

RECOMMENDATION ITU-R F.1668-1

Error performance objectives for real digital fixed wireless links used in 27 500 km hypothetical reference paths and connections

(Question ITU-R 210/9)

(2004-2007)

Scope

This Recommendation provides updated information on error-performance objectives for real digital fixed wireless links used in 27 500 km hypothetical reference paths and connections. It is the only Recommendation defining error-performance objectives for all real digital fixed wireless links. Performance events and objectives for connections using equipment designed prior to approval of ITU-T Recommendation G.826 in December 2002 are given in ITU-T Recommendation G.821 and Recommendations ITU-R F.634, ITU-R F.696 and ITU-R F.697. Recommendations ITU-R F.1397 and ITU-R F.1491 are superseded by this Recommendation. Example of a connection, path, link and hop are given in Annex 1. Definitions of the error performance events, derived from ITU-T Recommendations G.826 and G.828, are given in Annex 2. Examples of calculations of the error performance parameters are given in Annex 3.

The ITU Radiocommunication Assembly,

considering

- a) that ITU-T has specified the error performance parameters and objectives for international constant bit rate (CBR) digital paths and connections in ITU-T Recommendation G.826¹, and for international CBR synchronous digital paths in ITU-T Recommendation G.828²;
- b) that ITU-T has specified the error performance events and the block structures for synchronous digital hierarchy (SDH) multiplex and regenerator sections in ITU-T Recommendation G.829;
- c) that any real path link for digital data transmission may be realized using a linear and/or redundant topology, depending on the needs of network providers;
- d) that there is a need to establish the performance objectives for real digital radio links in order to allow proper engineering of the fixed wireless links;

¹ It is not required to apply this Recommendation to connections which operate below the primary rate using equipment designed prior to the approval (December 2002) of ITU-T Recommendation G.826 – End-to-end error performance parameters and objectives for international constant bit rate digital paths and connections.

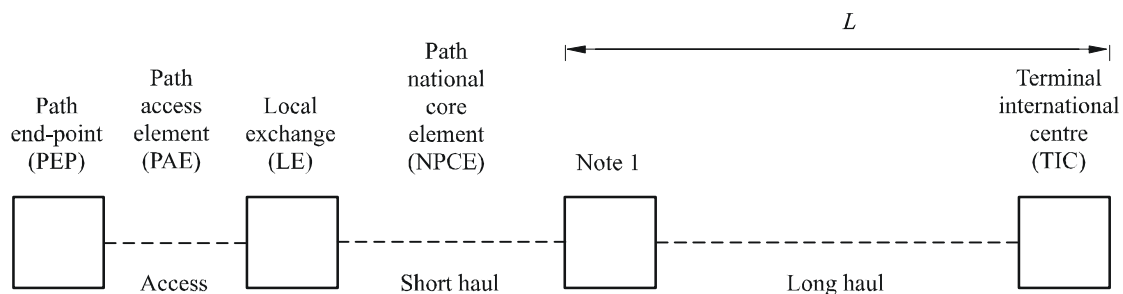
² ITU-T Recommendation G.826 deals with performance of PDH paths and of those SDH paths using equipment designed prior to the approval of ITU-T Recommendation G.828 in March 2000. ITU-T Recommendation G.828 deals with performance of SDH paths using equipment designed as of or after the adoption of ITU-T Recommendation G.828 in March 2000.

e) that for the purpose of this Recommendation, the national portion of a 27 500 km hypothetical reference path (HRPs) or hypothetical reference connection (HRCs) can be subdivided into three basic sections (see Fig. 1),

recommends

1 that the error performance objectives (EPOs) applicable to each direction of any real fixed wireless link of length L_{link} used in the international portions of a 27 500 km HRP and HRC can be derived by means of equation (1) and using the values in Tables 1a and 1b for SDH systems designed according to ITU-T Recommendation G.828 and values in Tables 2a and 2b for systems designed according to ITU-T Recommendation G.826.

FIGURE 1
Basic sections of the national portion of the HRP



Note 1 – Depending on the country network architecture, this centre may coincide with a primary centre (PC), secondary centre (SC) or tertiary centre (TC) (see ITU-T Recommendation G.801).

Access: Access network section, including the connections between PEP and the corresponding local access switching centre/cross connector (LE). It corresponds to the PAE.

Short haul: Short haul inter-exchange network section, including the connections between a local access switching centre/cross connector (LE) and a PC, SC or TC (depending on the network architecture).

Long haul: Long haul inter-exchange network section, including the connections between a PC, SC or TIC (depending on the network architecture) and the corresponding international gateway (IG).

Note 2 – TIC, PAE and NPCE are defined in ITU-T Recommendation M.1010.

1668-01

The lower limit of L_{link} used to scale the objectives to the real case is $L_{min} = 50$ km.

$$EPO = B_j \times (L_{link} / L_R) + C_j \quad (1)$$

where:

$j = 1$	for $L_{min} \leq L_{link} \leq 1\,000$ km	for intermediate country
$j = 2$	for $1\,000 \text{ km} < L_{link}$	for intermediate country
$j = 3$	for $L_{min} \leq L_{link} \leq 500$ km	for terminating country
$j = 4$	for $500 \text{ km} < L_{link}$	for terminating country.

EPO is substituted by the parameters errored second ratio (ESR), severely errored second ratio (SESR) and background block error ratio³ (BBER) as appropriate.

L_R is the reference length, $L_R = 2\,500$ km

B_R is a block allowance ratio, $B_R = (0 < B_R \leq 1)$;

TABLE 1a

**Parameters for the EPO for intermediate countries according to
ITU-T Recommendation G.828**

Parameter	Bit rate (kbit/s)	$L_{min} \leq L_{link} \leq 1\,000$ km		$1\,000$ km $< L_{link}$	
		B1	C1	B2	C2
ESR	1 664	$5 \times 10^{-4} (1 + B_R)$	0	5×10^{-4}	$2 \times 10^{-4} \times B_R$
ESR	2 240	$5 \times 10^{-4} (1 + B_R)$	0	5×10^{-4}	$2 \times 10^{-4} \times B_R$
ESR	6 848	$5 \times 10^{-4} (1 + B_R)$	0	5×10^{-4}	$2 \times 10^{-4} \times B_R$
ESR	48 960	$1 \times 10^{-3} (1 + B_R)$	0	1×10^{-3}	$4 \times 10^{-4} \times B_R$
ESR	150 336	$2 \times 10^{-3} (1 + B_R)$	0	2×10^{-3}	$8 \times 10^{-4} \times B_R$
SESR	1 664-150 336	$1 \times 10^{-4} (1 + B_R)$	0	1×10^{-4}	$4 \times 10^{-5} \times B_R$
BBER	1 664-48 960	$2.5 \times 10^{-6} (1 + B_R)$	0	2.5×10^{-6}	$1 \times 10^{-6} \times B_R$
BBER	150 336	$5 \times 10^{-6} (1 + B_R)$	0	5×10^{-6}	$2 \times 10^{-6} \times B_R$

TABLE 1b

**Parameters for the EPO for terminating countries according to
ITU-T Recommendation G.828**

Parameter	Bit rate (kbit/s)	$L_{min} \leq L_{link} \leq 500$ km		500 km $< L_{link}$	
		B3	C3	B4	C4
ESR	1 664	$5 \times 10^{-4} (1 + B_R)$	0	5×10^{-4}	$1 \times 10^{-4} \times B_R$
ESR	2 240	$5 \times 10^{-4} (1 + B_R)$	0	5×10^{-4}	$1 \times 10^{-4} \times B_R$
ESR	6 848	$5 \times 10^{-4} (1 + B_R)$	0	5×10^{-4}	$1 \times 10^{-4} \times B_R$
ESR	48 960	$1 \times 10^{-3} (1 + B_R)$	0	1×10^{-3}	$2 \times 10^{-4} \times B_R$
ESR	150 336	$2 \times 10^{-3} (1 + B_R)$	0	2×10^{-3}	$4 \times 10^{-4} \times B_R$
SESR	1 664-150 336	$1 \times 10^{-4} (1 + B_R)$	0	1×10^{-4}	$2 \times 10^{-5} \times B_R$
BBER	1 664-48 960	$2.5 \times 10^{-6} (1 + B_R)$	0	2.5×10^{-6}	$5 \times 10^{-7} \times B_R$
BBER	150 336	$5 \times 10^{-6} (1 + B_R)$	0	5×10^{-6}	$1 \times 10^{-6} \times B_R$

³ BBER parameter is applicable only to paths.

TABLE 2a

**Parameters for the EPO for intermediate countries according to
ITU-T Recommendation G.826**

Parameter	Bit rate (Mbit/s)	$L_{min} \leq L_{link} \leq 1\,000\text{ km}$		$1\,000\text{ km} < L_{link}$	
		B1	C1	B2	C2
ESR	<primary rate	$2 \times 10^{-3} (1 + B_R)$	0	2×10^{-3}	$8 \times 10^{-4} \times B_R$
ESR	1.5-5	$2 \times 10^{-3} (1 + B_R)$	0	2×10^{-3}	$8 \times 10^{-4} \times B_R$
ESR	>5-15	$2.5 \times 10^{-3} (1 + B_R)$	0	2.5×10^{-3}	$1 \times 10^{-3} \times B_R$
ESR	>15-55	$3.75 \times 10^{-3} (1 + B_R)$	0	3.75×10^{-3}	$1.5 \times 10^{-3} \times B_R$
ESR	>55-160	$8 \times 10^{-3} (1 + B_R)$	0	8×10^{-3}	$3.2 \times 10^{-3} \times B_R$
ESR	>160-400	Not applicable	Not applicable	Not applicable	Not applicable
SESR	≤ 400	$1 \times 10^{-4} (1 + B_R)$	0	1×10^{-4}	$4 \times 10^{-5} \times B_R$
BBER	1.5-400	$1 \times 10^{-5} (1 + B_R)$	0	1×10^{-5}	$4 \times 10^{-6} \times B_R$

TABLE 2b

**Parameters for the EPO for terminating countries according to
ITU-T Recommendation G.826**

Parameter	Bit rate (Mbit/s)	$L_{min} \leq L_{link} \leq 500\text{ km}$		$500\text{ km} < L_{link}$	
		B3	C3	B4	C4
ESR	<primary rate	$2 \times 10^{-3} (1 + B_R)$	0	2×10^{-3}	$4 \times 10^{-4} \times B_R$
ESR	1.5-5	$2 \times 10^{-3} (1 + B_R)$	0	2×10^{-3}	$4 \times 10^{-4} \times B_R$
ESR	>5-15	$2.5 \times 10^{-3} (1 + B_R)$	0	2.5×10^{-3}	$5 \times 10^{-4} \times B_R$
ESR	>15-55	$3.75 \times 10^{-3} (1 + B_R)$	0	3.75×10^{-3}	$7.5 \times 10^{-4} \times B_R$
ESR	>55-160	$8 \times 10^{-3} (1 + B_R)$	0	8×10^{-3}	$1.6 \times 10^{-3} \times B_R$
ESR	>160-400	Not applicable	Not applicable	Not applicable	Not applicable
SESR	≤ 400	$1 \times 10^{-4} (1 + B_R)$	0	1×10^{-4}	$2 \times 10^{-5} \times B_R$
BBER	1.5-400	$1 \times 10^{-5} (1 + B_R)$	0	1×10^{-5}	$2 \times 10^{-6} \times B_R$

2 that the EPOs for the access and short haul sections should make use only of the block allocation contribution specified in ITU-T Recommendations G.826 and G.828 for the national portion of a 27500 km HRP and HRC, and that the long haul section should make use of the distance-based allocation and part of the fixed block allowance allocation;

3 that for the EPOs applicable to each direction of any real fixed wireless link of length L_{link} belonging to the long haul inter-exchange network sections of the national portion of HRP and HRC the values in Table 3a for SDH systems designed according to ITU-T Recommendation G.828 and in Table 3b for other systems designed according to ITU-T Recommendation G.826 should apply. The lower limit of L_{link} , used to scale the objectives to the real case, is $L_{min} = 50$ km.

TABLE 3a

EPOs for real SDH fixed wireless links belonging to the long haul inter-exchange network section of the national portion of the HRP according to ITU-T Recommendation G.828

Rate (Mbit/s)	1 664 (VC-11, TC-11)	2 240 (VC-12, TC-12)	6 848 (VC-2, TC-2)	48 960 (VC-3, TC-3)	150 336 (VC-4, TC-4)
ESR	$0.01 \times A$	$0.01 \times A$	$0.01 \times A$	$0.02 \times A$	$0.04 \times A$
SESR	$0.002 \times A$				
BBER	$5 \times 10^{-5} \times A$				$1 \times 10^{-4} \times A$

TABLE 3b

EPOs for real fixed wireless links belonging to the long haul inter-exchange network section of the national portion of the HRP and HRC according to ITU-T Recommendation G.826

Rate (Mbit/s)	<primary rate	1.5 to 5	>5 to 15	>15 to 55	>55 to 160	>160 to 400
ESR	$0.04 A$	$0.04 A$	$0.05 A$	$0.075 A$	$0.16 A$	Not applicable
SESR	$0.002 A$	$0.002 A$	$0.002 A$	$0.002 A$	$0.002 A$	$0.002 A$
BBER ⁽¹⁾	Not applicable	$2 A \times 10^{-4}$	$2 A \times 10^{-4}$	$2 A \times 10^{-4}$	$2 A \times 10^{-4}$	$1 A \times 10^{-4}$

⁽¹⁾ BBER parameter is applicable only to paths.

where:

$$A = (A_1 + 0.002) L_{link}/100 \quad \text{for } 50 \text{ km} \leq L_{link} \leq 100 \text{ km}$$

$$A = A_1 + 2 \times 10^{-5} L_{link} \quad \text{for } 100 \text{ km} < L_{link}$$

A_1 has provisionally been agreed to be in the range of 0.01 to 0.02 (1% to 2%) (see Notes 3 and 4);

4 that for the EPOs applicable to each direction of any real fixed wireless link forming all of the short haul network sections of the national portion of the HRP and HRC the values given in Table 4a for SDH systems designed according to ITU-T Recommendation G.828 and in Table 4b for other systems designed according to ITU-T Recommendation G.826 should apply.