

RECOMMENDATION ITU-R PI.842-1

COMPUTATION OF RELIABILITY AND COMPATIBILITY OF HF RADIO SYSTEMS

(Question ITU-R 217/3)

(1992-1994)

The ITU Radiocommunication Assembly,

considering

- a) that the reliability of a radio system is defined as the probability that a required performance is achieved;
- b) that reliability is a figure of merit of performance;
- c) that compatibility is a measure of the degradation caused by interference to the performance of a radio system;
- d) that predicted reliabilities and compatibilities are valuable in the selection of preferred combinations of antennas (including, where necessary, their design optimization), frequencies and necessary transmitter power to achieve a desired performance,

recommends

that the following methods for calculating the various types of reliability and compatibility should be used in the planning and design of radio systems.

1. Introduction

The reliabilities discussed in this Recommendation form a hierarchy as illustrated in Fig. 1. Basic reliabilities are discussed in § 2 to 5, overall reliability in § 6, reliability in HF networks in § 7 and compatibility in § 8.

Specific definitions of different types of reliability are given in Appendix 1.

2. Inputs to the basic reliability computation

For the computation of basic circuit reliability the method involves the following parameters: monthly median available receiver signal power (Recommendation ITU-R PI.533); monthly median atmospheric, man-made and galactic noise powers (Recommendation ITU-R PI.372); upper and lower decile deviations from the monthly median signal and noise powers – long term (day-to-day) and short term (within-the-hour); required signal-to-noise ratio (Recommendation ITU-R F.339).

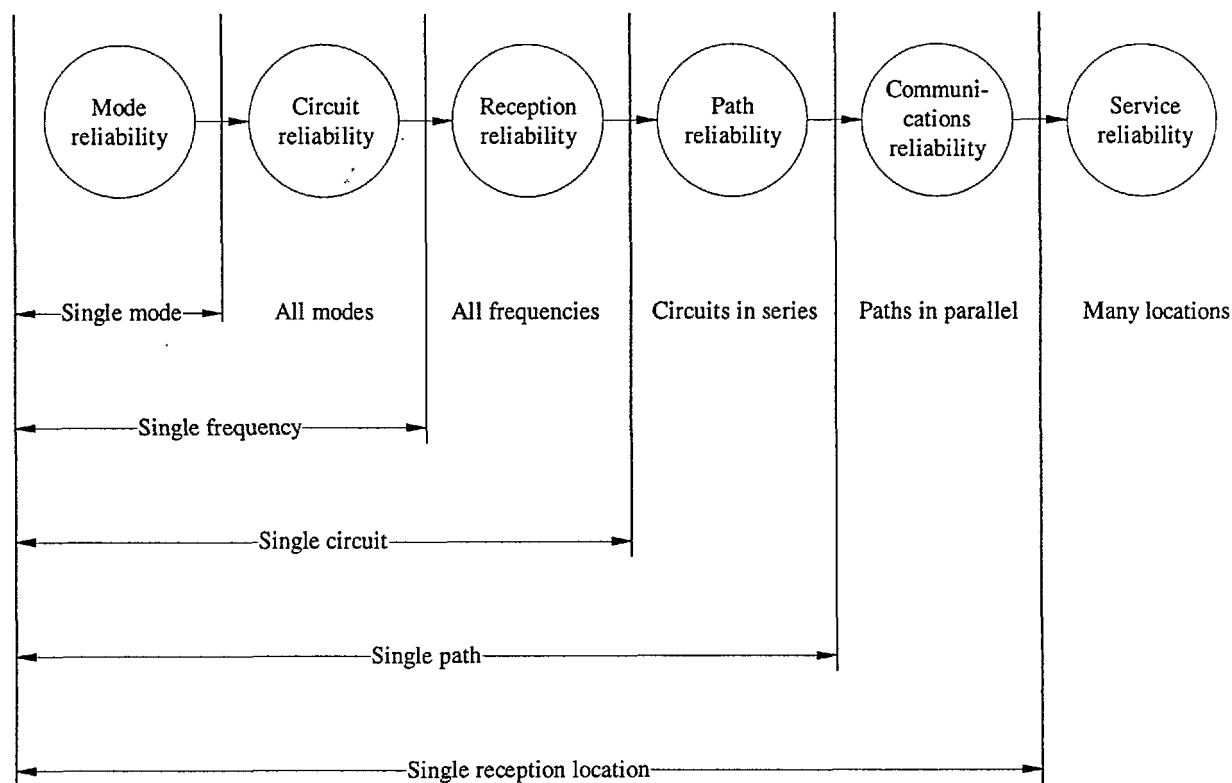
3. Computation of basic circuit reliability (BCR)

Basic circuit reliability may be estimated according to the procedure outlined in Table 1 using the information in Table 2.

This procedure involves the intermediate calculation of the composite median available receiver power of the wanted signal (Step 1), the median signal-to-noise ratio (Steps 2-3), the resultant upper decile of the signal-to-noise ratio (Steps 4-6), and the resultant lower decile of the signal-to-noise ratio (Steps 7-9).

The required signal-to-noise ratio (Step 10) is user defined (Recommendation ITU-R RF.339 tabulates signal-to-noise ratios required to provide specific performances). The basic circuit reliability is then estimated using the statistical distribution given in Step 11.

FIGURE 1
Chart of reliabilities



4. Basic reception reliability (BRR)

$$\text{For } n \text{ frequencies} \quad BRR = 100 \left[1 - \prod_{i=1}^n \left(1 - \frac{BCR(f_i)}{100} \right) \right] \quad \%$$

where $BCR(f_i)$ is the percentage basic circuit reliability for frequency f_i .

For a single operational frequency, BRR is equal to BCR.

5. Basic service reliability (BSR)

The determination of basic service reliability involves the use of test points within the required service area. Basic service reliability is the value of BRR exceeded by a required percentage of the test points.

TABLE 1
Computation of basic circuit reliability (BCR)

Step	Parameter	Description of parameter	Source of parameter value
1	S	Median available receiver power of wanted signal (dBW)	Prediction method P_r in § 6 of Rec. ITU-R PL533
2	$F_a A$ $F_a M$ $F_a G$	Median noise factor for atmospheric noise Median noise factor for man-made noise Median noise factor for galactic noise	Rec. ITU-R PL372
3	S/N	Median resultant signal-to-noise ratio (dB) for bandwidth b (Hz)	$S - 10 \log_{10} \left[\frac{F_a A}{10^{10}} + \frac{F_a M}{10^{10}} + \frac{F_a G}{10^{10}} \right] - 10 \log_{10} b + 204$
4	$D_u S_d$ $D_u S_h$	Signal upper decile deviation (day-to-day) (dB) Signal upper decile deviation (within-the-hour) (dB)	Table 2 using basic MUF for the path 5
5	$D_l A$ $D_l M$ $D_l G$	Lower decile deviation (dB) of atmospheric noise man-made noise galactic noise	Rec. ITU-R PL372 Rec. ITU-R PL372 2
6	$D_u SN$	Upper decile deviation of resultant signal-to-noise ratio (dB)	Root sum square of $D_u S_d$, $D_u S_h$ and $10 \log_{10} \left[\frac{\frac{F_a A}{10^{10}} - \frac{D_l A}{10^{10}}}{10^{10}} + \frac{\frac{F_a M}{10^{10}} - \frac{D_l M}{10^{10}}}{10^{10}} + \frac{\frac{F_a G}{10^{10}} - \frac{D_l G}{10^{10}}}{10^{10}} \right]$