Received: 8 September 2009

Source: Annex 2 to Document 1A/135

Reference: 1A/158, 5C/158, 6A/176 and 1A/170

Document 1A/177-E
9 September 2009
English only

North American Broadcasters Association (NABA)

ADDITIONS TO THE PRELIMINARY DRAFT NEW REPORT

Impact of power line telecommunication systems on radiocommunication systems operating in the LF, MF, HF and VHF bands below 80 MHz

The North American Broadcasters Association (NABA, *www.nabanet.com*) is an association of broadcasters in Canada, Mexico, and the United States, and the NABA Technical Committee is its standing technical body. NABA is thus in a position to present the technical viewpoints of the most authoritative association of professional North American Broadcasters in television and sound programme production, post-production, and distribution for terrestrial, satellite, and cable broadcasting.

NABA is a Sector Member of ITU-R and a long-time participant in ITU-R Study Groups, Working Parties, Task Groups, Rapporteur Groups, etc. NABA numbers among its members Chairmen, Vice-Chairmen and members of the above groups. NABA also participates widely in the ITU work on radio, television and multimedia services and has a strong interest in spectrum management studies including spectrum engineering techniques, spectrum management fundamentals, spectrum monitoring, and inter-service sharing, interference and compatibility.

NABA notes that Working Party 1A has developed a preliminary draft new Report on the “Impact of Power Line Telecommunication (PLT) systems on radiocommunication systems operating in the LF, MF, HF and VHF bands below 80 MHz” (Annex 2 to Document 1A/135). A Correspondence Group, formed by WP 1A at its February – March 2009 meeting, has editorially improved the Report which is now found in Document 1A/158. NABA also notes that the report contains an example, provided by Working Party 5C, of the cumulative HF skywave interference to the Broadcasting Service. The example is found in Annex 2 of Document 1A/158, Section A2.4. WP 1A, in its liaison statement back to WP 5C (Document 5C/158), questioned the parameters upon which the calculations were based. These parameters include: 1) the use of “quiet rural” noise level from Recommendation ITU-R P.392; 2) the duty cycle for the PLT modem; and 3) the market penetration of PLT modems. NABA has analyzed the input parameters to the PLT tool and the above concerns of WP 1A.

NABA notes that the calculation in the Report addresses the potential for interference into HF receivers located at Winnipeg in the Province of Manitoba, Canada. NABA also notes that Manitoba is a rural area of Canada with a population density less than two persons per km^2. In addition, a NABA member, the CBC Radio-Canada, utilizes many of the frequencies allocated to the Broadcasting Service in the bands below 80 MHz. Thus, NABA agrees that the use of the "quiet rural" noise level from Recommendation ITU-R P.372 is appropriate in the calculation.

An extensive set of field test measurements has been completed and is provided in Annex 1. These tests measured the RF emissions outside of residential dwellings containing various in-house PLT devices. These tests were made under the direction of one of the most world-renowned laboratories for radiocommunications, the Canadian Communications Research Centre (CRC).[1]

The results of these tests by the CRC concerning PLT emissions provide a reference for the RF levels that can be expected when PLT devices are operated using in-house electric wiring. The test results show that over the frequencies allocated to the Broadcasting Service from 7 300 kHz to 12 100 kHz, the median e.i.r.p. per PLT modem is -80.4 dBm/Hz. NABA also notes that the maximum e.i.r.p. was 20 dB higher at -59.5 dB/Hz. Therefore, the value of -80 dBm/Hz used in the example calculation is consistent with the median levels in the NABA findings but does not represent the potential for actual higher peak levels.

The example calculation used a PLT modem duty cycle of 30 percent. The CRC tests found that the in-house modem would continue to operate and emit RF signals even when no data was being transferred. Some modems may be operating at a 50 percent duty cycle (100 percent per modem pair). Consequently, the example calculation provided a conservative estimate at 30 percent.

The example calculation used a market penetration of 0.05 modems per capita. NABA notes that Japan provided market penetration values to Working Party 6A in Document 6A/176. The market penetration (PLT systems per household) ranged from 20 percent to 35 percent with an average of 30 percent. At an average penetration of 30 percent with two modems per system (in-house PLT modems operating in pairs) and a population density of four people per household, the market penetration is 0.15 modem per capita. Since this value is three times higher than the market penetration used in the Report, the example calculation provides a conservative estimate of the PLT noise that could be experienced in Canada from sources beyond its borders.

NABA concludes that the parameters used in the example calculation are reasonable and that the results correctly indicate that the PLT signal will exceed the median "quiet rural" man-made noise by at least more than 6 dB as shown in Figure A2-13 of Document 1A/158. NABA proposes that these findings be included in Annex 2 to Document 1A/158 as shown below in Annex 2.

---

[1] The CRC is the Canadian Government's primary laboratory for research and development (R&D) in advanced telecommunications, with a critical mass and expertise in four major platforms that form the basic transport mechanism for information delivery around the world: wireless, broadcasting, satellite and fibre optics. The CRC has been committed to applied and basic research in communications and related technologies since the late 1940s.

Over the last 50 years many scientific and engineering milestones have been achieved at the CRC, contributing advancements in wireless and satellite communications and broadcast technologies. An institute of Industry Canada since 1993, the CRC has maintained its tradition of excellence in managing technical issues concerning the radio spectrum, the deployment of wireless communications and broadcast services, and the development of new technologies and knowledge for exploitation by Canadian industry. CRC is Canada's main research centre for radiocommunications technology R&D. The CRC mission is to be the centre of excellence for communications R&D, ensuring an independent source of advice for public policy purposes.

NABA also notes that the National Telecommunications and Information Administration (NTIA) has reported on an extensive analysis of emissions arising from access-PLT systems and the resulting potential for interference due to skywave propagation (see Annex 3). Unfortunately, NTIA made the erroneous assumption that the “roll-off factor” would be 40 dB per decade below 30 MHz. This assumption is a point of contention as discussed in Document 1A/170. Furthermore, the field test results from the CRC measurements in Annex 1 clearly demonstrate that the actual factor was 18.2 dB per decade. Consequently, the radiated emission levels assumed by NTIA are significantly lower than actual. In spite of this error, the results presented in the NTIA report show that the PLT emissions will exceed the noise floor of a receiver by as much as 40 dB. The following Figures taken directly from the NTIA report clearly illustrate the impact that PLT systems will have on the noise floor of a radio receiver.

Quote

4.3.1 Receiver Noise Floor Increase Along the Power Line

Results were considered from simulations of potential interference to a land mobile receiver on roads next to the simulated power line for all three BPL device injection points across both narrowband and wideband systems, and across frequencies in the 2 to 30 MHz range. The results are presented in terms of the percentage of points along the BPL energized power line that increased the receiver noise floor by various levels.

4.3.1.1 Receiver noise floor increase relative to the injection point

The results shown in Figures 4-4 and 4-5 illustrate the percentage of simulated points along the modeled power line that result in a given level of noise floor increase for all simulation frequencies shown in Table 4-1 for narrowband and wideband BPL signals, respectively. These figures show that the percentage of locations resulting in a given increase in the noise floor varied somewhat by injection point. …

FIGURE 4-4

Increase in receiver noise floor [(I+N)/N] as a function of the percentage of measurement points around the power line for narrowband BPL signals

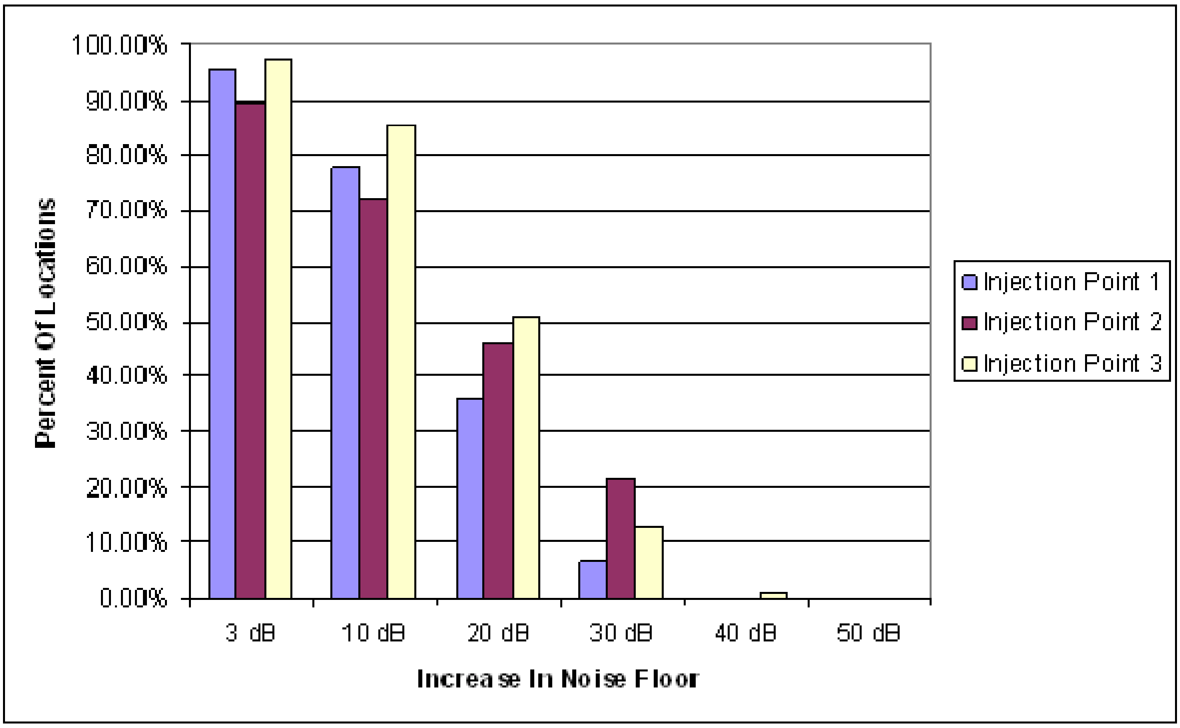
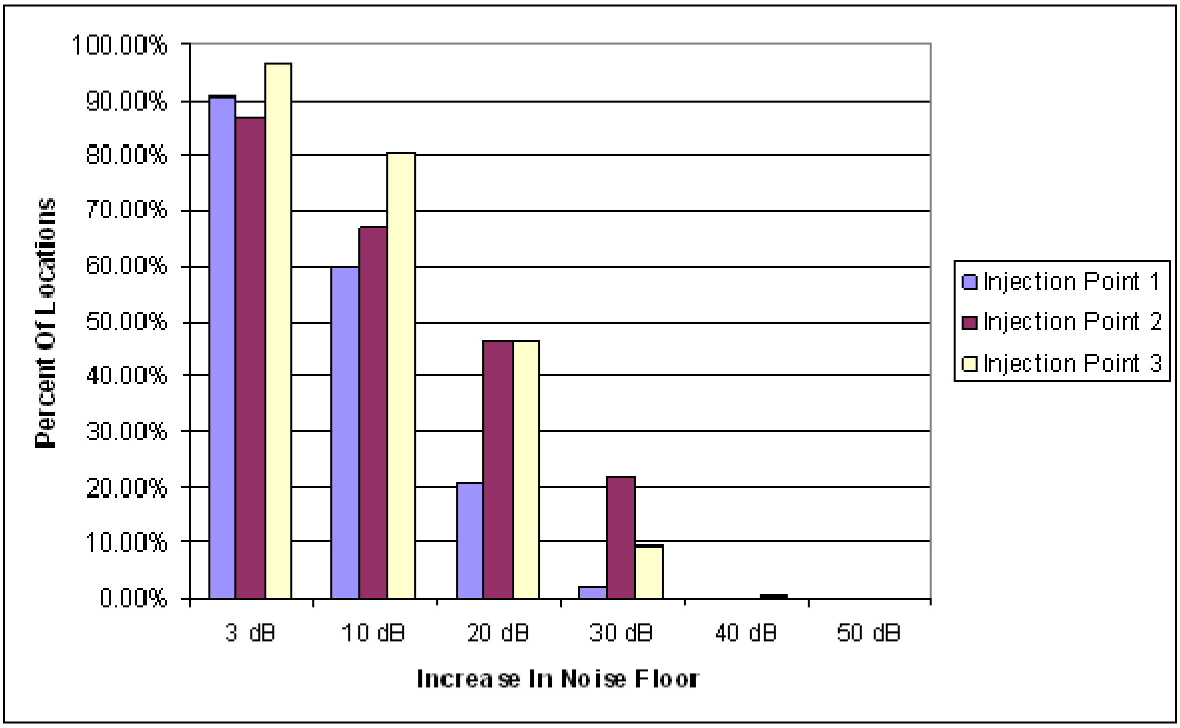


FIGURE 4-5

Increase in receiver noise floor [(I+N)/N] as a function of the percentage of measurement points around the power line for wideband BPL signals



Unquote

Conclusions

– There is sufficient evidence that emissions from PLT systems will adversely raise the noise floor within the frequency bands allocated to the Broadcasting Service.

– The results of an analysis by the NTIA in the United States show that PLT emissions will exceed the noise floor of a receiver by as much as 40 dB.

– The potential exists for skywave propagation of PLT emissions to cause harmful interference to broadcast receivers beyond national borders.

– The assumptions in the sample skywave calculation were conservative and reasonable.

 • PLT e.i.r.p. emission level of -80 dBm/Hz

 • Modem duty cycle of 30 percent

 • Modem penetration rate of 0.05 modem per capita

– The cumulative PLT signal will exceed the median "quiet rural" man-made noise level by more than 6 dB.

Annex 1

"Measurements of EM radiation from in-house Power Line Telecommunication (PLT) devices operating in a residential environment – Field Test Report", Communications Research Centre (Canada), 24 March 2009

CRC PLT Test Report

Annex 2

The following edits are proposed for Annex 2, Section A2.4.5 of Document 1A/158:

A2.4.5 Calculation of HF radio noise from PLT systems

In this section an example where the cumulative PLT tool is used to evaluate the interference potential at a hypothetical receiver location. The location was selected on the basis that it should be a city for easy reference. The input parameters are given as an example in section A2.1.

A2.4.5.1 Example receiver location in Winnipeg, Canada

In this example, a hypothetical receiver location at Winnipeg Canada (49.53N and 97.09W) was used. NABA notes that Winnipeg located in the Province of Manitoba is a rural area of Canada with a population density less than two persons per km^2 and that the use of the "quiet rural" noise level from Recommendation ITU-R P.372 is appropriate in the calculation. In addition, it is noted that CBC Radio-Canada, utilizes many of the frequencies allocated to the Broadcasting Service in the HF bands below 80 MHz.

The analysis is performed under the following assumptions:

Average e.i.r.p. per PLT installation is P_{TX} = −80 dBm/Hz (e.g. −50 dBm/Hz HomePlug modems and equivalent antenna gain from wiring of−30 dBi). NABA notes that the results of field measurments by the Communications Research Centre (Canada) concerning PLT emissions provide a reference for the RF levels that can be expected when PLT devices are operated on the in-house electric wiring. The test results show that over the frequencies allocated to the Broadcasting Service from 7 300 kHz to 12 100 kHz, the median e.i.r.p. per PLT modem is -80.4 dBm/Hz. NABA also notes that the maximum e.i.r.p. was 20 dB higher at -59.5 dB/Hz. Therefore, the value of -80 dBm/Hz used in this example calculation is consistent with the median levels in the NABA findings but may not represent the potential for higher peak levels.

Market penetration is η_{PEN} = 0.05 PLT modems per capita. NABA notes that Japan provided market penetration values to Working Party 6A in Document 6A/176. The market penetration (PLT systems per household) ranged from 20 percent to 35 percent with an average of 30 percent. At an average penetration of 30 percent with two modems per system (in-house PLT modems operating in pairs) and a population density of four people per household, the market penetration is 0.15 modem per capita. Since this value is three times higher than the market penetration used in the Report, the example calculation provides a conservative estimate of the PLT noise that could be experienced in Canada from sources beyond its borders.

Duty cycle of each modem is η_{USAGE} = 0.3. The NABA tests found that the in-house modem would continue to operate and emit RF signal even no data was being transferred. Some modems may be operating at a 50 percent duty cycle (100 percent per modem pair). Consequently, the example calculation provided a conservative estimate at 30 percent.

The transmitter location grid used extends from –120 to –50 degrees longitude and –15 to 55 degrees latitude, and PLT modems outside this area are disregarded. No knowledge of receiver antenna characteristics is assumed, hence an isotropic receiver antenna is used in the analysis.

A population data prediction from 2010 is used.

Cumulative PLT tool execution within MATLAB is shown below:

```
-------------------------------------------------------------------------
Cumulative PLT Tool
Roald Otnes, Norwegian Defence Research Establishment (FFI), October 2006
NATO RTO IST-050/RTG-022 on HF Interference, Procedures and Tools
-------------------------------------------------------------------------
This program will estimate the cumulative effects from PLT,
based on ICEPAC sky wave path loss predictions and population data
from "Gridded population of the world" (gpwv3) database

The program has been tested on MATLAB versions 6.5 and 7.1,
and with ICEPAC version 05.0119WW

Please run ICEAREA INVERSE one time as normal to set up all parameters, before
running this program to sweep some of the parameters.
ICEAREA INVERSE will then be called (batch mode) for all chosen parameter combinations.

Use of text-based interface:
-----------------------------
Enter will provide default parameters.
Use MATLAB syntax for the parameters to be swept.
Be aware that using default values for all swept parameters will take very long time to run.
Ctrl-C in MATLAB window to abort.
Do NOT close down the ICEPAC window that pops up; that will make Windows confused.
ICEAREA INVERSE batch calculation: (C)ompute new or (L)oad previous? c
ICEPAC installation directory [c:\itshfbc\]:
Select the input file created from the initial setup run  (eg.WINNIPEG.ice)
ICEPACfile =
WINNIPEG
Swept months [2:2:12]: 2:2:12
Swept UTCs [0:4:20]: 0:4:20
Swept SSNs [50 100 200]: [50 100 200]
Swept Qs [0 5]: [0 5]
Swept freqs [2 4 8 16 24]: [2 4 8 12 16 20 24]
Total number of ICEAREA INVERSE runs planned: 1 512
Save ICEAREA INVERSE results for later use (disk space required: 20 267.1 MB). [Y]/N? Y
Output directory [.\ICEPAC\]:
Select population file (eg. glp10ag15.bil  for 2010 data)
----------------------------------
e.i.r.p. per PLT modem (dBm/Hz) [–80]:
Market penetration (PLT modems per capita) [0.05]:
Duty cycle (fraction of time each PLT modem is transmitting) [0.3]:
Market factor (penetration * duty cycle): –18.2 dB
e.i.r.p. per capita: –98.2 dBm/Hz
```

Results will be saved to file .\icepac\WINNIPEG_summary.txt
Modifying ICEAREA INVERSE input files
copy c:\itshfbc\run\temp1.txt c:\itshfbc\run\iceareax.da1
1 file(s) copied.
copy c:\itshfbc\run\temp2.txt c:\itshfbc\area_inv\default\WINNIPEG.ice
1 file(s) copied.
c:\itshfbc\bin_win\icepacw.exe c:\itshfbc\ INV CALC default\WINNIPEG.ice
copy c:\itshfbc\area_inv\default\WINNIPEG.ig1 .\icepac\WINNIPEG_00001.ig1
1 file(s) copied.

Integral of population / loss over entire area: –31.4 dB
Received PLT noise: –129.7 dBm/Hz

Atmospheric noise lower limit: –159.7 dBm/Hz
Man-made, rural: –115.0 dBm/Hz
Man-made, quiet rural: –129.0 dBm/Hz
Absolute protection requirement: –139.1 dBm/Hz
----
and so on for 1 511 other parameter combinations.

The MATLAB command window presented above starts with documentation and usage explanation followed by user input parameters and brief reports from individual ICEPAC runs. The first of 1 512 runs (for 6*6*3*2*7 parameter combinations) is shown above, The 1 512 ICEPAC runs with the 281 × 281 grid used in this example took a total of about 22 hours on a standard desktop computer circa 2006, and filled 20 GB of disk space when the detailed ICEPAC results were saved (optional) for later use.

As the input value “e.i.r.p. per PLT modem” is bandwidth normalized and given in units of dBm/Hz, the resulting estimate of the cumulative PLT signal is also given in units of dBm/Hz. The results are saved to a tab-separated text file, one line per ICEPAC run, similar to the WINNIPEG example given in section 5.1. (NOTE – In the case of discarded ICEPAC runs, the number in the “PLT noise” column will be replaced by “NaN”):

WINNIPEG [ISOTROPE], 2010 population data, e.i.r.p. = –98.2 dBm/Hz per capita

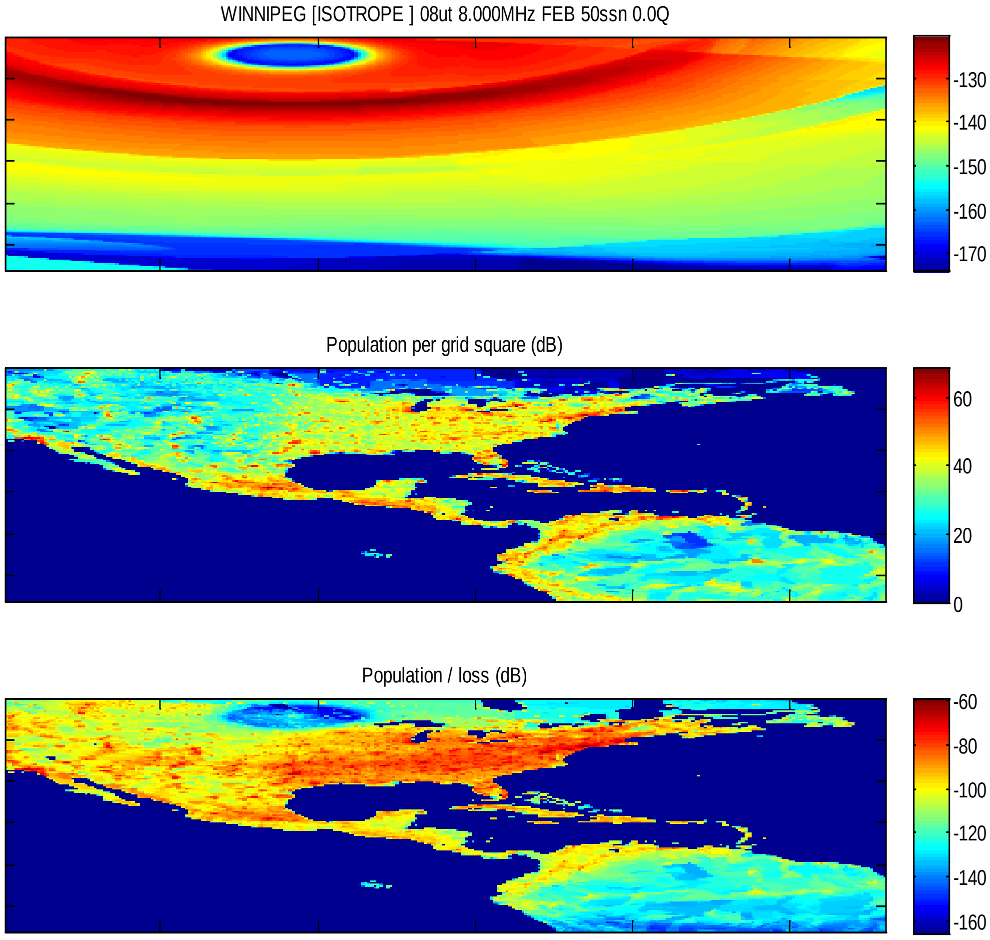
Month	UTC	SSN	Q	Freq	PLT noise	Atm (low)	Rural	Quiet rural	Abs. prot. req.
2	0	50	0	2.000	–129.69	–159.65	–114.99	–129.01	–139.06
2	0	50	0	4.000	–134.53	–152.37	–123.18	–137.62	–145.08
2	0	50	0	8.000	–139.32	–146.21	–131.36	–146.23	–151.10
2	0	50	0	16.000	–149.54	–160.64	–139.55	–154.84	–157.12
2	0	50	0	24.000	–165.75	–187.36	–144.34	–159.87	–160.65

A2.4.5.2 Cumulative PLT output maps

The cumulative PLT tool also provides the option of plotting “maps” illustrating the correspondence between ICEPAC path loss and population density. This requires that the detailed ICEPAC results have been saved to disk. An example for a case where the predicted PLT signal exceeds the median quiet rural man-made noise by more than 6 dB is shown in Figure A2-13. In general, high predicted PLT signal levels correspond to cases where there is low path loss from densely populated regions. NABA concluded that the parameters used in the example calculation are reasonable for the reasons stated above and that the results correctly indicate that the PLT signal levels exceed the median “quiet rural” man-made noise by at least more than 6 dB

FIGURE A2-13

Top plot: Median path loss (dB) as predicted by ICEPAC for a combination of input parameters for a receiver in Winnipeg; Middle plot: Population per 0.25 × 0.25 degrees grid square in dB (10log10 (population)); bottom plot: Product (dB-sum) of the top two plots



The maps in Figure A2-13 are generated using the MATLAB cumulative PLT tool as shown below:

ICEAREA INVERSE batch calculation: (C)ompute new or (L)oad previous? L
ICEPACfile =
WINNIPEG
(C)ompute cumulative PLT noise for all files, or (P)lot One? p
Select UTC, one of (0 4 8 12 16 20): 8
Select Freq, one of (2 4 8 16 24): 8
----
e.i.r.p. per PLT modem (dBm/Hz) [-80]:
Market penetration (PLT modems per capita) [0.05]:
Duty cycle (fraction of time each PLT modem is transmitting) [0.3]:
Market factor (penetration * duty cycle): –18.2 dB
e.i.r.p. per capita: –98.2 dBm/Hz

Month: 2 / UTC: 8 / SSN: 50 / Q: 0 / Freq: 8.00
Integral of population / loss over entire area: –41.3 dB
Received PLT noise: –139.6 dBm/Hz
Atmospheric noise lower limit: –146.2 dBm/Hz
Man-made, rural: –131.4 dBm/Hz
Man-made, quiet rural: –146.2 dBm/Hz
Absolute protection requirement: –151.1 dBm/Hz

Annex 3

James C. Richards and Jonathan V. Williams, “Potential Interference from Broadband over Power Line (BPL) Systems to Federal Government Radiocommunication Systems at 1.7 – 80 MHz – Phase 2 Study,” Volume I, NTIA Report 08-450, October 2007.

NTIA BPL Phase2
Volume I