International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.722.2

Corrigendum 1

(09/2005)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Digital terminal equipments – Coding of analogue signals by methods other than PCM

Wideband coding of speech at around 16 kbit/s using Adaptive Multi-Rate Wideband (AMR-WB)

Corrigendum 1

ITU-T Recommendation G.722.2 (2003) – Corrigendum 1

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ITU-T Recommendation G.722.2

Wideband coding of speech at around 16 kbit/s using Adaptive Multi-Rate Wideband (AMR-WB)

Corrigendum 1

Summary

This corrigendum details a number of corrections to the text and formulas in the main body of ITU-T Rec. G.722.2 in order to align the text with the C-code in Annex C. Also, a couple of corrections to the Annex C electrical C-code attachment are presented.

Source

Corrigendum 1 to ITU-T Recommendation G.722.2 (2003) was approved on 13 September 2005 by ITU-T Study Group 16 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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ITU-T Recommendation G.722.2

Wideband coding of speech at around 16 kbit/s using Adaptive Multi-Rate Wideband (AMR-WB)

Corrigendum 1

1 Subclause 5.7 – Adaptive codebook

The text in the second last paragraph (before equation 39) should be as follows:

Thus, for ~~8.85,~~ 12.65, 14.25, 15.85, 18.25, 19.85, 23.05 or 23.85 kbit/s modes, there are two possibilities to generate the adaptive codebook $v(n)$, $v(n) = v'(n)$ in the first path, or $v(n) = \sum_{i=1}^{1} b_{LP}(i+1)v'(n+i)$ in the second path, where b_{LP} = [0.18,0.64,0.18]. The path which results in minimum energy of the target signal $x_2(n)$ defined in Equation (40) is selected for the filtered adaptive codebook vector. For 6.60 <u>and 8.85</u> kbit/s mode<u>s</u>, $v(n)$ is always:

$$v(n) = \sum_{i=1}^{1} b_{LP}(i+1)v'(n+i)$$

…

2 Subclause 5.8.3 – Codebook search

The text in the ninth paragraph should be as follows:

The correlation at the numerator of the search criterion Q_k is now given by:

$$\sout{R = \sum_{i=0}^{N_p-1} d'(i)} \quad \underline{R = \sum_{i=0}^{N_p-1} d'(m_i)}$$

and the energy at the denominator of the search criterion Q_k is given by:

$$E = \sum_{i=0}^{N_p-1} \phi'(m_i, m_i) + 2 \sum_{i=0}^{N_p-2} \sum_{j=i+1}^{N_p-1} \phi'(m_i, m_j)$$

…

3 Subclause 6.1 – Decoding and speech synthesis

The text in step 1 should be as follows:

The following steps are repeated for each subframe:

1) **Decoding of the adaptive codebook vector**: The received pitch index (adaptive codebook index) is used to find the integer and fractional parts of the pitch lag. The adaptive codebook vector $v(n)$ is found by interpolating the past excitation $u(n)$ (at the pitch delay) using the FIR filter described in ~~5.6~~5.7. The received adaptive filter index is used to find out whether the filtered adaptive codebook is $v_1(n) = v(n)$ or $v_2(n) = 0.18v(n) + 0.64v(n-1) + 0.18v(n-2)$.

…

Equation 65 in Step 6 should be as follows:

Finally, the gain is updated with the value of the smoothed gain as follows:

$$\hat{g}_c = 0 g_0 + (1 - 0)\hat{g}_c \; \underline{\hat{g}_c = S_m g_0 + (1 - S_m)\hat{g}_c} \tag{65}$$

…

Step 7 text should be modified as follows:

7) **Pitch enhancer**: A pitch enhancer procedure modifies the total excitation $u(n)$ by filtering the fixed codebook excitation through an innovation filter whose frequency response emphasizes the higher frequencies more than lower frequencies, and whose coefficients are related to the periodicity in the signal. A filter of the form

$$F_{inno}(Z) = -c_{pe} z + 1 - c_{pe} z^{-1} \tag{66}$$

where $c_{pe} = 0.125(1 - r_v)$ $\underline{c_{pe} = 0.125(1 + r_v)}$, with $r_v = (E_v - E_c)/(E_v + E_c)$ as described above.

The filtered fixed codevector is given by:

$$c'(n) = c(n) - c_{pe}\big(c(n+1) + c(n-1)\big) \tag{67}$$

and the updated excitation is given by:

$$u(n) = \hat{g}_p v(n) + \hat{g}_c c'(n) \tag{68}$$

The above procedure can be done in one step by updating the excitation as follows:

$$u(n) = u(n) - \hat{g}_c c_{pe}\big(c(n+1) + c(n-1)\big) \tag{69}$$

4 Annex C (electronic attachment) file bits.h

C-code before the change:

```
static const Word16 nb_of_bits[NUM_OF_MODES] = {
    NBBITS_7k,
    NBBITS_9k,
    NBBITS_12k,
    NBBITS_14k,
    NBBITS_16k,
    NBBITS_18k,
    NBBITS_20k,
    NBBITS_23k,
    NBBITS_24k,
    NBBITS_24k,
NBBITS_SID};
```

C-code after the change:

```
static const Word16 nb_of_bits[NUM_OF_MODES] = {
    NBBITS_7k,
    NBBITS_9k,
    NBBITS_12k,
    NBBITS_14k,
    NBBITS_16k,
    NBBITS_18k,
    NBBITS_20k,
    NBBITS_23k,
    NBBITS_24k,
    ~~NBBITS_24k,~~
NBBITS_SID};
```

5 Annex C (electronic attachment) file const.h

C-code before the change:

```
#define MODE_7k       0
#define MODE_9k       1
#define MODE_12k      2
#define MODE_14k      3
#define MODE_16k      4
#define MODE_18k      5
#define MODE_20k      6
#define MODE_23k      7
#define MODE_24k      8
#define MRDTX         10
#define NUM_OF_MODES  11                    /* see bits.h for bits
definition             */
```

C-code after the change:

```
#define MODE_7k       0
#define MODE_9k       1
#define MODE_12k      2
#define MODE_14k      3
#define MODE_16k      4
#define MODE_18k      5
#define MODE_20k      6
#define MODE_23k      7
#define MODE_24k      8
#define MRDTX         ~~10~~9
#define NUM_OF_MODES  ~~11~~10                    /* see bits.h for bits
definition             */
```

6 Electronic attachments

bits.h and const.h modules are zipped with the text of the corrigendum and are available for free download from the ITU publication website at http://www.itu.int/ITU-T/publications/recs.html.

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