



Suruhanjaya Komunikasi dan Multimedia Malaysia
Malaysian Communications and Multimedia Commission

**MANDATORY STANDARD ON ELECTROMAGNETIC FIELD
(EMF) EMISSIONS FROM RADIOCOMMUNICATIONS
INFRASTRUCTURE**

PUBLIC INQUIRY PAPER

30 September, 2010

Preface

On 27 April 2010, the Minister of Information, Communication and Culture (the Minister) directed the Malaysian Communications and Multimedia Commission (Commission) to determine the mandatory standard on Electromagnetic Field (EMF) emissions from radiocommunications infrastructure.

According to the Minister's direction, the mandatory standard on electromagnetic field (EMF) emissions from radiocommunications infrastructure may comply with any of the requirements of internationally recognized EMF emission standards.

The Commission is hereby holding a Public Inquiry to determine the standard on electromagnetic field (EMF) emissions from radiocommunications infrastructure and invites members of the public and interested parties to participate in this inquiry by making written submissions on any matter they consider relevant to the inquiry on Section Eight and Nine of this document.

Written submissions should be provided to the Commission by **12 noon, 15 November 2010 (Monday)** and addressed to:

The Chairman
Malaysian Communications and Multimedia Commission
Off Pesiaran Multimedia
63000 Cyberjaya
Selangor Darul Ehsan
Malaysia

Attention: EMF Public Inquiry
(Encik Mohd Ali Hanafiah Mohd Yunus)

or E-mail: emfpi@cmc.gov.my
or Fax: +60 3 86 88 10 05

As this is a public inquiry, the Commission may make extracts or entire submissions available for others to read. Commercially sensitive material, will not be made publicly available, and should be provided under a separate cover and clearly marked "**COMMERCIAL IN CONFIDENCE**".

The Commission envisages preparing its report setting out the Commissions' findings by **15 December 2010** and the period of the inquiry will therefore be up to the time when the report is prepared.

Respondents are invited to comment on any matter they consider relevant to the inquiry, including proposing or suggesting amendments or variations to the standard proposed in this paper.

Respondents are encouraged to support their comments with reasons and where appropriate provide or refer to evidence or other relevant information in support of the comments.

For further information regarding this inquiry, please direct your inquiries to:

Technology, Standards and Network Division
Malaysian Communications and Multimedia Commission
Off Pesiaran Multimedia
63000 Cyberjaya
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GLOSSARY

Act/CMA	Communications and Multimedia Act 1998 (Act 588)
Commission	Malaysian Communications and Multimedia Commission
ICNIRP	International Commission on Non Ionization Radiation Protection
MTSFB	Malaysian Technical Standards Forum Berhad
WHO	World Health Organisation
WIEWG	MTSFB Wireless Industry Emission Work Group

SECTION ONE: INTRODUCTION

1. On 27 April 2010, the Minister directed the Commission to determine a mandatory standard for electromagnetic field (EMF) emissions from radiocommunications infrastructure (Ministerial Direction No. 7 of 2010).
2. According to the Minister's direction, the standard on EMF emissions from radiocommunications infrastructure may comply with any of the requirement of internationally recognized standards for EMF emissions.
3. Please refer to the **Appendix** for a copy of the Ministerial Direction.
4. The Commission has experienced an increasing concern by the public on EMF emissions from radiocommunications infrastructure. In this regard, the Commission is of the opinion that a mandatory standard on EMF emissions from radiocommunications infrastructure will ensure industry-wide compliance with this standard and thus increase public confidence.
5. Currently Malaysian EMF emissions limits are defined by the Jabatan Telekom Malaysia (JTM) document "Regulatory Framework on the Sharing of Radiocommunications Infrastructure", saved under section 275 of the Act. The Commission is of the opinion that Malaysia should now align the EMF emission limits to a widely accepted international standard.
6. For the purposes of determining the standard for EMF emissions from radiocommunications infrastructure, the Commission took into consideration proposals from MTSFB Wireless Industry Emission Work Group (WIEWG) and the Draft Malaysian Standard developed by the Technical Committee (TC) on EMF of SIRIM Berhad under the purview of the Department of Standards, Malaysia.
7. This consultation paper is structured in the following manner:

SECTION TWO sets out the legal context for a determination by the Commission.

SECTION THREE provides the background to this Consultation Paper.

SECTION FOUR sets out the Draft Malaysian Standard on EMF.

SECTION FIVE sets out the proposal and study of MTSFB Wireless Industry Emission Working Group.

SECTION SIX sets out the basis of decision.

SECTION SEVEN sets out the public inquiry process.

SECTION EIGHT details out the Specifications of the EMF emissions from radiocommunications infrastructure.

SECTION NINE sets out the implementation by service providers subjected to the mandatory standard.

SECTION TWO: LEGAL CONTEXT FOR A DETERMINATION BY THE COMMISSION ON THE STANDARDS FOR EMF EMISSIONS FROM RADIOCOMMUNICATION INFRASTRUCTURE UNDER THE COMMUNICATIONS AND MULTIMEDIA ACT 1998

8. On 27 April 2010, the Minister of Information, Communication and Culture, under Section 7 of the Act, directed the Commission to determine the standards on electromagnetic field (EMF) emission from radiocommunications infrastructure. Section 7(1) of the Act states that:

"The Minister may, from time to time, issue directions to the Commission on the exercise of the Commission's powers and the performance of the Commission's functions and duties under this Act, whether of a general character or otherwise."

9. With regard to determining a standard, the Commission is acting under the Direction specified above, to carry out its duties to determine such standard under Section 104(2) of the Act, which states that:

"The Commission shall determine a mandatory standard if it is subject to a direction from the Minister to determine a mandatory standard in place of a voluntary industry code".

10. As such, the matter of mandating the standard on EMF emission from radiocommunications infrastructure falls under the Commission's power to determine, as provided for in Section 55(1). Section 55(1) states that:

"The Commission may, from time to time, determine any matter specified in this Act as being subject to the Commission's determination."

11. In carrying out its powers to determine, Section 55(3) further states that:

"Notwithstanding subsection (1), the Commission shall not conduct an inquiry unless it is satisfied that the matter is of significant interest to either the public or to current or prospective licensees under this Act."

12. Under the powers and functions provided for by the Act, the Commission is hereby holding a public inquiry to determine a mandatory standard on EMF emission from radiocommunications infrastructure in Malaysia and hereby invites members of the public to participate in this inquiry by making written submissions on this matter.

13. As this is a Public Inquiry, the Commission reserves its rights to make extracts or entire submissions available for others to read. Commercially sensitive material will not be made available, and should be provided under a separate cover and clearly marked "COMMERCIAL IN CONFIDENCE".

SECTION THREE: BACKGROUND ON RADIOCOMMUNICATIONS IN MALAYSIA

14. Radiocommunications have existed in Malaysia long before the country gained its independence in 1957. However these were originally mostly limited to official radiocommunications and after independence its usage was expanded to include point-to-point microwave backhaul communications.
15. In the mid 1980s, the government privatised the operation functions of Jabatan Telekom Malaysia. In the privatization spin off, mobile communications were introduced and it gained popularity. From then onwards the communications landscape has changed to being more personalized. In 2004, mobile communication gained momentum and surpassed that of fixed line subscribers. In 2009, mobile subscriptions exceeded the nation's population of 28 million inhabitants.
16. It is worth noting that with the increasing need for mobile coverage and services, more radiocommunications infrastructures are required to fulfill the needs of users. From previous mountain and hilltop infrastructures, radiocommunications infrastructures have now come closer to commercial and residential area. Being closer to the general public, this shift has resulted in the general public becoming more concerned on the possible health implications of EMF emissions.

RADIOCOMMUNICATIONS INFRASTRUCTURE UNDER CMA

17. One of the main principles of the licensing framework under the CMA is technology neutrality, and the requirement for licensing depends on the type of activity that is being undertaken. Generally, the provision for radiocommunications infrastructure require two types of licences which are as follows:
 - (a) Network Service Provider Licence - for **transmission** services; and
 - (b) Network Facilities Provider Licence - for **ownership of the physical infrastructure** required for the transmission signals.
18. EMFs are produced when the radiocommunications infrastructure are operational, i.e. when the antennas transmit signals. Hence the parties subjected to mandatory standards on EMF emissions would also involve Network Service Providers. This is inclusive of both individual and class licenses.

SECTION FOUR: TECHNICAL COMMITTEE (TC) ON ELECTROMAGNETIC FIELDS (EMF)

19. SIRIM Berhad is the sole national standards development agency appointed by the Department of Standards Malaysia to develop Malaysian Standards. The standards development covers all industry sectors and EMF falls under the authority of the Electrotechnical-1 Industry Standards Committee (ISC-E). The Technical Committee (TC) on EMF which reports to ISC-E is responsible for developing the Malaysian Standards on EMF.

20. The TC on EMF was chaired by Ministry of Health Malaysia. The members of the TC includes:

Energy Commission

Malaysia Nuclear Agency

Malaysian Association of Standards Users (MASU)

Malaysian Communications and Multimedia Commission

Malaysian Technical Standards Forum Berhad

Ministry of Health Malaysia (Engineering Service Division)

Sirim Berhad

Sinaran Consultancy Sdn Bhd

Tenaga Nasional Berhad (Transmission Division)

The Institute of Engineers, Malaysia

University Malaya (Department of Biomedical Imaging, Faculty of Medicine)

University Malaya (Faculty of Electrical Engineering)

Universiti Teknologi Malaysia

Universiti Teknologi Mara

Universiti Tenaga Nasional

21. The TC on EMF has developed the draft Malaysian Standard "Guidelines for Limiting Exposure to Time-varying Electric, Magnetic and Electromagnetic Fields – Part 2: for Frequency from 3 KHz to 300 GHz". The draft was approved by ISC-E on July 2009 and awaiting registration as Malaysian Standard MS2232: Part 2.

22. The draft Malaysian Standard among others proposed that the limits set by the International Commission on Non-Ionization Radiation Protection (ICNIRP) is adopted.

SECTION FIVE: MTSFB WIEWG

23. The Malaysian Technical Standards Forum Bhd (MTSFB) was established under the Act to develop technical standards for the telecommunications and multimedia industry. The MTSFB Work Group which is responsible to develop technical standard for EMF emission from radiocommunications infrastructure is the MTSFB Wireless Industry Emission Work Group (WIEWG). The WG was chaired by DiGi Telecommunications Sdn Bhd and the members are represented by telecommunications service providers and the Commission as below:

Celcom (Malaysia) Berhad

DiGi Telecommunications Sdn. Bhd.

Malaysian Communications and Multimedia Commission

Maxis Communications Berhad

Rohde & Schwarz Malaysia Sdn. Bhd.

24. MTSFB WIEWG WG has developed a document titled "Technical Standard on RF Emission Control of Cellular Radio Sites". The document has also among others proposed for the adoption of International Commission on Non Ionization Radiation Protection (ICNIRP) limits guidelines as the standards for EMF emission from radiocommunications infrastructures.

SECTION SIX: BASIS OF DECISION

25. The decision made is taking into the consideration of the following principles:

- It is recommended that the adoption of ICNIRP for the EMF emission from radiocommunications infrastructures in Malaysia for reasons:-
 - It is developed taking into consideration reliable scientific research and studies from around the world.
 - It is developed by the ICNIRP with the support and cooperation of the Environmental Health Division of the World Health Organisation.
 - It is widely accepted by many countries around the world as the basis for EMF emission protection.
 - The limits are also already been used locally besides the JTM existing limits.
 - The limits are also proposed by the industry, Ministry of Health, other related governmental agencies, academicians and the consumer association MASU, as stated in the mentioned Draft Malaysian Standard and the MTSFB WIEWG developed document.
- This limit which is widely accepted globally and recognised by WHO would assist the Commission and related agencies in addressing the health concerns of the public on the issue of EMF emissions from radiocommunications infrastructure.
- The mandatory standard would be the basis for actual site measurement and software simulation on EMF emission from radiocommunications infrastructures.

26 Based on the prescribed principles, the Commission has decided to determine the Mandatory Standards for EMF emission from radiocommunications infrastructure in Malaysia as:

The International Commission on Non-Ionization Radiation Protection (ICNIRP) Guidelines

SECTION SEVEN: THE PUBLIC INQUIRY PROCESS

- 27 Section 60 of the CMA provides that a Public Inquiry is to be conducted as and when the Commission thinks fit. The CMA also acknowledges that a Public Inquiry may be conducted in private or public.
- 28 The Commission has decided that the Public Inquiry will be carried out through the publication of this consultation paper.
- 29 The consultation paper will be subject for public inquiry for a period of not less than 45 days, within which the members of the public and other interested parties are invited to make submissions to the Commissions about the matter.
- 30 Pursuant to Section 65, the Commission is thereafter obliged to publish a report of its findings as a result of the Public Inquiry within 30 days of the conclusion of the Public Inquiry. The report will then be registered and made available to the public.
- 31 Finally, within 45 days from the conclusion of the Public Inquiry, the Commission shall determine the standards based on report published.

Time Frame for the Process

- 32 The time frame for the process is as follows:

Action Dates

No.	Action	Date
1	Deliberation on Public Inquiry	27 September, 2010
2	Publication of Public Inquiry via Consultation Paper	30 September, 2010
3	Close of feedback on Public Inquiry (46 days) at 1200 hrs	15 November, 2010
4	Report on Public Inquiry (report to be published within 30 days of the conclusion of the PI)	15 December, 2010
5	Determination of Standard by the Commission	(within 45 days of the conclusion of PI) 15 days after Publish of Report on Public Inquiry

SECTION EIGHT: DETAILED SPECIFICATIONS OF THE MANDATORY STANDARDS ON EMF EMISSION FROM RADIOCOMMUNICATIONS INFRASTRUCTURE

Licenses subject to the Mandatory Standards

33 This Mandatory Standards applies to all Network Facility Providers (NFP) and Network Service Providers (NSP) operating communications infrastructure which emits Electromagnetic Fields for the purpose of communications. These infrastructures shall include base stations, repeaters, towers and broadcast transmitters operating in populated areas.

Exposure Limits

34 The limit for EMF emission at public accessible areas of a radiocommunications infrastructure site shall not be more than the parameters below:

Table 1: Exposure Limits for General Public

Frequency range	E-field strength (Vm^{-1})	H-field strength (Am^{-1})	B-field (μT)	Equivalent plane wave power density S_{eq} (Wm^{-2})
1 MHz - 10 MHz	$87\sqrt{f}$	$0.073/f$	$0.092/f$	-
10 MHz - 400 MHz	28	0.073	0.092	2
400 MHz - 2GHz	$1.375\sqrt{f}$	$0.0037\sqrt{f}$	$0.0046\sqrt{f}$	$f/200$
2 GHz - 300 GHz	61	0.16	0.20	10

Notes:

1. A power density of 10 W/m^2 is equivalent to 1mW/cm^2
2. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla or 12.57 milligauss

35 The limit for EMF emission for occupational workers shall not be more than the parameters below:

Table 2: Exposure Limits for Occupational Workers

Frequency range	E-field strength (V/m)	H-field strength (A/m)	B-field (μT)	Equivalent plane wave power density S_{eq} (W/m^2)
1 MHz - 10 MHz	$610f$	$1.6/f$	$2.0/f$	-
10 MHz - 400 MHz	61	0.16	0.2	10
400 MHz - 2 GHz	$3\sqrt{f}$	$0.008\sqrt{f}$	$0.01\sqrt{f}$	$f/40$
2 GHz - 300 GHz	137	0.36	0.45	50

Notes:

1. A power density of 10 W/m^2 is equivalent to 1mW/cm^2
2. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla or 12.57 milligauss

Prediction Methods for Compliance Achievement

- 36 The compliance procedure shall be achieved using methods mentioned as below using ICNIRP guidelines reference levels as the limit.

Compliance by EIRP calculation

- 37 In the case of single transmitter sites (3 sectors/panel for coverage in all directions will be considered as one transmitter) assessment of the value of $(EIRP/EIRP_{th})$, is to be made at various publicly accessible points in the environment surrounding the Base Transceiver Station (BTS) site under study (on rooftop, on ground, at adjacent buildings etc...). The assessment is based on the formulae:

$$\sum \frac{EIRP_i}{EIRP_{th,i}} \leq 1$$

where $EIRP_i$ is the temporal averaged radiated power of the antenna at a particular frequency i , and $EIRP_{th,i}$ is the EIRP threshold relevant to the particular antenna parameters and accessibility conditions.

- 38 The criteria for listing various accessibility conditions depending on accessibility of various areas in the proximity of the transmitter to people and directivity categories for a set of reference antenna parameter or types are listed in ITU K.52 Annex B.
- 39 The calculation procedure is detailed with the help of examples in ITU K.52 Appendix II and III.
- 40 If the value of $(EIRP/EIRP_{th})$ is found to be less than unity at all points in the environment, the site is declared compliant.

Compliance by software simulation

- 41 For complex sites (2 or more transmitters/antenna) as envisaged in a shared BTS site like rooftop pole or rooftop having multiple towers or multiple antennae mounted on a single tower in urban area that involve reflections from building, fluctuations in earth elevations, etc., require complicated multi-ray algorithms. These more sophisticated methods to predict EMF exposure are needed to refine the zone boundaries obtained using K.52 or for complex situation where the EIRP methods of K.52 may be insufficient.
- 42 For such complex scattering environments, it would require detailed electromagnetic mapping of the area around the BTS using appropriate software based on ray tracing or hybrid ray tracing method. (Refer to section I.2.3: Ray Tracing Method of calculation, Appendix-I of ITU-T Rec. K.61)
- 43 The test results of software simulation are to be presented in the form of the power density, calculated in a plane of interest, expressed as a percentage of ICNIRP general public reference level with logarithmic legend. Various positions 2 meters above the Roof Top Level of the BTS site, Ground level and Roof Top or floors of adjacent buildings in the vicinity of 30 meters radius from the BTS under consideration should be considered.

- 44 Based on these simulated results, it is recommended that EMF measurements are performed in the electromagnetic exposure is found to be more than 30% of the ICNIRP general public reference levels.

Compliance of Shared sites

- 45 Following special cases termed as 'shared sites' and are defined as follows:
- i. A ground base tower site with transmitters from multiple service providers;
 - ii. A roof top, with cluster of transmitters from multiple service providers; and
 - iii. Other infrastructures with transmitters from multiple service providers (examples include advertisement boards, minarets, lamp post etc.).
- 46 For the purpose of compliance with the mandatory standard every shared site shall be assigned an 'RF owner'. The 'RF owner' shall have the onus of proving compliance to the limits and shall also be responsible for implementation of remedial measures if required. The 'RF owner' is also responsible for future compliance assessment of change/addition to the particular site.
- i. In the case of existing shared sites, if the infra site owner is a service provider, the service provider shall be the 'RF owner' of the site. In the case of sites owned by a State Backed Company (SBC) or one owned by a none-service provider (for example a roof top site owned by an individual), then the service provider with the most antennas at the site shall be designated as the 'RF owner'. (If 2 or more service providers have equal number of antennas, the first, top or best privileged service provider shall be 'RF owner')
 - ii. For all new sites, the first service provider shall be the 'RF owner'.
- 47 In case of non compliance, where public access cannot be restricted to exclusion zones (like adjacent building with over exposure), the rectification of non compliance shall be the joint responsibility of the 'RF owner' as well as all the service providers operating antennas at the site. The cause of non compliance can be single service provider or combined effect. Where limits are exceeded the following rules shall apply to rectify the breach:
- i. All service providers have to individually prove their compliance for the non compliance point or area. The single or multiple service providers who fail to prove their individual compliance will be asked to use mitigation techniques either by reducing transmitted power, increasing antenna height, changing antenna direction (azimuth), or if required relocating antenna.
 - ii. In case of all service providers individually proving compliance but where the combined effect of many antennas have caused non compliance, the problem can be rectified with simulation or frequency selective measurements with the following rules being applicable:
 - a. Simulate individual exclusion zones for every antenna and rectify or move the antenna whose exclusion zone is crossing non compliant area(s) or point(s). If no individual antenna's exclusion zone is crossing non compliant area, then remove the antenna whose exclusion zone is nearest to the non compliant area or point. Repeat the process till the site is compliant.

- b. Do frequency selective measurement with worst case extrapolation and if any individual service provider is crossing ICNIRP threshold, rectify or move the offending antenna(s). If no individual antenna or service provider is crossing threshold independently in frequency selective measurement, rectify or move the antenna/service provider with maximum value of power density. Repeat the process till the site is compliant.

48 At a given point or location marginal contribution of EMF radiation from BTS located farther than 100 meters can be ignored for the purpose of the estimation of the overall EMF exposure.

49 All service providers have to individually and jointly comply with the restriction prescribed for EMF exposure limits for general public. Hence responsibility of EMF compliance of shared sites lies with all on site service providers. In the case of overall non-compliance, of shared site, penalty shall be imposed on all service providers on site.

Exclusion Zones Calculation

Single Antennas or Sectoral Antennas at Single Pole

50 The exclusion zone distance for general public and occupational exposure can be calculated using the formulas in below table (Refer to ITU K.70, Appendix-C):

Radio Frequency Range	General Public Exposure	
1 to 10 MHz	$r = 0.10 \sqrt{(eirp \times f)}$	$r = 0.129 \sqrt{(erp \times f)}$
10 to 400 MHz	$r = 0.319 \sqrt{eirp}$	$r = 0.409 \sqrt{erp}$
400 to 2000 MHz	$r = 6.38 \sqrt{(eirp / f)}$	$r = 8.16 \sqrt{(erp / f)}$
2000 to 300000 MHz	$r = 0.143 \sqrt{eirp}$	$r = 0.184 \sqrt{erp}$

Radio Frequency Range	General Occupational Exposure	
1 to 10 MHz	$r = 0.0144 \times f \times \sqrt{eirp}$	$r = 0.0184 \times f \times \sqrt{erp}$
10 to 400 MHz	$r = 0.143 \sqrt{eirp}$	$r = 0.184 \sqrt{erp}$
400 to 2000 MHz	$r = 2.92 \sqrt{(eirp / f)}$	$r = 3.74 \sqrt{(erp / f)}$
2000 to 300000 MHz	$r = 0.0638 \sqrt{eirp}$	$r = 0.0819 \sqrt{erp}$

where:

r is the minimum antenna distance, in meters.

f is the frequency in MHz

erp is the effective radiated power in the direction of the largest antenna gain, in Watts.

$eirp$ is the equivalent isotropic radiated power in the direction of the largest antenna gain, in Watts.

Multiple antennas site

- 51 Analytical formulas are sufficient for calculations of exclusion zone parameters for single antennas or multiple antennas at single location. However, on many sites numerous antennas are installed in close proximity to each other and the calculation of exclusion zones through analytical formulas become impractically conservative or difficult to interpret due to the complexity of the environment. For complex scattering environments, exclusion zones/compliance distances for multiple antennas in close proximity are drawn by software simulation based on Ray tracing.
- 52 The 3D exclusion zones results after electromagnetic mapping is used for prediction of exact exclusion zones distances.

Signages

Exclusion Zones and implementation of Signage

- 53 EMF exposure assessment is made if the intentional emitters are present, and conducted for all locations where people might be exposed to EMF in course of their normal activities. All such exposures to EMF pertain to one of these three zones (See Figure below) :
- i. **Compliance zone:** In the compliance zone, potential exposure to EMF is below the applicable limits for both controlled/occupational exposure and uncontrolled/general public exposure.
 - ii. **Occupational zone:** In the occupational zone, potential exposure to EMF is below the applicable limits for controlled/occupational exposure but exceeds the applicable limits for uncontrolled/general public exposure.
 - iii. **Exceedance zone:** In the exceedance zone, potential exposure to EMF exceeds the applicable limits for both controlled/occupational exposure and uncontrolled/general public exposure.

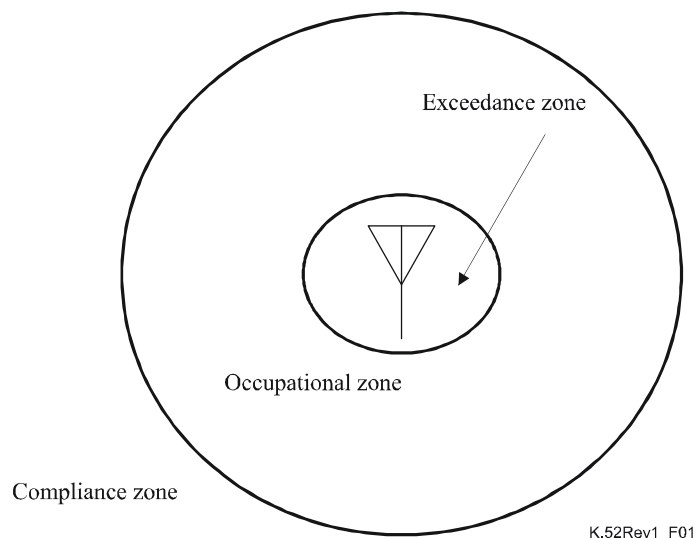


Figure 1: Illustration of exposure zones

Safety Signage

- 54 Notice signage: The service provider will ensure provision of proper signage at the entrance of site (roof top or tower both) the following notice sign board shall be placed by the service provider.



MS2232: Part 2 (Annex C)

- 55 Warning signage for public: The service provider will ensure provision of proper signage on the boundary of occupational exclusion zones by way of fencing/ yellow coloured lines and following sign board.



MS2232: Part 2 (Annex C)

- 56 Warning signage for occupational workers: The service provider will ensure provision of proper signage on the boundary of exceeds exclusion zones or on the radiating structure (tower/pole) by way of fencing/red coloured lines and following sign board.



MS2232: Part 2 (Annex C)

Measurement Techniques

- 57 At any given BTS Location under test, the Electric Field Strength/Power Density measurements have to be undertaken at:
- The positions of expected maximum EMF exposure, based on the site parameters such as antenna direction;
 - Various points & Corners on the roof top (which are publicly accessible) in case of roof top sites;
 - Various points near exclusion zones boundaries shall be selected for measurement;
 - On roof top of adjacent buildings, and at various heights if required; and/or
 - Representative locations on Ground Level surrounding the site.
- 58 At each location, the measurement will be done for a period not less than 6 minutes, and Peak value of Electric Field/Power density will be measured during the above period of 6 minutes using the Broad Band Field Meter. For BTS sites, the highest field values normally occur close to antennas in regions where the fields could vary appreciably on scale of size of human body. Spatial averaging may be required to yield a more accurate result. (Refer ITU K.61 section 6.1).
- 59 The choice of instrument can be made based on characteristics like frequency range, antenna directivity, measured quantity, device selection and there calibration requirements. (Refer ITU K.61 section 7.1) A proper measuring instrument with valid calibration shall be used for measurement.

Broadband Measurement

- 60 The measurements can first be made using a Broadband Test Set. A broadband measurement will give overall value of power density of all frequencies together. It won't tell you the difference between contributions to overall radiation level made by individual sources such as GSM-900 and GSM-1800 mobile phone services. If the total broadband measurement is less than 1% of the ICNIRP general public reference level, the position can be declared compliant.

Frequency Selective Measurement Method for Site Compliance

- 61 If the total broadband measurement is more than 1% of the ICNIRP general public reference levels, frequency selective measurements with extrapolation for maximum traffic must be performed.
- 62 Selective measurement is usually necessary in case of:
- multiple sources with different limits;
 - multiple sources to which different measurement techniques are recommended (e.g., Post-processing for GSM or others); or
 - it is necessary to determine relative contribution of multiple sources.
- 63 Most of the broadband test sets are not sensitive enough to measure the - usually low level - individual sources. So it would be next to impossible to detect the source responsible for overall non-compliance. High sensitivity, frequency selective measuring instrument is therefore essential. The contribution of each BTS shall be combined for determination of compliance to limits prescribed for exposure to the general public.
- 64 If the measured EMF exposure at each operating frequency at publicly accessible areas in the environment surrounding the BTS Site is within limits specified, and also, the RMS (Root Mean Square) of their ratios with respect to the respective limits is less than 1, the site is declared compliant. In case the site is not compliant, the measurements are to be repeated after appropriate mitigation measures have been undertaken.
- 65 In case of sites shared by multiple service providers, frequency selective measurements are also useful to determine the relative contributions from each service provider, without allowing operation of only one service provider at a time during a measurement survey.

Extrapolation procedures for worst case traffic

- 66 In case of TDMA or channelised mobile wireless system, frequency selective measurement with one or all of the control channels, which always transmit at full power can be done and the exposure that would occur if all channels are operating at maximum power can be calculated.
- 67 In case of a GSM System, the measurements will have to be done at all the Broadcast Control Channel (BCCH) Frequencies (for all service providers) used at the site. The contribution of each BTS shall be combined for determination of compliance to limits prescribed for exposure to the general public. Appropriate mitigation Techniques shall be deployed for safety of general public.
- 68 The value of resultant Electric Field for a service provider will be determined as follows:

$$E_{\text{ext}} = E_{\text{BCCH}} \times \sqrt{[1 + (N_c - 1) \times \alpha_{\text{APC}} \times \alpha_{\text{DTX}}]}$$

Where

E_{BCCH} is the value of the measured peak electric field at a location for the BCCH of nth sector.

N_c is the number of carriers in the nth sector.

α APC and α DTX as both statistical and experimental parameters (<1): are attenuation factors due to strategies implemented to reduce the radiated power, i.e. Automatic Power Control (APC) and Discontinuous Transmission (DTX); For worst traffic assumptions both attenuation factors shall be assumed to be 1.

69 A similar method can be used for UMTS/CDMA/WCDMA. At off-peak times, you can measure a frequency block and calculate the overall exposure on the assumption that only the pilot channel was operating. For UMTS other approaches could be followed according to the signal characteristics and attenuation of the C-PICH by the telecom provider. CDMA/UMTS mobile phone systems use spread spectrum technology and employs a constant power control/pilot channel (imbedded in the carrier) which has a fixed power relationship to the maximum allocated power.

70 Instruments are available that enable the constant power reference channel (e.g. Common Pilot Channel (CPICH) in UMTS/WCDMA) to be decoded and measured for its power allowing a calculation of maximum power density to be made. If the measured control channel field strength is E_{CPICH} and the ratio of the maximum allocated power to the power in the control channel is β then the extrapolated field strength is: $E_{max} = (\sqrt{\beta}) E_{CPICH}$.

71 The total extrapolated field for one carrier frequency can then be expressed as the quadratic sum of all (M) detected and extrapolated CPICH channels:

$$E_{total} = \sqrt{\sum_{i=1}^M (E_{max}^2)_i}$$

72 Note that the parameters n , β and M are set by the telecommunications service provider. A typical value for β is 0.1 (10% of total power allocated to CPICH).

73 Whatever the method, the test equipment must have the matching bandwidths, adjustable to individual channels, channel groups, or entire frequency blocks.

Mitigation Techniques

74 It is necessary to control EMF exposure in locations accessible to people where the EMF exceeds human EMF exposure safety limits. An effective way to control exposure where other installations characteristics cannot be changed is to restrict access to areas where the limits are exceeded. Typical examples for restricting or controlling access to public for over exposed areas with proper signage are coloured lines, fencing, lock and key, etc.

75 If public access cannot be controlled or restricted in an over exposed area than the site will be declared 'non-compliant' if it cannot be resolved by engineering controls like reducing the power of antenna, changing direction or tilt, or increasing height or if required shifting the site to other proper location.

Site Record Keeping

- 76 The site radio equipment installation record shall be kept at the site. A copy of the record of the installation may be given to the property owner for reference. The service provider shall make information on the site RF emission database available to the relevant authorities, property owners and the public upon their request.
- 77 The service provider is responsible to update its site records if any changes are made to the RF emission levels and the corresponding exclusion zones due to modifications done on the radio system by the service provider.
- 78 The content of the information on the site RF emission database shall contain the following items:
 - a) Radio equipment layout plan;
 - b) Antenna layout plan;
 - c) Radio equipment technical specification (to include SIRIM certification and AA reference numbers);
 - d) Antenna technical specification;
 - e) RF emission levels showing the exclusion zone relative to the site make up;
 - f) Service provider's contact number contactable 24 hours 7 days a week; and
 - g) Date of last update of Site Record book.

References

1. Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz): CENELEC EN 50383;
2. Draft IEC Determination of RF field strength and SAR in the vicinity of radiocommunication base stations for the purpose of evaluating human exposure : IEC 62232 Ed. 1.0
3. Draft Malaysian Standard Guidelines for Limiting Exposure to Time-varying Electric, Magnetic and electromagnetic Fields – Part 2: For Frequency from 3 KHz to 300 GHz (MS2232: Part 2);
4. Evaluation of human exposure to electromagnetic fields from a stand-alone broadcast transmitter (30 MHz - 40 GHz): IEC 62577 Ed. 1.0;
5. Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz), 1998 published by International Commission on Non-Ionizing Radiation Protection (ICNIRP);
6. Guidance on complying with limits for human exposure to electromagnetic fields: ITU-T Recommendation K.52(2004);
7. Guidance to measurement and numerical prediction of electromagnetic fields for compliance with human exposure limits for telecommunication installations: ITU-T Recommendation K.61 (2003);
8. Malaysian Communications and Multimedia Act 1998 (Act 588);
9. Mitigation techniques to limit human exposure to EMFs in the vicinity of radiocommunication stations: ITU-T Recommendation K.70(2007);
10. Regulatory Framework on the Sharing of Telecommunications Infrastructure (ISSN 15511 - 2829) – Reg-R002 published by Jabatan Telekom Malaysia (JTM); and
11. Technical Standard on RF Emission Control of Cellular Radio Sites (MTSFB 004 : 2005 Revision 1) published by MTSFB.

SECTION NINE: IMPLEMENTATION

79 In Prediction Methods for Compliance Achievement, Service providers subjected to the mandatory standards are required to submit:

- the simulation of EMF emission from **new radiocommunication installation** to SKMM 9 months after the commence of the Mandatory Standard on EMF Emission from Radiocommunications Infrastructure; and
- the simulation of EMF emission from **all radiocommunication installation** to SKMM 18 months after the commence of the Mandatory Standard on EMF Emission from Radiocommunications Infrastructure.

APPENDIX: MINISTERIAL DIRECTION No. 7 of 2010



منتري قنراخن كومونيگاسي دان كبودايان مليسيا

MENTERI PENERANGAN KOMUNIKASI DAN KEBUDAYAAN MALAYSIA
MINISTER OF INFORMATION COMMUNICATIONS AND CULTURE MALAYSIA

COMMUNICATIONS AND MULTIMEDIA ACT 1998

MINISTERIAL DIRECTION ON THE STANDARD FOR ELECTROMAGNETIC FIELD EMISSION FROM RADIOCOMMUNICATIONS INFRASTRUCTURE

DIRECTION NO. **7** of 2010

In exercise of the powers conferred by sections 7 and 104(3) of the Communications and Multimedia Act 1998 [Act 588], the Minister issues the following Direction to the Commission:

Citation and commencement

1. This Direction may be cited as the **Ministerial Direction on the Standard for Electromagnetic Field (EMF) Emission from Radiocommunications Infrastructure, Direction No. 7 of 2010** and shall come into operation on the date of registration of this direction.

Interpretation

2. Any term used in this Direction shall, unless the context otherwise requires, have the same meaning as in the Act or the Regulations made under it.

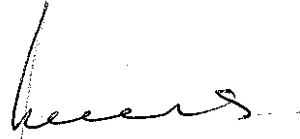
Electromagnetic Field (EMF) Emission from Radiocommunications Infrastructure

3. The Commission shall determine a mandatory standard for the electromagnetic field (EMF) emission from radiocommunications infrastructure.

4. The mandatory standard for the electromagnetic field (EMF) emission from radiocommunications infrastructure may comply with any of the requirements of internationally recognised standards for the electromagnetic field emission from radiocommunications infrastructure.

5. The matters which the Commission may address in the Mandatory Standard are not limited to the matters referred to in paragraph 4 above.

Made: 27 April 2010
[KPKK (S) 600-1/2(7)]



DATO' SERI UTAMA DR. RAIS YATIM
Minister of Information, Communication and Culture