

RECOMMENDATION ITU-R M.1037*

Bit error performance objectives for aeronautical mobile-satellite (R) service (AMS(R)S) radio link

(Question ITU-R 112/8)

(1994)

The ITU Radiocommunication Assembly,

considering

- a) that the aeronautical mobile-satellite (R) service (AMS(R)S) provides communications relating to safety and regularity of flight (see Nos. 1.33 and 1.59 of the Radio Regulations);
- b) that the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs) provide technical data for AMS(R)S operations**;
- c) that aircraft earth station antenna radiation patterns are unlikely to provide complete coverage of the desired volume (relative to the aircraft's horizontal line of flight) defined by an elevation range of 5° to 90° and an azimuth range of 360° with flight attitudes of +20°/−5° of pitch and +25°/−25° of roll;
- d) that the communications performance objectives for AMS(R)S are required to be met under stringent environmental conditions;
- e) that the service link performance is usually more difficult to achieve than the feeder link because of the relatively low gain of the aircraft antenna;
- f) that an outage (radio unavailability) occurs when any performance criteria is degraded with respect to its required performance level for a period of 10 s or more***,

recommends

- 1 that the bit error ratio (BER) for voice communications at the output of the AMS(R)S radio link should not be worse than 1×10^{-3} for more than 0.1% of the time on a daily basis for aircraft in normal flight at locations where the satellite elevation look angles are greater than 5° above horizontal, and in the aircraft antenna minimum coverage volume****;

* Radiocommunication Study Group 8 made editorial amendments to this Recommendation in 2004 in accordance with Resolution ITU-R 44.

** INMARSAT Aeronautical System Definition Manual (SDM), RTCA DO-210 (Minimum Operational Performance Standards for AMSS) and RTCA DO-215 (Guidance on AMSS End to End Performance) also provide additional technical data for AMS(R)S operations.

*** The maximum outage period is not expected to exceed 90 s on a daily basis.

**** The aircraft antenna *minimum coverage volume* is defined as the minimum fraction of the hemisphere above the aircraft, excluding the lowest 5° above the horizon, over which an aircraft earth station shall simultaneously satisfy all technical requirements, with the aircraft in the horizontal plane.

Current technology constraints limit the minimum coverage volume to 85% for low gain aeronautical antennas, and 75% for high gain aeronautical antennas.

As technology improves, the minimum coverage volume is expected to be adjusted to match more closely the service coverage requirements (see *considering* c)).

2 that the BER for packet mode data communications at the output of the AMS(R)S radio link should not be worse than 1×10^{-5} for more than 0.1% of the time on a daily basis for aircraft in normal flight at locations where the satellite elevation look angles are greater than 5° above horizontal, and in the aircraft antenna minimum coverage volume;

3 that the following Notes should be regarded as part of the Recommendation.

NOTE 1 – It is important for designers to allow adequate link margins for interference and degradation which may occur during the operational life of the system.

NOTE 2 – The measurement of the BER in § 1 and 2 should be based on an appropriate measurement window, depending on the applicable link bit rate, which would be used to establish the BER performance on a daily basis.

A sufficient number of daily measurement periods should be taken to provide a good estimate of the BER probability taking into account the effects of propagation as stated in Notes 4 and 8 below.

NOTE 3 – The performance objectives specified in § 1 and 2, pertain to performance over the entire satellite radio link.

NOTE 4 – Ionospheric effects, tropospheric effects and multipath fading should be considered. Performance objectives in § 1 and 2 assume appropriate techniques are used to overcome short duration fades, which are typical of the aeronautical multipath environment. The effects of ionospheric scintillation attenuation are excluded from requirements of § 1 and 2 but should be considered in system design.

NOTE 5 – The aircraft earth station, aeronautical earth station and satellite are considered to be continuously operational over the measured period.

NOTE 6 – Future voice quality objective may be stated in terms of actual voice grade. Further study on this subject is required.

NOTE 7 – recommends 1 and 2 should not apply to present operational and notified AMS(R)S networks, which have been designed to meet performance objectives of 99% of the time at the satellite edge of coverage.

NOTE 8 – The link design to meet BER performance objectives in § 1 and 2 should be based upon propagation data over at least a four-year period including the worst month of any year.
