

## RECOMMENDATION ITU-R F.1705

**Analysis and optimization of the error performance of digital fixed wireless systems for the purpose of bringing into service and maintenance**

(Question ITU-R 235/9)

(2005)

**Scope**

This Recommendation provides analysis for optimization of the error performance of digital fixed wireless systems (FWSs) for the purpose of practical maintenance work prior to bringing into service. Annex 1 presents the guidance and systematic methods for the maintenance of both point-to-point (P-P) and point-to-multipoint P-MP systems.

The ITU Radiocommunication Assembly,

*considering*

- a) that many factors including fading due to multipath effects may distort and attenuate received signals on line-of-sight paths and thereby impair the performance of FWSs;
- b) that countermeasures such as diversity reception and adaptive equalization are available to reduce the effects of multipath fading on system performance;
- c) that methods for the analysis and optimization of the error performance degradation of digital FWSs due to many factors are needed for the bringing into service (BIS) and/or maintenance of FWSs and for radio equipment development;
- d) that the performance limits and the technical guidance on BIS or maintenance for FWSs are given in Recommendations ITU-R F.1330 (Performance limits for bringing into service of the parts of international plesiochronous digital hierarchy and synchronous digital hierarchy paths and sections implemented by digital radio-relay systems) and ITU-R F.1566 (Performance limits for maintenance of digital fixed wireless systems operating in plesiochronous and synchronous digital hierarchy-based international paths and sections), respectively;
- e) that it is often necessary to optimize the performance of FWSs after they are installed, in particular during the maintenance work before BIS,

*recommends*

- 1 that the guidance and the systematic method for the analysis and optimization of digital FWS error performance detailed in Annex 1 should be applied in cases of sub-optimal performance.

**Annex 1****Analysis and optimization of the error performance of digital FWSs for the purpose of bringing into service and maintenance****1 Introduction**

The purpose of this Annex is to provide guidance on the availability of methods for fault analysis and optimization of the performance of digital FWSs. Detailed information on propagation aspects of the design of fixed wireless systems is contained in Recommendation ITU-R P.530 (Propagation data and prediction methods required for the design of terrestrial line-of-sight systems).

ITU-R error-performance Recommendations (e.g. Recommendation ITU-R F.1668 – Error performance objectives for real digital fixed wireless links used in 27 500 km hypothetical reference paths and connections) place requirements on the design and operation of FWSs to meet the performance objectives of these Recommendations. In view of these requirements, this Recommendation seeks to provide guidance for commissioning and operating FWSs in situations where difficulties are experienced due to poor error performance. Guidance on performance limits for systems BIS is given in Recommendation ITU-R F.1330. This Recommendation may also serve to provide maintenance trigger points for operational systems. Furthermore it is noted that error cause assessment can basically be triggered by the performance limits given in Recommendation ITU-R F.1566.

There has been a great deal of development of systems and techniques to provide high quality FWSs. Measurement technologies and software are now available for the analysis of digital FWSs in the laboratory and in field operation.

In view of these developments it is recommended that where system analysis for fault rectification or optimization for the purpose of meeting the required performance objectives is necessary, then measuring instruments and software may be applied to achieve the above aims.

More detailed general information on FWS operations can be found in the ITU-R Handbook on digital radio-relay systems.

## 2 Link analysis

There are many potential causes of errors on FWSs. The analysis of system errors is thus complex and potentially time-consuming. To progress the analysis and optimization of systems it is necessary to adopt a systematic approach to understanding the nature of the errors and their relationship to the environment in which the FWS operates.

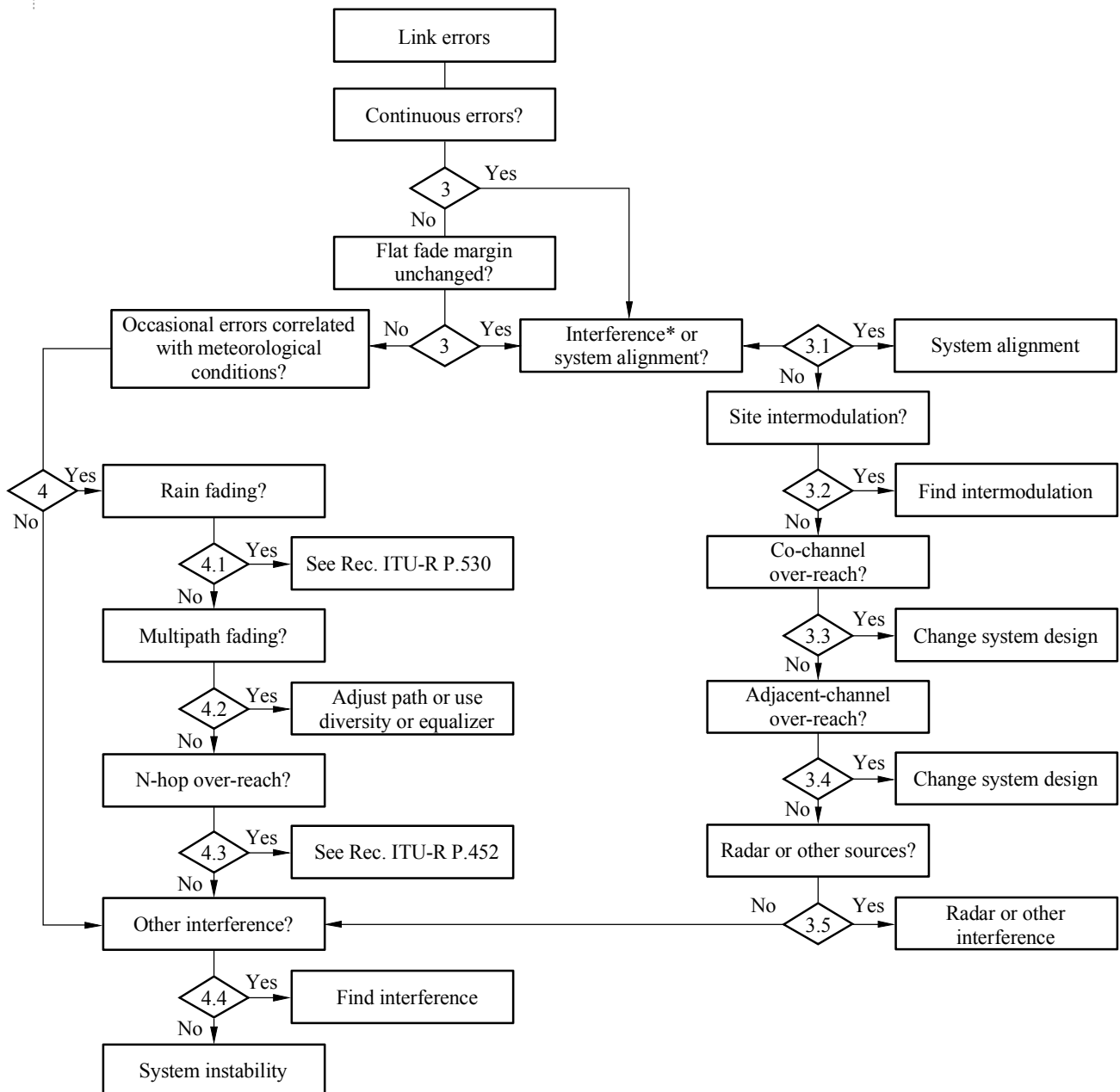
In the absence of a systematic approach to error performance analysis, it is easy for the system operator to ascribe all errors to fading and do nothing to rectify the problem. The purpose of this guide is to simplify the process of system analysis and optimization by giving directions that assist in the improvement of system performance. Measurement and analysis tools are available to assist this process even in the face of seemingly severe error-performance problems.

A basic flow chart is shown in Fig. 1 for assessing the potential causes of system errors, which are observed in P-P FWSs with multi-hop connection. There are many branches in this flow chart each of which requires some special knowledge about the system and its environment. To gain the necessary knowledge, specific measurements or analyses are required at each branch of Fig. 1. Following such measurements, further application software may be required to assist in evaluating the measurements and to derive an optimum solution.

For FWSs used in the access portion, in particular for P-MP systems operating in different propagation environments, another flow chart in Fig. 2 could be used.

The following sections set out guidance for each decision point, the numbering of each section corresponding to a decision in the flow charts of Figs. 1 and 2.

FIGURE 1  
Flow chart for assessing the causes of link errors observed  
in P-P FWS with multi-hop connection



\* Interference may come from services sharing the same band as well as unwanted emissions from other bands.

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