**
More	☐	☐	☐	☐	☐
Less	☐	☐	☐	☐	☐
Same	☐				
Don't Know	☐				

c.

		Next 15-years			
		<25%	**25-50%**	**50-75%**	**>75%**
More	☐	☐	☐	☐	☐
Less	☐	☐	☐	☐	☐
Same	☐				
Don't Know	☐				

8. Do you use or are you planning to use digital modulation (i.e. DRM) in the HF bands?

	Yes	**No**	**Don't Know**
Now	☐	☐	
In 5 years	☐	☐	☐
In 10 years	☐	☐	☐
In 15 years	☐	☐	☐

9. What are or will be your target service area(s) and service periods? (Tick all that apply)

a.

	Now				
	Breakfast	Midday	Drive-time	Evening	Night-time
Europe	☐	☐	☐	☐	☐
Africa	☐	☐	☐	☐	☐
Middle East	☐	☐	☐	☐	☐
Asia	☐	☐	☐	☐	☐
Americas	☐	☐	☐	☐	☐
Oceania	☐	☐	☐	☐	☐

b.

Next 5 years

	Breakfast	Midday	Drive-time	Evening	Night-time
Europe	☐	☐	☐	☐	☐
Africa	☐	☐	☐	☐	☐
Middle East	☐	☐	☐	☐	☐
Asia	☐	☐	☐	☐	☐
Americas	☐	☐	☐	☐	☐
Oceania	☐	☐	☐	☐	☐

c.

Next 10 years

	Breakfast	Midday	Drive-time	Evening	Night-time
Europe	☐	☐	☐	☐	☐
Africa	☐	☐	☐	☐	☐
Middle East	☐	☐	☐	☐	☐
Asia	☐	☐	☐	☐	☐
Americas	☐	☐	☐	☐	☐
Oceania	☐	☐	☐	☐	☐

d.

Next 15 years

	Breakfast	Midday	Drive-time	Evening	Night-time
Europe	☐	☐	☐	☐	☐
Africa	☐	☐	☐	☐	☐
Middle East	☐	☐	☐	☐	☐
Asia	☐	☐	☐	☐	☐
Americas	☐	☐	☐	☐	☐
Oceania	☐	☐	☐	☐	☐

10. If you intend to transmit to a given target area at a given time using digital modulation, are you planning to transmit the same programme using analogue modulation on a different frequency?

	Yes	**No**	**Don't Know**
Now	☐	☐	
For 5 years	☐	☐	☐
For 10 years	☐	☐	☐
For 15 years	☐	☐	☐

11. Comments_____

_____

_____

When completed, please return to:

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Annex 3

High Frequency Co-ordination Conference (HFCC) revised HF broadcasting statistics

1 Introduction

This text provides updated statistics and other information concerning the HF broadcasting service which supports the need for additional spectrum for the broadcasting service as identified in Chapter 5 of the CPM Report for WRC-07.

It also provides general information on the international broadcasting service, the distribution methods used, an outline of the planning criteria used in the HF bands and an indication of how much additional spectrum is required in which bands in order to reduce congestion.

2 Background information on the International Broadcasting Service

The international broadcasting service has existed for over 70 years. It was initially used to provide news and information to individuals living away from their home country. However, the broadcasting service expanded rapidly to become a means to inform, educate and, to some extent, entertain the general public worldwide. It allows individuals to have access to news and information about other countries that may not be available elsewhere.

It is able to warn individuals about major events that may affect them as well as providing information on relief operations following a natural or man-made disaster.

2.1 Distribution

Frequencies in the HF bands have been used by the broadcasting service for transmissions over long distances since it started over 70 years ago. HF is still an important part of the overall distribution of radio broadcasting services as it allows individuals to listen using a portable receiver whether they are at home, in a car, or in a remote location.

In the last 10 years or so, other forms of distribution, such as internet, satellite and local stations, have become viable and are being used by many broadcasters to supplement their HF coverage. However, although offering advantages in terms of audio quality and availability, there are disadvantages compared to HF distribution that need to be understood:

– Internet, satellite and local stations are dependent on a third party, often referred to as a gatekeeper, to deliver the programme to the listener. It is possible that these forms of delivery can be withdrawn without notice for a variety of reasons.

– Internet and satellite services require more complex receiving equipment than for HF. In many parts of the world, this is likely to be too expensive for the average individual.

– Internet services are less flexible than other forms of distribution as they rely on a connection to internet. At present this is often via cable or limited range wireless connection limiting the options for listening location.

– Local stations, mainly VHF FM, have small coverage areas compared to HF. It is not feasible to cover large areas using FM outlets alone.

The introduction of such additional forms of distribution has allowed broadcasters to reduce their use of the HF bands. However, these additional means of delivery will not replace HF which remains the main distribution method for the international broadcasting service.

2.2 Planning

Unlike many other services, the HF broadcasting service does not have a fixed “Plan” whereby each station is allotted a frequency.

Traditionally, each broadcaster chose the frequencies they wished to use from within the bands authorized by their administration. This process often resulted in broadcasters operating on the same or adjacent channel (±5 kHz) causing mutual interference. Such interference was difficult, if not impossible to resolve quickly. Consequently, a small number of broadcasters coordinated their frequency requirements before each broadcasting season to avoid such mutual interference as far as possible.

This overall unsatisfactory situation led to a proposal at WARC-79 to investigate a new way of planning HF broadcasting services.

Two World Administrative Radio Conferences (WARC’s) were held in the 1980’s to develop an improved Planning system for HF broadcasting. HFBC-84 developed the technical criteria and a new Planning Method. HFBC-87 looked at the results of the test plans prepared by the proposed Planning Method. As the results were not acceptable to administrations, improvements to the Planning Method were agreed. Unfortunately, despite these improvements, further tests demonstrated that it was impossible to accommodate the number of requirements in the HF spectrum available to the broadcasting service. The Planning Method was abandoned in the early 1990’s.

2.3 Informal coordination

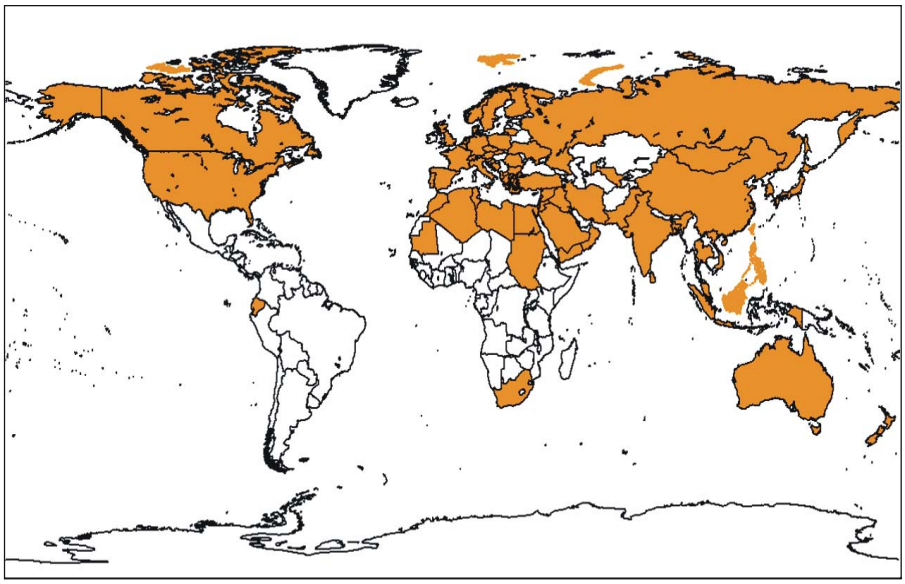
In 1990, short-wave broadcasters from East and West Europe met in Bulgaria with the aim of improving cooperation in HF frequency planning. This was the first meeting of the High Frequency Coordination Conference (HFCC) which continues to meet twice a year to coordinate HF schedules.

As the success of this informal process was recognized, more broadcasters joined and 2 further groups, ASBU and ABU-HFC, were established by the Arab States Broadcasting Union (ASBU) and the Asia Pacific Broadcasting Union (ABU). Membership of HFCC is open to all organizations that provide HF frequency management and planning. Currently, there are around 75 members representing HF broadcasting services via the territory of over 85 administrations within these 3 groups. A map showing the membership of these Groups is given in Fig. 1.

Initially, the combined database of requirements was inspected to identify transmissions to the same Ciraf Zone on the same or adjacent (±5 kHz) frequency to identify possible interference problems (referred to as collisions). Over time, a more rigorous technical examination of requirements was developed to identify possible collisions which would then be discussed and, hopefully, resolved between the parties involved. The technical examination uses criteria contained in ITU-R Recommendations. Unlike the proposed Planning System developed in the 1980’s, this technical examination does not consider possible interference from transmissions more than 5 kHz away from the wanted transmission.

FIGURE 1

Map showing HFCC/ASBU/ABU-HFC Membership



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2.4 International regulations

With the abandonment of the Planning Procedure in the early 1990's there was still a problem with what should replace RR Article 17 as this Article did not meet the needs of all administrations.

A number of options were considered but the one method that appeared to offer the flexibility required was a combination of the best parts of RR Article 17, the technical analysis developed for the HFBC Conferences in the 1980's coupled with the informal coordination process to resolve interference problems. This method was finally adopted at WRC-97 as RR Article 12.

RR Article 12 came into force on 1st January 1999 with the first broadcasting season using this new procedure being A99.

2.5 Technical and operational considerations

The RF channel bandwidth required for a HF broadcasting service is 10 kHz whether using amplitude modulation (AM) or digital modulation (N). Broadcasting services are normally planned to operate on a 10 kHz raster to the same geographic area. Interference from a transmission 10 kHz from a wanted service is ignored unless there is a problem in practice. This is then resolved, if possible, by informal coordination between the parties involved.

However, it is possible to interleave other transmissions to a different geographic area on the 5 kHz points. This interleaving gives rise to adjacent channel interference at ±5 kHz which is taken into account during the informal coordination process.

At peak broadcasting periods in a geographic area, it is common to have transmissions at 5 kHz spacing instead of the usual 10 kHz spacing purely due to the lack of adequate spectrum. This can be seen in Figs. 2 and 3. Although the informal coordination process tries to minimize the mutual interference levels, in many cases there are no options other than to accept the level of interference in the expectation that some part of the wanted service area receives an audible service on some days.

FIGURE 2

Bandscan of 9 500-9 600 kHz at 1 400-1 500 UTC at Vienna in B05

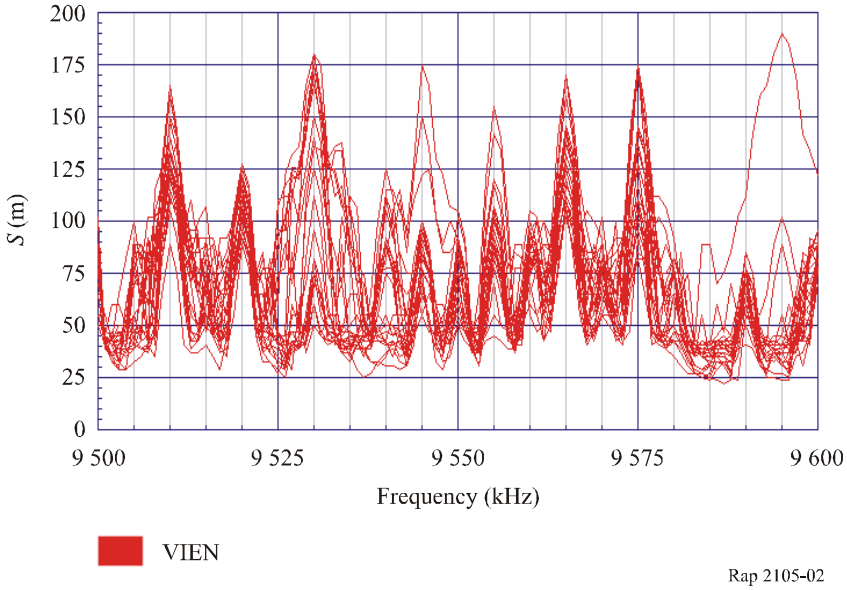
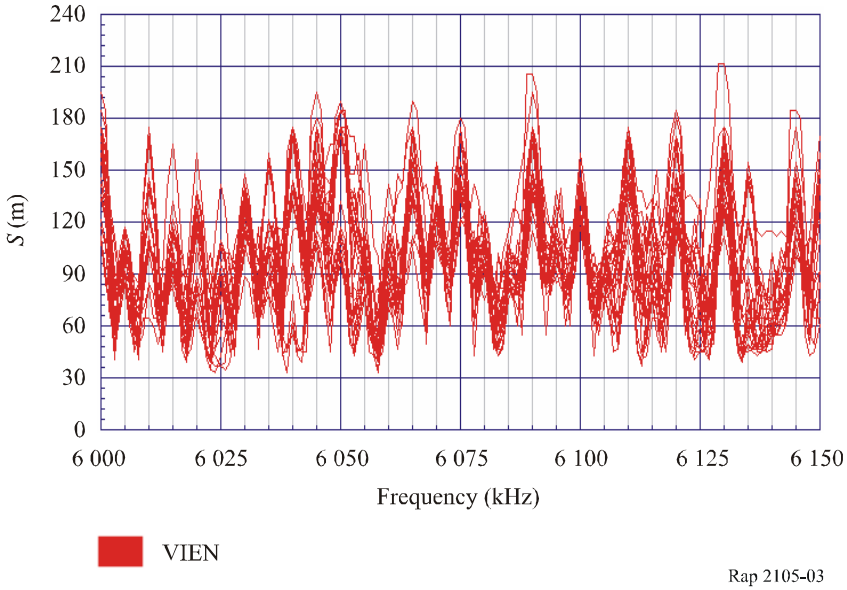


FIGURE 3

Bandscan of 6 000-6 150 kHz at 1700-1 800 UTC at Vienna in B05



As the broadcasting service has a long history of using the HF bands and monitoring the audibility of transmissions, a great deal of subjective information has been collected. This allows frequency managers to interpret the output of the propagation prediction method (Recommendation ITU-R P.533) such that the planned transmissions have a greater chance of success. Furthermore, with this knowledge, transmissions can be planned to take advantage of known compatible situations between transmissions to improve overall spectrum efficiency. It is common for a single frequency to be used for multiple simultaneous transmissions to different geographic areas particularly in the lower bands. This simultaneous use, or sharing of a single frequency, is made feasible by the fact that propagation of a frequency varies significantly with time of day. For

example, at 6 MHz, the service area tends to be small and close to the transmitter during daylight but is large and at long distances from the transmitter during darkness.

Despite the undoubted improvement in the planning of the HF broadcasting service, there is still a problem with the lack of spectrum to satisfy all requirements, particularly in the lower broadcasting bands.

3 Statistical analysis

For each broadcasting season, the HF informal coordination groups maintain an up-to-date schedule of requirements submitted by Frequency Management Organizations (FMO's). These schedules improve in accuracy over time as the FMO's submit updates to their initial requirements to take account of changes in program requirements and changes due to the ongoing coordination process. Around a month after the start of a broadcasting season, the operational seasonal schedule is published. This schedule has been shown to be more than 95% accurate and has been used for the following statistical analysis.

As indicated in Fig. 1, it should be noted that the combined HFCC/ASBU/ABU-HFC database does not include all requirements for all countries. There are a number of HF broadcasting organizations who are not members of any of these informal coordination groups so do not submit their requirements.

Chart 1 shows the total transmitter hours per day submitted to the coordination groups for each season from B00 to B06. This chart shows all requirements for 3 types of HF frequency bands used:

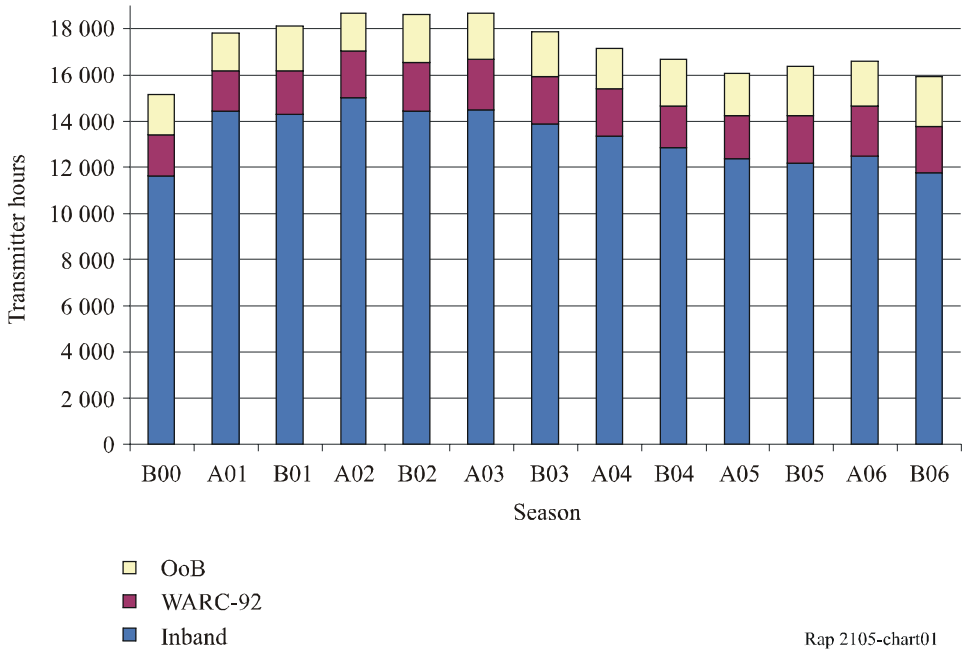
– Bands allocated to the broadcasting service (Inband).

– Bands allocated to the broadcasting service by WARC-92 (WARC-92).

– Any frequencies used that are outside the previous 2 types of band (Out-of-Band (OoB)).

CHART 1

Transmitter hours in the HFCC/ASBU/ABU-HFC joint operational schedule database



It is apparent that the number of transmitter hours submittend has fallen since the peak in the A03 season. However, it does appear as though the requirements have stabilised since the A05 season.

The following are just some of the factors that contribute to this reduction:

– Broadcasters reducing the number of simultaneous requirements as the benefits of coordination are realized such that acceptable audibility can be achieved over a larger area with the use of fewer frequencies.

– Broadcasters being encouraged to delete requirements that were planned but did not operate during the season - this is an ongoing activity in HFCC using monitoring to identify such requirements.

– Broadcasters opting to use other forms of delivery (local FM/MF, Satellite and Internet) allowing them to reduce HF transmissions to some parts of the world.

– Broadcasters deciding to close their services using the HF bands.

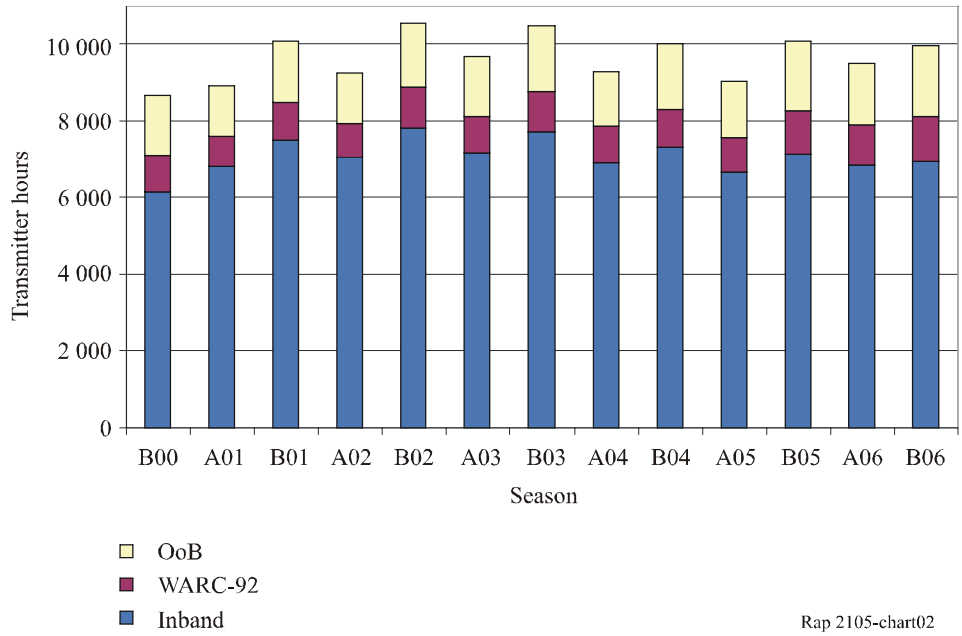
– Broadcasters reducing transmissions to save money.

Although the overall reduction looks significant at around 15% overall since the A03 season, the reduction is not of the same scale in the lower frequency bands.

Chart 2 shows the number of transmitter hours per day in the bands 4-10 MHz. This chart shows that there is a seasonal variation in the number of transmitter hours coordinated with the highest number in the B seasons (Northern Hemisphere Winter). The difference between A and B seasons is of the order of 10% with the reduction in B-seasons from a peak in B02 to B04 of around 5%.

CHART 2

Transmitter hours in the HFCC/ASBU/ABU-HFC joint operational database in the range 4-10 MHz

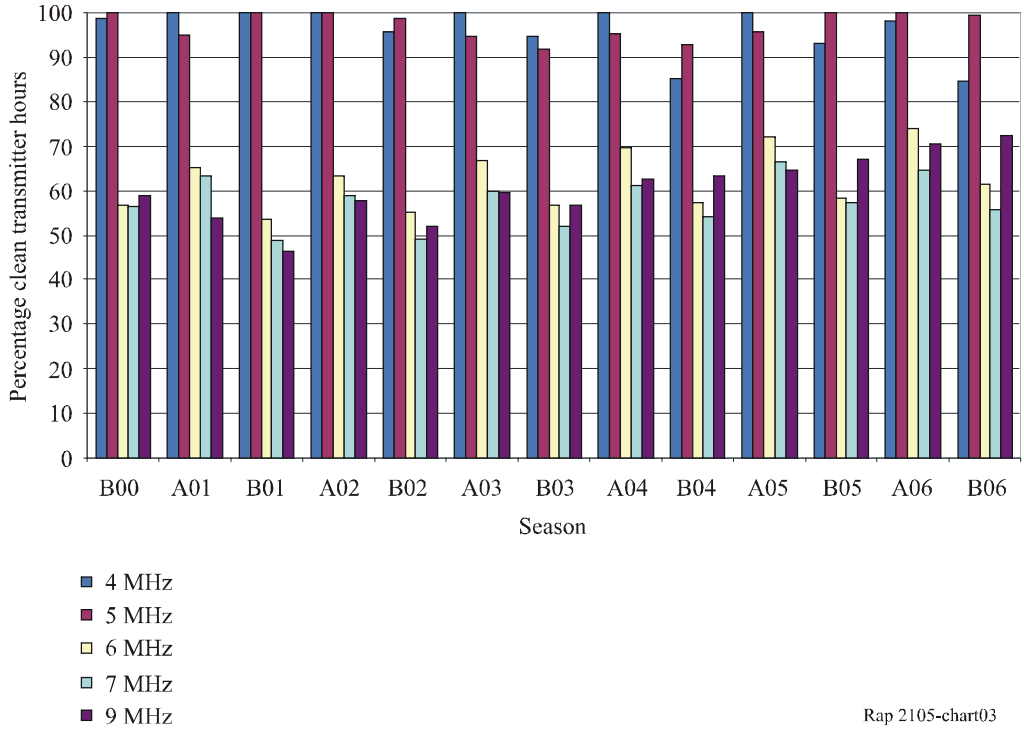


This demonstrates that the 4-10 MHz bands are still heavily used by the broadcasting service despite the overall reduction in transmitter hours. In fact, more than half the daily transmitter hours fall into the 4-10 MHz band although the amount of available spectrum is significantly less than for the amount of spectrum in the bands above 10 MHz.

Chart 3 shows the percentage of transmitter hours with no co-channel or adjacent channel interference (“clean” hours) in each band between 4-10 MHz for each season. ALL transmissions in the 4-10 MHz band region have been taken into account including those falling in the OoB region. This shows that there has been a small increase in the percentage of clean hours for the 6, 7 and 9 MHz bands since B01 but that congestion is still very severe.

CHART 3

Percentage of transmitter hours with no co- or adjacent (± 5 kHz) interference

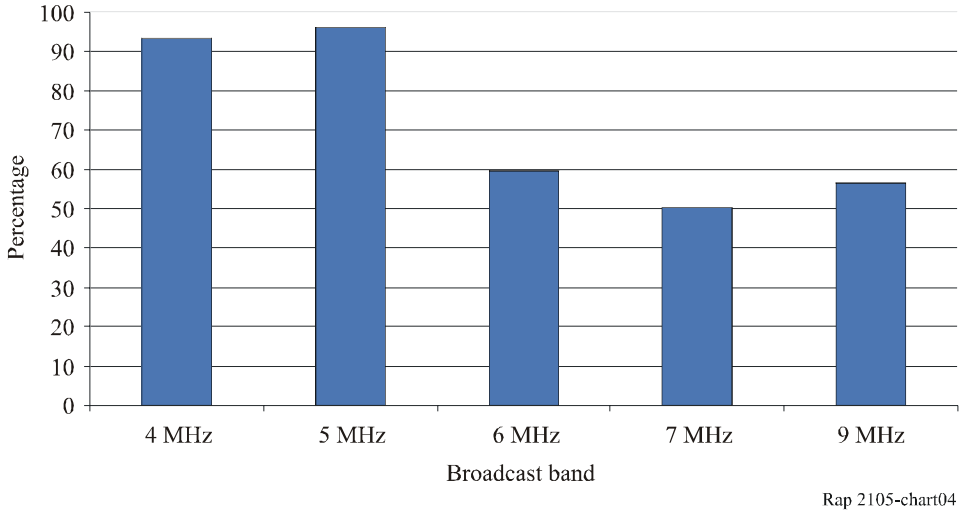


The 4 and 5 MHz bands are predominately for broadcasting in the Tropical Zone and are shared with the Fixed and some Mobile services. Although they do not appear to be congested there is little requirement information for these bands available within the coordination groups.

As there is such a variation in congestion in the bands between 4-10 MHz A to B seasons and over the range from B00 to B05, it is difficult to determine how much spectrum would be required in each band to reduce the level of congestion. Chart 4 shows the average number of clean hours for all seasons considered to date. It should be noted that this includes transmissions in the Inband and WARC-92 bands only.

CHART 4

Percentage of transmitter hours with no co- or adjacent channel interference averaged across seasons (inband and WARC-92 only)



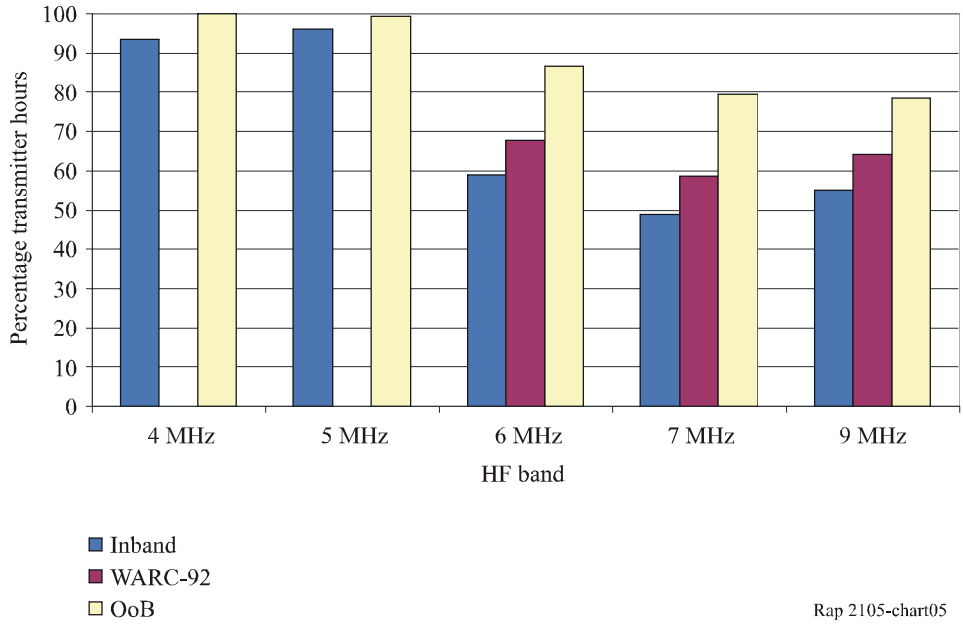
This clearly shows that the most congested bands are the 6, 7 and 9 MHz bands with less than 60% of transmitter hours free of co- and adjacent channel interference. The most congested band is 7 MHz which has only around 50% of transmissions free of either co- or adjacent channel interference.

The level of congestion varies with band type as can be seen in Chart 5. This shows the percentage of clean transmitter hours per band and frequency band type (Inband, WARC-92 and OoB). This demonstrates the reason the WARC-92 bands are already heavily used although they were not available until 1st April 2007 and why there is a growing use of spectrum outside the bands allocated to the broadcasting service. Very simply put, there is a much higher possibility of a successful transmission on a frequency outside the bands currently allocated to the broadcasting service.

It is anticipated that congestion will increase in these bands as broadcasters have to move to lower frequencies with declining sunspot activity.

CHART 5

Percentage of transmitter hours with no co- or adjacent channel interference by band category



In preparing for WRC-03, an estimate of the amount of spectrum in each band required to clear co- and adjacent channel interference was made. This original analysis was made on the HFCC/ASBU/ABU-HFC database as it stood at the end of each coordination meeting rather than on the status of the database around 4 weeks after implementation of the season. Table 2 gives the equivalent analysis using the average number of transmission hours and collision information across all seasons from B00 to B06. Although there is only 7 years of data, it represents usage across a wide range of sunspot activity compared to the information prepared for WRC-03 which was principally for mid – to high sunspot activity.

TABLE 2

Collision statistics and spectrum required for inband and WARC-92 requirements

HF broadcast band (MHz)	Transmitter hours	Mutual co-channel collision hours	Mutual adj-channel collision hours	Satisfied hours		Spectrum available (inc. WRC 92 bands) (kHz)	Additional spectrum required to satisfy co-channel requirements (kHz)	Additional spectrum required to satisfy adj-channel requirements (kHz)	Percentage of satisfied hours
4	87.7	2.6	3.7	82.0		50	2	2	93.5
5	398.0	1.5	13.6	382.9		300	1	11	96.2
6	2770.2	387.9	972.6	1654.4		300	70	176	59.7
7	2003.8	496.5	794.6	1007.5		250	123	197	50.3
9	2819.1	420.2	1049.1	1592.6		500	132	329	56.5
Total	**8078.8**	**1308.7**	**2833.6**	**4719.4**		**1400**	**328**	**716**	

At first sight, it may appear that there is an error in Table 2 as the sum of co-channel, adjacent channel collision hours and clean hours is greater than the number of transmitter hours. In practice, it is possible that a transmission with a co-channel collision could also have adjacent collisions.

The present estimate for additional spectrum from Table 2 is now a minimum of 330 kHz to a maximum of 720 kHz. The increase in the minimum amount of additional spectrum, compared to the WRC-03 analysis, is due to the impact of lower sunspot activity and broadcasters needing to use the lower broadcasting bands.

According to Table 2, little additional spectrum appears to be required in the 4 MHz and 5 MHz bands. As explained earlier, this is due to the fact that most broadcasting currently in these bands is in the Tropical Zone and that many of these requirements are generally not submitted to the informal coordination groups. The only band available outside the Tropical Zone for broadcasting in the 4-5 MHz band is 50 kHz (3 950-4 00 kHz) in Region 1 and 100 kHz (3 900-4 000 kHz) in Region 3. The situation in 4 MHz in Region 1 is that there is extreme congestion at low sunspot activity and northern hemisphere winter periods. Experience of using this band suggests that 50 kHz is too small to provide flexibility and efficiency for the transmissions required. Any spectrum allocated to the broadcasting service in the part of the HF band should be a minimum of 100 kHz.

The amount of spectrum currently used by the broadcasting service OoB is difficult to determine as transmissions are less densely packed than in the Inband part of the spectrum. The density of transmissions near the edges of the Inband and WARC-92 bands is similar but reduces further from the band edges. Inspection of the HFCC/ASBU/ABU-HFC Operational schedules shows that the main OoB spectrum used for broadcasting are as shown in Table 3.

TABLE 3

Existing OoB spectrum currently used for broadcasting

From (kHz)	To (kHz)	Bandwidth (kHz)
5 745	5 900	155
6 200	6 255	55
7 350	7 600	250
9 265	9 400	135
9 900	9 990	90

Broadcasting transmissions are therefore spread across an additional 210 kHz at 6 MHz, 250 kHz at 7 MHz and 225 kHz at 9 MHz giving a total of 685 kHz in the bands between 6-10 MHz. The situation in the bands below 6 MHz is rather more complex to analyze due to the Regional nature of the allocations to the broadcasting service together with the lack of full details of current usage in these bands.

As congestion is the OoB region is significantly less than for the other bands, Table 4 is an attempt to identify the amount of spectrum occupied by the OOB transmissions assuming the same density of usage as in the Inband and WARC-92 bands. This suggests that the current equivalent additional spectrum already used by the broadcasting service outside the broadcasting bands is around 300 kHz.

TABLE 4

Equivalent spectrum needed to satisfy OoB requirements

HF broadcast band (MHz)	Transmitter hours (inband)	Transmitter hours (OoB)	Spectrum available (WRC 92 and WRC-03 bands) (kHz)	Equivalent spectrum used by OoB requirements (kHz)
4	87.7	27.5	50[(1)]	16
5	398.0	109.4	300	82
6	2466.7	261.9	300	32
7	1706.5	628.0	250	92
9	2425.5	551.7	500	114
Total	**7084.4**	**1578.5**	**1400**	**336**

(1) Region 1 only.

As this spectrum would be as heavily congested as the Inband and WARC-92 band spectrum, a further assessment could be made to determine how much additional spectrum would be required to reduce the congestion in a similar manner. From Table 3 and Table 4, this would be somewhere in the range 300-685 kHz. Adding the results from Table 2 gives a total spectrum requirement for the broadcasting service as somewhere between 665 kHz to 1 050 kHz.

Taking into account the preferred bands identified in Resolution 544 (WRC-03), the amount of additional spectrum preferred by the broadcasting service would be an allocation of 530 kHz (midway between 330 kHz and 720 kHz) distributed as follows in Table 5:

TABLE 5

Additional allocations preferred by the broadcasting service

From (kHz)	To (kHz)	Total (kHz)
4 550	4 650	100
5 780	5 900	120
7 450	7 650	200
9 350	9 400	50
9 900	9 950	50

The band 4 550-4 650 kHz is identified as a possible new band but consideration should also be given to extend the present 4 MHz band in Region 1 by 100 kHz as an alternative.

The band 7 450-7 650 kHz assumes the situation after 29 March 2009. It is noted that the CPM Report contains two examples of additional allocations to the broadcasting service under Method 3. Example 1 does not contain any additional spectrum for the broadcasting service around 7 MHz even though this is the most congested broadcasting band. Should WRC-07 decide not to allocate spectrum to the broadcasting service in this band, additional spectrum to that shown in Table 5 will be needed in the 6, 9 and 4 MHz bands.

It should be noted that from Table 3 that a significant number of administrations have already permitted much of this spectrum to be occupied by broadcasting transmissions on a non-interference basis to other services.

To allow maximum flexibility for the broadcasting service to resolve incompatibilities, it is preferable for any new spectrum to be allocated to the broadcasting service under the procedures of RR Article 12. This would mean allocating additional spectrum on either an Exclusive or Primary basis. Allocating spectrum to the broadcasting service on a Primary basis does not preclude allowing access by other services on a Secondary basis, particularly in the lower bands. Propagation considerations in these lower bands mean that the broadcasting service will only be able to use the spectrum for a limited period each day, around local dawn and evening periods permitting access outside these periods by the other services.

4 Transition period

Use of the lower HF bands is greater at sunspot minimum conditions and particularly during Northern hemisphere winter periods (B – Seasons). Ideally, it would be of greatest benefit to the broadcasting service to have access to any new spectrum allocated at WRC-07 before the next sunspot minimum period.

Chart 6, from NOAA, shows that the next sunspot minimum appears to have occurred around the beginning of 2007. As it is unrealistic to expect access to any new spectrum immediately, the next option would be prior to the next sunspot minimum period forecast to be around 11 years later in 2018. To ease congestion in the existing bands allocated to the broadcasting service, it would be helpful to allow the broadcasting service access to any new spectrum at least 2 years before sunspot minimum when sunspot activity is low forcing broadcasters to use the lower bands. The latest date for the broadcasting service would therefore be either 27 March 2016 or 30 October 2016.

It is recognized that there should be sufficient time for any service involved in changes to the Table of Allocations to make the necessary changes. The suggested date of 30 October 2016 for implementation is around 9 years after WRC-07. It is thought that this may provide sufficient time to make such changes.

CHART 6

Current sunspot cycle from NOAA