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Recommendation ITU-R M.1824-2
(02/2022)

System characteristics of television outside broadcast, electronic news gathering and electronic field production in the mobile service for use in sharing studies

M Series
Mobile, radiodetermination, amateur and related satellite services

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Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R M.1824-2*

System characteristics of television outside broadcast, electronic news gathering and electronic field production in the mobile service for use in sharing studies

(Questions ITU-R 1/5 and ITU-R 7/5)

(2007-2015-2022)

Scope

This Recommendation, dealing with system characteristics of television outside broadcast (TVOB), electronic news gathering (ENG) and electronic field production (EFP) in the mobile service to assist sharing studies, contains the typical operational and technical characteristics of broadcast auxiliary services (BAS)[1], which are required for sharing studies both between the BAS in the mobile service and other radiocommunication services and between mobile broadband networks used for ENG applications in the mobile service and other radiocommunication services.

Keywords

ENG, BAS, SAB, Mobile broadband

Abbreviations

AM	Amplitude modulation
BAS	Broadcast auxiliary services
BER	Bit error ratio
BPSK	Binary phase shift keying
BS	Base station
BWA	Broadband wireless access
CNR	Carrier to noise ratio
EFP	Electronic field production
e.i.r.p.	equivalent isotropically radiated power
ENG	Electronic news gathering
FM	Frequency modulation
IF	Intermediate frequency
LTE	Long Term Evolution
MIMO	Multiple-input multiple-output
MS	Mobile station
OB	Outside broadcasting

* This Recommendation should be brought to the attention of Radiocommunication Study Group 6.

1 The term “BAS”, also known as services ancillary to broadcasting (SAB), is defined in Report ITU-R BT.2069.

OFDM	Orthogonal frequency division multiplex
PSK	Phase shift keying
QAM	Quadrature amplitude modulation
QPSK	Quaternary phase shift keying
Rx	Receiver
RZ-SSB	Real zero single sideband
SISO	Single-input single-output
SSB	Single sideband
TVOB	Television outside broadcast
Tx	Transmitter

The ITU Radiocommunication Assembly,

considering

a) that some administrations operate extensive terrestrial broadcast auxiliary services (BAS) under mobile service allocations;

b) that some administrations are migrating from analogue to digital terrestrial BAS under mobile allocations;

c) that many administrations are likely to operate BAS including both terrestrial analogue and digital electronic news gathering (ENG) and television outside broadcast (TVOB) equipment in the mobile allocations for a reasonable amount of time;

d) that the frequency bands used for these BAS including TVOB, ENG and electronic field production (EFP) are, in many cases, shared by the mobile service and other services;

e) that the technical and operational characteristics of terrestrial BAS deployed under the mobile service are different from those systems deployed under the fixed service;

f) that several types of antennas are used by the BAS operated in various vehicles, and those antennas are controlled in elevation and azimuth during their operation to establish reliable links to the studio;

g) that it is desirable to identify the system parameters and operational characteristics to facilitate sharing with other services;

h) that ENG applications require low latency and high quality of service transmission of high-definition video and audio streams for live programmes;

i) that ENG applications require reliable connectivity even in the event of a disaster,

recognizing

a) that Resolution ITU-R 59 resolves to carry out studies on availability of frequency bands and/or tuning ranges for worldwide and/or regional harmonization and conditions for their use by terrestrial electronic news gathering systems,

noting

a) that mobile broadband networks can be used for ENG applications when it is advantageous to do so;

b) that Recommendation ITU-R F.1777 provides system characteristics of TVOB, ENG and EFP in the fixed service for use in sharing studies;

c) that Report ITU-R BT.2069 addresses spectrum usage and operational characteristics of terrestrial ENG, TVOB and EFP systems;

d) that Report ITU-R BT.2299 – Broadcasting for public warning, disaster mitigation and relief, provides a compilation of supporting evidence that terrestrial broadcasting plays a critically important role in disseminating information to the public in times of emergencies,

recommends

1 that the operational and technical characteristics described in Annex 1 should be used for sharing studies between BAS deployed in the mobile service and other services;

2 that the operational and technical characteristics provided in Annex 2 should be used for sharing studies between mobile broadband networks used for ENG applications in the mobile service and other services.

Annex 1

Operational and technical characteristics of BAS systems deployed in the mobile service

1 Operational characteristics of BAS systems in the mobile service

Broadcasters use several frequency bands and several types of antennas depending on the situation where terrestrial crews send and receive live images. Figures 1 and 2 are examples of link situations. These systems are used for reporting the events of national disasters, contents production outside studio, etc. noting that the timing and location of national disaster events cannot be predicted.

Moreover, since broadcasters need to send the live video of national disasters and the contents which are needed in programme production; the geographical relation between the ENG equipment and collecting station or relay station installed on the helicopter or vehicular cannot be predicted. As a consequence, the antennas of ENG equipment need to point to any azimuth and elevation angle.

Figure 1 shows the example operation for transmitting live video to the collecting station, in order to broadcast the events which occur at the suburban area. In this case, the terrestrial video engineer who controls the microwave equipment points the antenna to the relay station installed on helicopter to avoid terrestrial obstacles. The relay station on the helicopter relays the live video to the collecting station which sends it to the broadcasting studio. The return link is also necessary to allow the terrestrial video engineers to collect information from the broadcasting studio.

Figure 2 shows the example of operation for transmitting live video to the collecting station, in order to broadcast the events which occur at the urban area. In this case, there are several ways to make a microwave link to the collecting station. The camera crew riding on the motorcycle takes the live video and transmits it to the relay station installed on the vehicle which is also running in front of the motorcycle. In some cases, the relay station installed on the helicopter picks up the video which is transmitted by the camera crew riding on the motorcycle. A low gain antenna is usually used in these cases. The relay station installed on the vehicle also transmits live video to the helicopter which relays it to the collecting station, or directly transmits it to the collecting station by using a high gain antenna.

Broadcasters choose the antenna and frequency band depending on circumstances where the microwave links are to be established.

FIGURE 1

Example of operation for transmitting video to the collecting stations via helicopter

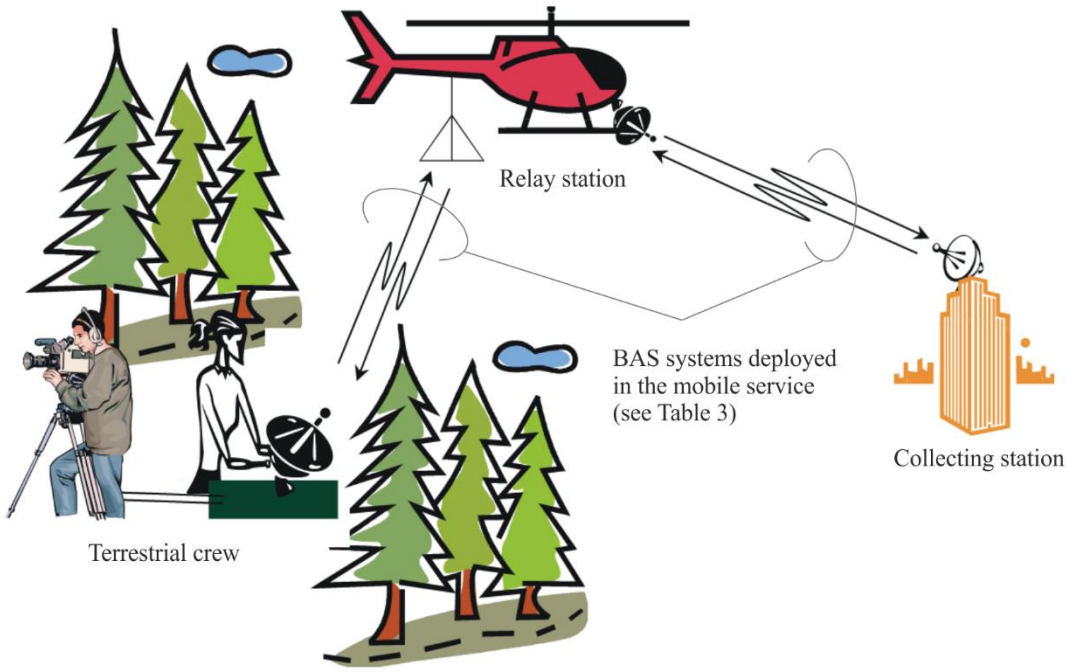
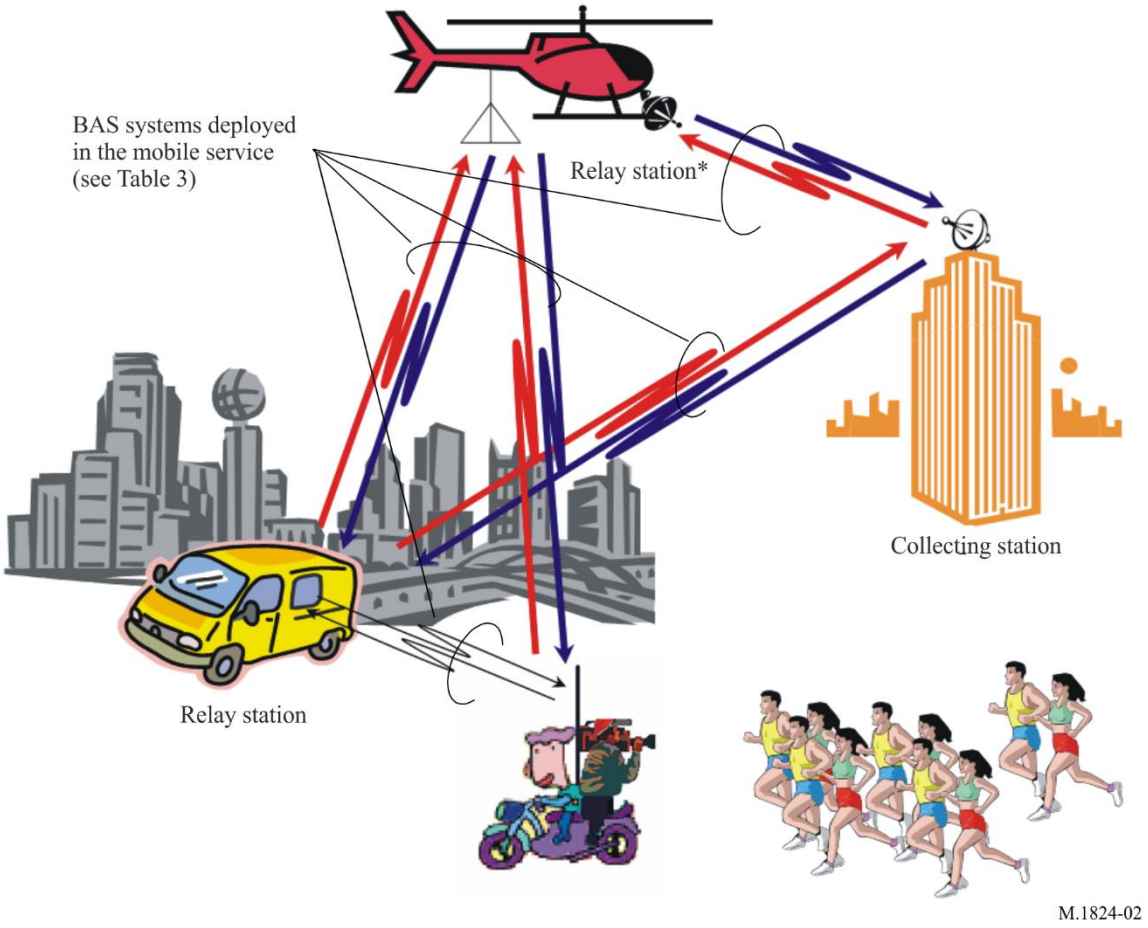


FIGURE 2

Example of operation for transmitting live video to the collecting stations via vehicles



* The altitude of the relay station installed on helicopter depends on the aviation law of operating area. For example, 150 m or more over rural area and 300 m or more over urban area in Japan.

2 Technical characteristics of BAS systems deployed in the mobile service[2]

Table 1 summarizes the technical parameters of BAS video link systems.

Table 2 summarizes the technical parameters of BAS talkback and walkie-talkie[3] systems.

Table 3 summarizes the technical parameters of BAS audio link systems[4].

[2] The radio microphone systems, which are currently operated in the bands 40.68 MHz to 47.27 MHz and 779.125 MHz to 805.875 MHz on a licensed basis in Japan, are not included in this Recommendation.

[3] These systems are used as the BAS audio link application in absence of alternative measures to establish the audio link.

[4] The terminologies of video link, talkback and audio link systems are defined in the Report ITU-R BT.2069.

TABLE 1

Parameters of BAS video link systems operated in the mobile service

Frequency allocation[(1)]	**770-806 MHz (r2, R3, 5.293)** **790-862 MHz (5.314, 5.316)**	**1 240-1 300 MHz (5.330)** **2 330-2 370 MHz (R1, R2, R3)**	**5 850-5 925 MHz (R1, R2, R3)** **6 425-6 570 MHz (R1, R2, R3)** **6 870-7 125 MHz (R1, R2, R3)**	**10.25-10.45 GHz (R1, R3, 5.480)** **10.55-10.68 GHz (R1, R2, R3)** **12.95-13.25 GHz (R1, R2, R3)**	**41.55-41.95 GHz (r1, r2, r3, 5.551F)**	**Note**
Antenna type and gain	Helix (10-13 dBi)	Helix (10-13 dBi)	Parabolic (22-35 dBi) Helix (10-13 dBi)		Parabolic (30-41 dBi) Horn (12-25 dBi)	H, V or circular polarization
	YAGI (12-19 dBi)	YAGI (12-19 dBi)	Horn (5-20 dBi)		N/A	Circular polarization
	Co-linear (5-6 dBi) Non-directional (2 dBi)	Co-linear (5-6 dBi) Non-directional (2 dBi)	Horn (15-20 dBi) Non-directional (2 dBi)		Dielectric rod (10 dBi) Non-directional (2 dBi)	H and V polarization
Tracking method	Automatic or Manual					
Modulation	QPSK-OFDM 16-QAM-OFDM 32-QAM-OFDM	BPSK-OFDM QPSK-OFDM 8-PSK-OFDM 16-QAM-OFDM 32-QAM-OFDM 64-QAM-OFDM	QPSK-OFDM 16-QAM-OFDM 32-QAM-OFDM 64-QAM-OFDM	QPSK-OFDM 16-QAM-OFDM 32-QAM-OFDM 64-QAM-OFDM 256-QAM-OFDM 1 024-QAM-OFDM 4 096-QAM-OFDM	N/A	QPSK-OFDM 16-QAM-OFDM 32-QAM-OFDM 64-QAM-OFDM 8-PSK 16-QAM
	FM		FM		FM	

Maximum capacity (Mbit/s)	16	30	60	30	60	154 [(a)]	313 [(a)]	30	60	154 [(a)]	313 [(a)]	N/A	N/A	401 [(a)]	803 [(a)]	[(a)] In the case of MIMO transmission with two Tx antennas
Channel spacing (MHz)	9	9	18	9	18	9	18	9	18	9	18	N/A	N/A	62.5	125	For the digital system
	9	N/A	N/A	N/A	18	N/A		N/A	18	N/A		33	100	N/A		For the FM system

TABLE 1 (*continued*)

Frequency allocation[1]	**770-806 MHz (r2, R3, 5.293)** **790-862 MHz (5.314, 5.316)**	**1 240-1 300 MHz (5.330)** **2 330-2 370 MHz (R1, R2, R3)**		**5 850-5 925 MHz (R1, R2, R3)** **6 425-6 570 MHz (R1, R2, R3)** **6 870-7 125 MHz (R1, R2, R3)**				**10.25-10.45 GHz (R1, R3, 5.480)** **10.55-10.68 GHz (R1, R2, R3)** **12.95-13.25 GHz (R1, R2, R3)**				**41.55-41.95 GHz (r1, r2, r3, 5.551F)**				**Note**
Feeder/ multiplexer loss (typical) (dB)	1	1		1	1	1	1	1	1	1	1	1	1	1	1	For both transmitter and receiver
Maximum antenna input power (dBW)	7	11 [c] 13 [d]	14 [c] 16 [d]	4	7	4	7	4 [a]	7 [b]	4 [a]	7 [b]	0	0	0	0	[a] –6 dBW in 10.60-10.68 GHz by the transmitter power [b] –3 dBW in 10.60-10.68 GHz by the transmitter power [c] 1 240-1 300 MHz [d] 2 330-2 370 MHz
e.i.r.p. (maximum) (dBW)	25	29 [c] 31 [d]	32 [c] 34 [d]	38	41	38	41	38 [a]	41 [b]	38 [a]	41 [b]	40	40	40	40	[a] 29 dBW in 10.60-10.68 GHz [b] 32 dBW in 10.60-10.68 GHz [c] 1 240-1 300 MHz [d] 2 330-2 370 MHz
Receiver IF bandwidth (MHz)	9	9	18	9	18	9	18	9	18	9	18	27	80	62.5	125	
Receiver noise figure (dB)	4	4	4	4	4	4	4	4	4	4	4	6	6	10	10	
Receiver thermal noise (dBW)	–130.5	–130.5	–127.4	–130.5	–127.4	–130.5	–127.4	–130.5	–127.4	–130.5	–127.4	–123.7	–119.0	–116.0	–113.0	

TABLE 1 (*continued*)

Frequency allocation[1]	**770-806 MHz (r2, R3, 5.293)** **790-862 MHz (5.314, 5.316)**	**1 240-1 300 MHz (5.330)** **2 330-2 370 MHz (R1, R2, R3)**				**5 850-5 925 MHz (R1, R2, R3)** **6 425-6 570 MHz (R1, R2, R3)** **6 870-7 125 MHz (R1, R2, R3)**				**10.25-10.45 GHz (R1, R3, 5.480)** **10.55-10.68 GHz (R1, R2, R3)** **12.95-13.25 GHz (R1, R2, R3)**				**41.55-41.95 GHz (r1, r2, r3, 5.551F)**				**Note**
Normal Rx input level (dBW)	–88	SISO –93 [a]	MIMO –103 [b]	SISO –97 [c]	MIMO –100 [b]	–88	–85	–95 [d]	–92 [d]	–88	–85	–95 [d]	–92 [d]	–82	–77	–92.8 [e]	–90.2 [e]	[a] 64-QAM(3/4) [b] 16-QAM-MIMO [c] 16-QAM(2/3) [d] 64-QAM(5/6) [e] 16-QAM(3/4)
Rx input level for 1×10^{-3} BER (dBW)	– –120 – –113 –110.7 – – – –	– 122.8[a] – 119.6[a] – 115.0[a] – 113.0[a] – 110.0[a] – 107.2[a] – – –	– 123.0[a] – 121.5[a] – 115.5[a] – 111.5[a] – – – – –	– 119.7[a] – 116.5[a] – 111.9[a] – 109.9[a] – 106.9[a] – 104.1[a] – – –	–119.9[a] –118.4[a] –112.4[a] –108.4[a] – – – – –	– –120 – –113 –110.7 –108.2 – – –	– –116.9 – –109.9 –107.6 –105.1 – – –	– – 121.1[b] – 114.8[b] – 111.8[b] – 109.3[b] – 104.0[b] –98.7[b] –93.4[b]	– – 118.0[b] – 111.7[b] – 108.7[b] – 106.2[b] – 100.9[b] –95.6[b] –90.3[b]	– –120 – –113 –110.7 –108.2 – – –	– –116.9 – –109.9 –107.6 –105.1 – – –	– – 121.1[b] – 114.8[b] – 111.8[b] – 109.3[b] – 104.0[b] –98.7[b] –93.4[b]	– – 118.0[b] – 111.7[b] – 108.7[b] – 106.2[b] – 100.9[b] –95.6[b] –90.3[b]	N/A	N/A	– – 106.0[a] – 102.5[a] –98.8[a] –94.6[a] –91.3[a] – – –	– –103.0[a] –99.5[a] –95.8[a] –91.6[a] –88.3[a] – – –	BPSK-OFDM QPSK-OFDM 8-PSK-OFDM (8-PSK) 16-QAM-OFDM (16-QAM) 32-QAM-OFDM 64-QAM-OFDM 256-QAM-OFDM 1024-QAM-OFDM 4096-QAM-OFDM [a] Rx input level for 1×10^{-4} BER [b] Rx input level for 1×10^{-7} BER

TABLE 1 (*end*)

Frequency allocation[1]	**770-806 MHz (r2, R3, 5.293)** **790-862 MHz (5.314, 5.316)**	**1 240-1 300 MHz (5.330)** **2 330-2 370 MHz (R1, R2, R3)**		**5 850-5 925 MHz (R1, R2, R3)** **6 425-6 570 MHz (R1, R2, R3)** **6 870-7 125 MHz (R1, R2, R3)**				**10.25-10.45 GHz (R1, R3, 5.480)** **10.55-10.68 GHz (R1, R2, R3)** **12.95-13.25 GHz (R1, R2, R3)**				**41.55-41.95 GHz (r1, r2, r3, 5.551F)**				**Note**
Rx input level for CNR = 27 (dBW)	–103.5	N/A	N/A	N/A	–100.4	N/A		N/A	–100.4	N/A		–96.7	–92.0	N/A		For FM system
Nominal long term interference (dBW)	–140.5	–140.5	–137.4	–140.5	–137.4	–140.5	–137.4	–140.5	–137.4	–140.5	–137.4	–133.7	–129.0	–126.0	–123.0	
Spectral density (dB(W/MHz))	–150.0	–150.0	–150.0	–150.0	–150.0	–150.0	–150.0	–150.0	–150.0	–150.0	–150.0	–148	–148	–144.0	–144.0	

[1] Each Table contains the letters “R1”, “R2” and “R3”, “r1”, “r2”, “r3”, and the reference to footnote **5.xxx**. The letters “R1”, “R2” and “R3” stand for the ITU-R Region which has a primary mobile allocation to the specified frequency band, the letters “r1”, “r2” and “r3” stand for the ITU-R Region which has a secondary mobile allocation to the specified frequency band, and the reference to footnote **5.xxx** refers to the country footnote in the Table of Frequency Allocations.

TABLE 2

Parameters of BAS talkback/walkie-talkie* systems operated in the mobile service

Frequency allocation[(1)]	**26.574 MHz (R1, R2, R3)**	**143-144 MHz (5.211, 5.212, R2, R3) 146-148 MHz (R1, 5.217, R3) 148-149.9 MHz (R1, R2, R3) 149.9-150.05 MHz (5.223) 150-156.7625 MHz (R1, R2, R3) 156.8375-174 MHz (R1, R2, R3)**	**166.5-166.9 MHz (R1, R2, R3) 168.5-168.9 MHz (R1, R2, R3)**	**459.5125-460 MHz (R1, R2, R3) 469.5-470 MHz (R1, R2, R3)**
Antenna type and gain	Co-linear, 8 dBi for base station (BS), non-directional, 2 dBi for mobile station (MS)			
Modulation	SSB	FM	RZ-SSB	FM
Channel spacing (kHz)		20	6.25	25
Feeder/multiplexer loss (typical) (dB)	Tx: 1.5 (BS), 0 (MS) Rx: 1.5 (BS), 1 (MS)	Tx: 1 (BS), 0 (MS) Rx: 1	Tx: 4 (BS), 0 (MS) Rx: 1	Tx: 1 (BS), 0 (MS) Rx: 1
Maximum antenna input power (dBW)	17 (BS), 14 (MS)	17	17	13
e.i.r.p. (maximum) (dBW)	17.5 (BS), 16 (MS)	24 (BS), 19 (MS)	21(BS), 19 (MS)	20 (BS), 15 (MS)
Receiver IF bandwidth (kHz)	3	12/ 16	3.4 /5.8	12/16
Receiver noise figure (dB)	4	4	4	4
Receiver thermal noise (dBW)	–165.0	–159.0/–157.7	–164.5/–162.2	–159.0/–157.7
Minimum Rx input level (dBW)	–147	–147.1/–145.9	–146.5/–144.2	–147.1/–145.9
Nominal long-term interference (dBW)	–175.0	–169.0/–167.8	–174.5/–172.2	–169.0/–167.8
Spectral density (dB(W/kHz))	–179.8	–179.8	–179.8	–179.8
Audio frequency range	300-3 000 Hz	300-3 400 Hz	300-3 400 Hz	300-3 400 Hz

* These systems are used as the BAS audio link application in absence of alternative measures to establish the audio link.

(1) Each Table contains the letters “R1”, “R2” and “R3”, “r1”, “r2”, “r3”, and the reference to footnote **5.xxx**. The letters “R1”, “R2” and “R3” stand for the ITU-R Region which has a primary mobile allocation to the specified frequency band, the letters “r1”, “r2” and “r3” stand for the ITU-R Region which has a secondary mobile allocation to the specified frequency band, and the reference to footnote **5.xxx** refers to the country footnote in the Table of Frequency Allocations.

NOTE 1 – Antenna height and altitude above sea level of base stations will be required for sharing studies. For example, the antenna height more than 20 m and the altitude above sea level more than 1 000 m are used in some cases.

TABLE 3

Parameters of BAS audio link systems operated in the mobile service

Frequency allocation[1]	**38.96 MHz (R1, R2, R3)**	**164-167 MHz (R1, R2, R3)**	**462-465 MHz (R1, R2, R3)**	**3 405-3 423 MHz (r1, r2, r3, 5.432)**
Antenna type and gain	Non-directional (2 dBi)	Yagi (13 dBi) Non-directional (2 dBi)	Yagi (13 dBi) Non-directional (2 dBi)	Parabolic (22-26 dBi)
Modulation	FM AM	FM		
Channel spacing (kHz)	–	240	240	1 000
Feeder/multiplexer loss (typical) (dB)	Tx: 0 Rx: 1	Tx: 0 Rx: 1	Tx: 0 Rx: 1	Tx: 1 Rx: 1
Maximum antenna input power (dBW)	17	17	13	0
e.i.r.p. (maximum) (dBW)	19	30	26	25
Receiver IF bandwidth (kHz)	16/30	100	100	400
Receiver noise figure (dB)	4	4	4	4
Receiver thermal noise (dBW)	–157.8/–155.1	–149.8	–149.8	–139.8
Minimum Rx input level (dBW)	–125.7/–123	–123	–123	–95
Nominal long-term interference (dBW)	–167.8/–165.1	–159.8	–159.8	–149.8
Spectral density (dB(W/kHz))	–179.9	–179.9	–179.9	–179.9
Audio frequency range (kHz)	7	10	10	17

(1) Each Table contains the letters “R1”, “R2” and “R3”, “r1”, “r2”, “r3”, and the reference to footnote **5.xxx**. The letters “R1”, “R2” and “R3” stand for the ITU-R Region which has a primary mobile allocation to the specified frequency band, the letters “r1”, “r2” and “r3” stand for the ITU-R Region which has a secondary mobile allocation to the specified frequency band, and the reference to footnote **5.xxx** refers to the country footnote in the Table of Frequency Allocations.

NOTE 1 – Antenna height and altitude above sea level of collecting radio stations will be required for sharing studies. For example, the antenna height more than 20 m and the altitude above sea level more than 1 000 m are used in some cases.

Annex 2

Operational and technical characteristics of mobile broadband networks for ENG applications

1 Operational characteristics of mobile broadband networks used for ENG applications in the mobile service

Until recently, ENG applications used specialized systems. However, with recent advances in technology, commercial systems have evolved and now are able to fulfil the requirements of ENG in some cases. Therefore, they can be used when it is advantageous to do so. It has already been demonstrated in a number of instances.

In addition to meeting the demands of media consumers, mobile broadband networks can also support wireless feeds for news gathering applications for program development in the domain of electronic news gathering/outside broadcasting services (ENG/OB). This mobile broadband application provides real time feeds for broadcasting; the users could be professionals (e.g. camera people on a motorcycle following an event and transmitting the feed using Long Term Evolution (LTE)) or the general public (e.g. people with mobile broadband devices sending videos to newspapers and broadcasters). Suitably configured LTE networks enable the transmission of high-definition video streams from live cameras with the low latency and high quality required for studio feeds.

Compared to using alternative dedicated/transportable links for ENG/OB, such ENG/OB feeds over LTE networks can be more readily setup with less overhead. The LTE quality of service framework can ensure priority for the ENG/OB services above other types of traffic in the LTE network, thereby providing carrier-grade performance.

It should be noted that commercial communication networks would need to meet the quality of service requirements of ENG, including guaranteed throughput and latency in case of traffic congestion.

The applicable Recommendation for mobile broadband standards is Recommendation ITU-R M.1801.

2 Technical characteristics of mobile broadband networks used for ENG applications in the mobile service

The technical characteristics to be used in sharing studies are found in Report ITU-R M.2116 – Characteristics of broadband wireless access systems operating in the land mobile service for use in sharing studies.

This Report provides characteristics for a number of terrestrial broadband wireless access (BWA)[5] systems, including mobile and nomadic applications, operating, in the mobile service for use in sharing studies between these terrestrial BWA systems and other fixed or mobile systems. It contains technical and operational characteristics of mobile BWA[6] systems to be used for sharing studies for both mobile stations and base stations.

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[5] ‘Wireless access’ and ‘BWA’ are defined in Recommendation ITU-R F.1399.

[6] BWA radio interface standards can be found in Recommendation ITU-R M.1801.