



Recommendation ITU-R SM.1879-2
(08/2013)

**The impact of power line high data rate
telecommunication systems on
radiocommunication systems
below 470 MHz**

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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 SM.1879-2*

The impact of power line high data rate telecommunication systems on radiocommunication systems below 470 MHz

(Question ITU-R 221/1)

(01/2011-09/2011-2013)

Scope

This Recommendation addresses the impact of power line telecommunication (PLT) systems on radiocommunication services and provides as guidance a summary of the protection criteria for radiocommunication services below 470 MHz with regard to interference by an aggregate of PLT systems including examples of some national regulations.

The ITU Radiocommunication Assembly,

considering

- a) that there is increasing demand for broadband home networking and broadband connection to the Internet throughout the world;
- b) that power line telecommunication (PLT) systems may provide a means of connectivity by the introduction of radio-frequency (RF) signals onto the electrical power supply network;
- c) that although these systems have no frequency allocation in the Radio Regulations as they are not a radiocommunication service, RF energy will leak and radiate;
- d) that such systems may cause interference to the radiocommunication services operating up to 470 MHz and beyond, which provide an extensive range of scientific, public and government services;
- e) that some radiocommunication services have established criteria to assess the impact of interference from extraneous sources of RF energy that produce unwanted radiation in the frequency bands allocated to those services;
- f) that use of the radio spectrum requires definition of the maximum allowable error performance and availability degradations to radiocommunication systems caused by various sources of interference,

noting

- a) that detailed studies relevant to the impact of devices using PLT technology on radiocommunication services are documented in Reports ITU-R SM.2158 and ITU-R SM.2212;
- b) that Recommendation ITU-R P.372 describes levels of some types of radio noise;
- c) that intrinsic receiver noise and external radio noise, including atmospheric, man-made and galactic noise, determine how well radiocommunication services function;
- d) that radiation from power lines and PLT systems increase the level of man-made radio noise, causing an increase in the external radio noise environment;

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

- e) that the increase in external radio noise results in an increase in the minimum usable field strength and degradation of the quality, reliability, or both, of the fixed, mobile and broadcasting services;
- f) that the reception environment of the radio astronomy service requires protection from interference or extraneous sources of noise, or both;
- g) that some PLT systems incorporate adaptive power control and notching techniques designed to avoid frequencies used by certain radiocommunication services;
- h) that Recommendation ITU-T G.9964 (2011) defines a spectrum mask for PLT systems to use the frequencies up to 80 MHz,

recognizing

- a) the obligations on administrations to ensure the continued availability of the RF spectrum and guard against harmful interference;
- b) that protection of radiocommunication services from radiated disturbances from telecommunication networks is specifically called for in No. 15.12 of the Radio Regulations,

recommends

- 1 that administrations should take all necessary possible precautions to implement limits, measures and procedures to ensure that radiocommunication services are protected from interference caused by power line telecommunication systems;
- 2 that the information contained in this Recommendation should be taken into account as guidance by administrations when considering their own national rules and regulations regarding the use of PLT.

Annex 1

Protection criteria of radiocommunication services operating below 470 MHz

This Annex provides a summary of the protection criteria of radiocommunication services operating below 470 MHz with regard to interference by an aggregate of power line telecommunication systems. Details on interference considerations below 80 MHz are contained in Report ITU-R SM.2158 on the Impact of power line telecommunication systems on radiocommunication systems operating in the LF, MF, HF and VHF bands below 80 MHz (references are given in the first column of Table 1) and in Report ITU-R SM.2212 on the impact of PLT systems on radiocommunication systems operating in the VHF and UHF bands between 80 and 470 MHz (references are given in the first column of Table 2).

Reports ITU-R SM.2158 and ITU-R SM.2212 contain detailed studies and measurement tests as well as studies on mitigation techniques considered within ITU-R. It is to be noted that assumptions and measurement conditions fundamentally affect the results of these studies.

TABLE 1
Summary table of protection criteria for radiocommunication
services operating below 80 MHz*

Part of Report ITU-R SM.2158	Service/application	(Approximate) frequency bands (MHz)	Protection criteria (at the receiving antenna unless otherwise noted)
3.1	Broadcasting	2 (and below), 3, 4, 5, 6, 7, 9, 12, 13, 15, 17, 19, 21, 26 47-72 for above 76 see Table 2	Increase in the total noise floor due to PLT less than 0.5 dB Increase in the total receiving system noise power due to PLT not to exceed 1% (see Recommendation ITU-R BS./BT.1895). This is equivalent to about 0.05 dB increase in the total noise floor
3.2	Amateur	1.8, 3.5, 5, 7, 10, 14, 18, 21, 24, 28, 50, 70	Increase in the total noise floor due to PLT less than 0.5 dB
3.3	Aeronautical mobile	2, 3, 4, 5, 6, 8, 10, 11, 13, 15, 18, 22, 23	Increase in the total noise floor due to PLT less than 0.5 dB
3.3	Aeronautical radionavigation	0.19-0.535 75	Aggregate level of -107 dBm/Hz at the aircraft antenna -96 dBm/Hz (airborne)
3.6	Radiolocation	5, 8, 9.2, 12, 13, 16, 24.5, 25, 42	-147 dBm/500 Hz at a receiving antenna in the main beam of the antenna Recommendation ITU-R M.1874
3.8	Radio astronomy	13.36-13.41 25.55-25.67 37.5-38.25 73.0-74.6	-55.2 dB(μV/m)/0.05 MHz -53.2 dB(μV/m)/0.12 MHz -52.5 dB(μV/m)/0.75 MHz -50.2 dB(μV/m)/1.6 MHz at a receiving antenna location Report ITU-R RA.2131 and Recommendation ITU-R RA.769

* Where services or frequency bands are not specified in Table 1, an increase in the total noise floor due to PLT of less than 0.5 dB should be taken as the protection criteria.

TABLE 2

**Summary table of protection criteria for radiocommunication services/applications
operating between about 80 MHz and 470 MHz****

Part of Report ITU-R SM.2212	Service/application	(Approximate) frequency bands (MHz)	Protection criteria (at the receiving antenna)
3.1	Broadcasting	76-108, 174-240	Increase in the total receiving system noise power due to PLT not to exceed 1% (see Recommendation ITU-R BS./BT.1895). This is equivalent to about 0.05 dB increase in the total noise floor
3.2	Amateur and amateur-satellite	144-148 220-225 (Region 2 only) 420-450	Strength from PLT and its harmonics not to exceed 6 dB(μ V/m) in 120 kHz at 3 m
3.3	Aeronautical mobile (R) Aeronautical mobile (OR)	108-117.975 117.975-137 132-137 138-143.6	-165 dBm/Hz (airborne) -177 dBm/Hz (ground) -170 dBm/Hz (airborne) -181 dBm/Hz (ground) See Note** See Note**
3.4	Maritime mobile	156.4875-156.5625 156.7625-156.8375 161.9625-161.9875 162.0125-162.0375 216-220 456-459 460-470	See Note**
3.5	Radiodetermination: – Aeronautical radionavigation – Radiolocation	– 108-112 112-117.975 200-225 223-225 328.6-335.4 420-460 138-144 216-220 420-450	– -177 dBm/Hz (airborne) -171 dBm/Hz (airborne) See Note** See Note** -168 dBm/Hz (airborne) See Note** See Note** See Note** $I/N = -6$ dB (see Recommendation ITU-R M.1462)
3.7	Radio astronomy	150.05-153 322-328.6 406.1-410	-48.2 dB(μ V/m)/2.95 MHz -43.2 dB(μ V/m)/6.6 MHz (cont.) -58.2 dB(μ V/m)/10 kHz (line) -43.2 dB(μ V/m)/3.9 MHz at a receiving antenna location Report ITU-R RA.2131 and Recommendation ITU-R RA.769

TABLE 2 (*end*)

Part of Report ITU-R SM.2212	Service/application	(Approximate) frequency bands (MHz)	Protection criteria (at the receiving antenna)
3.8	Mobile-satellite	137-138 148-150.05 161.9625-161.9875 162.0125-162.0375 235-322 312-315 335.4-399.9 387-390 399.9-400.05 400.15-401 406-406.1	$\Delta T/T$ criterion of 1% (to be used in analogy to Recommendation ITU-R S.1432) See Recommendation ITU-R M.1478 NOTE – Special protection required for Cospas-Sarsat (406-406.1 MHz, see Nos. 5.266 and 5.267 of the Radio Regulations)
3.9	Radionavigation-satellite	149-9-150.05 399.9-400.05	$\Delta T/T$ criterion of 1% (to be used in analogy to Recommendation ITU-R S.1432)
3.9bis	Meteorological aids	401.15-406	Interference level at receiver not to exceed -187.8 dBm/Hz

** Where services or frequency bands are not specified in Table 2, an increase in the total noise floor due to PLT of less than 0.05 dB should be taken as the protection criteria.

Annex 2

Examples of national regulations

Some administrations have adopted or are in the process of adopting national regulations including technical and operational restrictions that may have been derived using different parameters and/or methodologies, taking into account, in particular, specific national deployment scenarios and technical characteristics, as well as other considerations. Examples can be found in the following Appendices to this Annex. These Appendices are provided for information.

Appendix 1 to Annex 2

United States of America

Regulation of RF emissions from power line communication systems in the United States of America

1 Introduction

In October 2004, the United States of America adopted new rules for access broadband over power line (access BPL) systems, a new type of carrier current technology that provides access to high speed broadband services using electric utility companies' power lines. [1], [2]

These rules recognized the need to ensure that RF energy from BPL signals on power lines does not cause harmful interference to licensed radio services.

2 Definition of BPL

The following definitions of BPL were adopted:

Access BPL: A carrier current system operating as an unintentional radiator using frequencies between 1 705 kHz and 80 MHz on medium voltage (MV) or low voltage (LV) lines to provide broadband communications and located on the supply side of the utility service's points of interconnection with customer premises.

MV wires carry between 1 000 and 40 000 V from a substation and may be overhead or underground; LV wires carry "low voltage" e.g. 240/120 V from a distribution transformer to a customer premise.

In Home BPL: A carrier current system operating as an unintentional radiator using frequencies between 1 705 kHz and 80 MHz on LV lines that are not owned, operated or controlled by an electric service provider. This includes closed networks within a customer premise and includes customer premise networks forming connections with access BPL systems.

3 Emission limits

In the United States of America, a single set of frequency-dependent radiated emission limits below 30 MHz. In the range 1 705 kHz to 30 MHz, the limit is 30 $\mu\text{V/m}$ at a measurement distance of 30 m.

Above 30 MHz, there is a distinction between Class A radiated emission limits (intended to protect commercial/industrial environments) and Class B radiated emission limits (intended to protect residential environments). Thus, for example, in the band 30-88 MHz, the Class A limit is 90 $\mu\text{V/m}$ at a measurement distance of 10 m; the Class B limit is 100 $\mu\text{V/m}$ at a distance of 3 m. Class A provides for ~ 10 dB (or $\sim 10 \times$) more power than Class B.

Those existing radiated emission limits apply to BPL below 30 MHz, and that above 30 MHz, Class A radiated emission limits should apply on MV wires and Class B radiated emissions rules apply on LV wires.

There are no conducted emission limits for BPL (including no limits in AM broadcast bands).

4 Special frequency protections

Certain frequency bands were determined to require special interference protection and a variety of frequency band exclusions, geographical exclusion zones and consultation requirements were adopted.

4.1 Frequency band exclusions

On overhead MV lines access BPL systems may not use (“place carrier frequencies in”) certain designated bands between 2 MHz and 22 MHz as well as 74.8-75.2 MHz. These are bands allocated to aeronautical mobile (R) and radionavigation services that are used to provide aeronautical safety of life services. This requirement does not apply to LV wires, nor to underground wires (LV or MV). A total of 1 731 kHz falls within the excluded bands, or 2% of the spectrum within the 1.7-80 MHz band.

4.2 Geographical exclusion zones

The rules prohibit access BPL operators from using the frequency band 2.1735-2.1905 MHz (global maritime distress band) within 1 km of about 110 designated United States Coast Guard and maritime radio stations. They also prohibit access BPL from using 73.0-74.6 MHz (VLBA radio astronomy frequencies) within 65 km of one radio astronomy observatory (this limit applies only to overhead MV) or within 47 km of the RA observatory (this limit applies to underground MV and overhead LV lines).

4.3 Consultation area requirements

Access BPL operators are required to give 30 day’s advance notice of all installations in the following bands and locations as follows:

- on 1.7-30 MHz, if within 4 km of monitoring stations and about 60 aeronautical and land HF radio stations;
- on 1.7-80 MHz, if within 4 km of about 16 radio astronomy sites;
- on 1.7-80 MHz, if within 1 km of United States Department of Commerce facilities in Boulder, Colorado;
- on 1.7-30 MHz, if within 37 km of three specified radar receive sites.

4.4 Consultation area notice requirements

For planned operations within the consultation areas defined above, access BPL operators must supply the following information:

1. name of the access BPL operator;
2. frequencies of the access BPL operation;
3. postal zip codes served by the access BPL operation;
4. the manufacturer of and type of access BPL equipment being deployed (i.e. FCC ID for certified equipment and make and model for verified equipment);
5. point of contact information (both telephone and e-mail address);
6. the proposed or actual date of initiation of access BPL operation.

Notice must be provided to designated consultation area contacts 30 days prior to initiation of any access BPL deployment.

4.5 Public safety licensee notice requirements

Access BPL systems are required to notify the public safety agencies in their local areas, e.g. state and local police, fire and emergency medical agencies.

The requirements are the same as for consultation areas, including subsequent notice of the activation of any major extensions of the BPL system or any changes in its operating characteristics, such as transmitting frequencies. Local public safety agencies already have designated frequency coordinators for their mobile communication systems, and these are the persons to be notified.

5 Interference mitigation

United States regulations do not rely on emission limits alone to protect against interference. Interference mitigation techniques are key elements of the new BPL policies. These techniques include complaint procedures, adaptive interference techniques and database requirements.

5.1 Interference complaint procedures

Procedures already existed for responding to interference complaints, and they remain unchanged.

The complainant must first take reasonable steps to confirm that interference exists, and is caused by a BPL system. The BPL operator must be notified, and he must then investigate within a reasonable time. The BPL operator has 24 h to investigate complaints from public safety licensees. If the complaint cannot be resolved the licensee can then file a complaint with the appropriate national administration agency.

5.2 Adaptive interference techniques

System operators are not required to use specific mitigation techniques but rather are subject to a more general requirement that their systems not cause interference. Interference mitigation techniques may include notching, frequency shifting or power reduction.

Within 18 months, new access BPL equipment must be able to implement adaptive interference mitigation techniques. If notching is used, notches will need to be at least 20 dB below applicable emission limits, below 30 MHz. Above 30 MHz, notches will need to be at least 10 dB below applicable emissions limits.

Equipment will need a “last resort” remote-controllable RF transmission shut-down feature for deactivation of any unit found to cause harmful interference.

Equipment will also need to comply with applicable emission limits upon power-up following a fault condition, or during a start-up operation after a shut-off procedure.

5.3 Access BPL database requirements

The BPL industry was required to establish a publicly accessible access BPL database within six months of the effective date of the new rules. A database manager has been selected to operate the database.

The database contains the same data as required for consultation areas. BPL operators must notify the database manager within 30 days prior to initiation of service and again upon commencement of service. The database must be updated within three business days of notice from BPL operator. The database manager has no role in any interference complaint/investigation. The database is to be staffed during normal business hours.