The New National Standard
for the Romanization of Bulgarian[1]

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This work presents the draft new national standard BDS 1596:2009 for the Romanization of Bulgarian, developed by the authors for the Bulgarian Institute for Standardization. The draft is based on the English-oriented Streamlined System designed in the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences in 1995, which subsequently became established in Bulgarian practice and was officialized by a series of governmental regulations and legislation. That evolution in the Bulgarian transliteration practice necessitated the development of a new state standard to replace the now-obsolete existing standard BDS 1596:1973.

1. Romanization of Bulgarian

Writing Bulgarian in the Roman alphabet has a long history going back to pre-Cyrillic times [3], medieval rendering of Bulgarian personal and geographic names in Latin language and other European languages using Roman script, and even the introduction of a Latin-scripted Bulgarian literary norm by the Bulgarian community of Banat region (Habsburg Empire, present Romania and Serbia) in 1866 [22]. The practice of Roman spelling of Bulgarian names, terms etc. naturally expanded along with the growth of economic, cultural and scientific communication between Bulgaria and Western Europe since the mid-19th century, with graphemic correspondences typically patterned on major European languages, notably French, German, and most recently English.

Since the Bulgarian Cyrillic spelling is reasonably phonetic, Romanization of Bulgarian is commonly done by transliterating Cyrillic into Roman letters rather than by Roman transcription of the sounds of spoken Bulgarian language. The two relevant alphabets in the process are the modern Bulgarian Cyrillic alphabet comprising 30 letters: **а, б, в, г, д, е, ж, з, и, й, к, л, м, н, о, п, р, с, т, у, ф, х, ц, ч, ш, щ, ъ, ь, ю, я,** and the basic modern version of the Latin alphabet comprising 26 letters (possibly augmented with diacritics): **a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z.**

2. Transliteration

Let $\Sigma = \{\mathbf{a}, \mathbf{б}, \mathbf{в}, \ldots, \mathbf{я}\}$, $\Sigma^+ = \{\sigma_1 \ldots \sigma_n \mid n \geq 1, \ \sigma_1, \ldots, \sigma_n \in \Sigma\}$, $\Delta \supseteq \{\mathbf{a}, \mathbf{b}, \mathbf{c}, \ldots, \mathbf{z}\}$, $\Delta^+ = \{\delta_1 \ldots \delta_n \mid n \geq 1, \ \delta_1, \ldots, \delta_n \in \Delta\}$.

Definition 2.1. A *transliteration system for the Romanization of Bulgarian* (or simply *transliteration*) is a mapping $T : \Sigma^+ \to \Delta^+$.

Definition 2.2. A transliteration T is *context-free* iff always
$$T(\sigma_1 \ldots \sigma_n) = T(\sigma_1) \ldots T(\sigma_n).$$

Notice that any context-free transliteration is completely determined by its restriction to Σ.

Definition 2.3. A transliteration T is *invertible* iff the mapping T is injective, i.e. $T(\sigma_1 \ldots \sigma_n) = T(\rho_1 \ldots \rho_m) \ \Rightarrow \ m = n, \ \rho_1 = \sigma_1, \ \ldots, \ \rho_n = \sigma_n.$

3. Transliteration systems for Bulgarian

The Bulgarian practice of Romanization of Bulgarian language had been evolving in an unregulated manner for a long time, up until the introduction since the mid-20th century of several transliteration systems closely related to the so called Slavic Scientific Transliteration originally promulgated by the 1898 Prussian Instructions for libraries (*Preußische Instruktionen*) and deriving from the Croatian and Czech alphabets [25]. These included the Andreichin System adopted by the Supreme Committee on Standardization in 1956 [14], the national standard BDS 1596:1973 adopted by the Council of Orthography and Transcription of Geographical Names in 1972 and by the UN in 1977 [1, 18], as well as the international standard ISO 9 of 1968 and later versions [10].

Another system was the French-oriented transliteration of personal and place names traditionally used in Bulgarian identity documents for travel abroad until 1999, conforming with international recommendations [17].

Systems oriented towards English language were introduced by the US Board on Geographic Names and the UK Permanent Committee on Geographical Names in 1952 (BGN/PCGN System, official in both the USA and UK) [24],

by the American Library Association and the Library of Congress in 1997 (ALA-LC System) [2], by Danchev, Holman, Dimova and Savova in 1989 (Danchev System) [7], and by Ivanov in 1995 (Streamlined System, official in Bulgaria) [12].

All these transliterate 18 Bulgarian letters uniformly:

а→a, б→b, в→v, г→g, д→d, е→e, з→z, и→i, к→k,

л→l, м→m, н→n, о→o, п→p, р→r, с→s, т→t, ф→f,

with certain variations in the case of the remaining 12 letters: ж→ž / zh, й→j / y, у→u / ou, х→h / kh, ц→c / ts, ч→č / ch, ш→š / sh, щ→št / sht, ъ→â / ǎ / ŭ / a / u, ь→j / y, ю→ju / yu, я→ja / ya. Divergence is particularly notable in the case of letter ъ, which denotes a specific Bulgarian schwa-like vowel. Less common transliterations such as й→i, ь→i, ю→iu, я→ia also occur in practice, as do transliterations related to positions of letters in certain keyboard layouts or to French, German etc. spelling patterns, and some obsolete forms such as the endings of family names -**off**, -**eff** instead of -**ov**, -**ev**.

4. Streamlined System

The Streamlined System is English-oriented, taking advantage of the global *lingua franca* role of English, with its wider comprehension further facilitated by the fact that non-English speakers from a number of nations have their own languages and non-Roman writing systems Romanized by English-oriented transliteration or transcription too. A similar shift from Slavic Scientific Transliteration towards English-oriented transliteration is observed in the case of other Cyrillic alphabets, notably Russian and Ukrainian [15, 19].

The Streamlined System was designed with the aim of striking an optimal balance between the following partly overlapping and partly conflicting priorities [12]:

- First, its primary purpose is to ensure a plausible phonetic approximation of Bulgarian words by English speaking users, including those having no knowledge of the Bulgarian language and no available additional explanations;
- Second – and of lesser priority, the system should allow for the retrieval of the original Cyrillic spellings as much as feasible;
- Third, transliterated Bulgarian words should fit an English language environment i.e. not be perceived as too un-English; and
- Fourth, transliterated word forms should be streamlined and simple (thus the system's name).

The system provides for certain exceptions. Namely, authentic Roman spellings of names of non-Bulgarian origin have priority, as do traditional Roman spellings that exist for few Bulgarian names [12].

Definition 4.1. The *Streamlined System* is the context-free transliteration S determined by a table consisting of the transliteration rules for the 18 uniformly transliterated letters and of the following rules for the remaining 12:

$$ж→zh, й→y, у→u, х→h, ц→ts, ч→ch,$$
$$ш→sh, щ→sht, ъ→a, ь→y, ю→yu, я→ya.$$

The principal difference between the Streamlined System and the diacritics-free versions of systems related to the Slavic Scientific Transliteration (including BDS 1596:1973) is in the latters' graphemic correspondences **й→j, ц→c, ь→j, ю→ju, я→ja**. On the other hand, the system differs from other English-oriented transliterations mentioned above in that they use the following rules:

Danchev System	у→ou, ъ→u
BGN/PCGN System	х→kh, ъ→ŭ, ь→' (apostrophe)
ALA-LC System	й→ĭ, х→kh, ц→t͡s, ъ→ŭ, ь→[skipped], ю→i͡u, я→i͡a

The streamlined approach could be applied in the case of other languages too, e.g. for the Romanization of the Russian and Macedonian versions of the Cyrillic alphabets, or the re-Romanization and pronunciation respelling of English [12, 13].

5. The Streamlined System gaining dominance

Originally, the Streamlined System was designed in order to provide for the Romanization of Bulgarian place names in Antarctica as required by international obligations. The work on the new system commenced in early 1995 at the Bulgarian Antarctic base on Livingston Island, and was completed in the Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences. The new system was adopted by the Antarctic Place-names Commission of Bulgaria on March 2, 1995 as part of their toponymic guidelines [11], and became subject to comparative study at the Department of English and American Studies at Sofia University [8].

The sphere of regulation and practical application of the new system expanded significantly in 1995-2009 to the extent of gaining dominance in Bulgarian practice. In 1999 the system was chosen both to replace the previously used French-oriented transliteration of personal and place names in the Bulgarian foreign passports, and to Romanize personal and place names in the new domestic identity cards [4, 5]. A 2006 amendment introduced a minor new exception rule, stipulating that word-final **-iya** in transliterated words be reduced to **-ia** [6], not without bringing some confusing inconsistency in the case of derivative words with the original Cyrillic digraph **ия** taking final position in some of them and non-final in others. For instance, **трия**, **кутия** and **трият**,

кутията are transliterated **tria**, **kutia** but **triyat**, **kutiyata**. This exception rule is not endorsed by the draft BDS 1596:2009 standard.

In 2006 the system was adopted for official use on road signs, street names, official information systems, databases, local authorities websites etc., as well as for all Bulgarian geographical names [16]. Eventually, the Streamlined System became part of Bulgarian law by way of the Transliteration Act passed in 2009, which mandated that Bulgarian geographical names, names of historical persons, cultural realities (a very wide even if undefined notion), and scientific terms of Bulgarian origins should be transliterated by this system both in official use and in some private publications [23].

6. BDS 1596:2009 Main version

This evolution in the Bulgarian transliteration practice necessitated the updating of the now-obsolete existing standard BDS 1596:1973 that was formally still in place yet effectively diminished from public and private usage in Bulgaria. For this purpose, the present draft standard BDS 1596:2009 was elaborated by the authors in the framework of a designated work group of the Bulgarian Institute for Standardization.

Like its predecessor, the draft new standard comprises both a main version that is not invertible, and a companion invertible variant to be used in cases where invertibility is essential.

Definition 6.1. The *main version* Tm is the context-free transliteration determined by the following table:

а→a, б→b, в→v, г→g, д→d, е→e, ж→zh, з→z, и→i, й→y,
к→k, л→l, м→m, н→n, о→o, п→p, р→r, с→s, т→t, у→u,
ф→f, х→h, ц→ts, ч→ch, ш→sh, щ→sht, ъ→a, ь→y, ю→yu, я→ya.

In other words, for a main version we take the Streamlined System proper: $\mathsf{Tm} = \mathsf{S}$.

The main version is not invertible indeed, for $\mathsf{S}(\mathbf{a})$, $\mathsf{S}(\mathbf{ж})$, $\mathsf{S}(\mathbf{й})$, $\mathsf{S}(\mathbf{ц})$, $\mathsf{S}(\mathbf{ш})$, $\mathsf{S}(\mathbf{щ})$, $\mathsf{S}(\mathbf{ю})$, $\mathsf{S}(\mathbf{я})$ are equal to $\mathsf{S}(\mathbf{ъ})$, $\mathsf{S}(\mathbf{зх})$, $\mathsf{S}(\mathbf{ь})$, $\mathsf{S}(\mathbf{тс})$, $\mathsf{S}(\mathbf{сх})$, $\mathsf{S}(\mathbf{шт})$, $\mathsf{S}(\mathbf{йу})$, $\mathsf{S}(\mathbf{йа})$, respectively.[2] While all transliterations preserve homographs, the uninvertible transliterations may produce some new ones. In particular, the equality $\mathsf{S}(\mathbf{a}) = \mathsf{S}(\mathbf{ъ})$ generates several hundred new homographs in addition to those existing in the original Cyrillic orthography of Bulgarian (cf. [20]).

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[2]These violations of invertibility can be regarded as basic ones entailing all the others by means of chains of equalities as in the following example:

$\mathsf{S}(\mathbf{тш}) = \mathsf{S}(\mathbf{т})\mathsf{S}(\mathbf{ш}) = \mathsf{S}(\mathbf{т})\mathsf{S}(\mathbf{сх}) = \mathsf{S}(\mathbf{т})\mathsf{S}(\mathbf{с})\mathsf{S}(\mathbf{х}) = \mathsf{S}(\mathbf{тс})\mathsf{S}(\mathbf{х}) = \mathsf{S}(\mathbf{ц})\mathsf{S}(\mathbf{х}) = \mathsf{S}(\mathbf{цх})$.

Theoretically, the system S could be modified to become both invertible and context-free in a number of different ways. For instance, that could be ensured by changing the transliteration of the letters **й**, **х**, **ъ**, **ь** to **й→yh**, **х→kh**, **ъ→ah**, **ь→yi**, and either changing that of **т** to **т→th**, or that of **ц**, **щ** to **ц→cs**, **щ→ct**.[3] However, the use of such exotic digraphs would affect the advantage of S being oriented towards English language. (An example of invertible system featuring unusual letter combinations is the Russian standard for the Romanization of Bulgarian GOST 7.79 of 2000 [9]). For that reason, to obtain an invertible companion variant Ti of S we modify below the system by making it non context-free and adding non-letter symbols, choosing for the purpose symbols that are normally not used as punctuation and are available on standard computer keyboards.

7. BDS 1596:2009 Invertible variant

We extend the Latin alphabet by adding the symbols grave ` and vertical bar | : $\Delta = \{\mathbf{a}, \mathbf{b}, \mathbf{c}, \ldots, \mathbf{z}, \grave{}, |\}$. Consider the non context-free transliteration $\mathsf{Ti} : \Sigma^+ \to \Delta^+$ introduced by the transliteration table of $\mathsf{S}$ with the rules for **ъ** and **ь** modified to **ъ→`a**, **ь→`y**, and, roughly speaking, the following 9 new rules added: **зх→z|h**, **йа→y|a**, **йу→y|u**, **сх→s|h**, **тс→t|s**, **тш→t|sh**, **тщ→t|sht**, **шт→sh|t**, **шц→sh|ts**. That is, all Bulgarian letters are transliterated as in the system S, with a grave inserted in front of the transliterations of **ъ**, **ь**, and with the transliterations of two consecutive letters separated by a vertical bar in the case of digraphs **зх**, **йа**, **йу**, **сх**, **тс**, **тш**, **тщ**, **шт**, **шц**.

Definition 7.1. More formally, the *invertible variant* $\mathsf{Ti} : \Sigma^+ \to \Delta^+$ is introduced by the equality $\mathsf{Ti}(\sigma_1 \ldots \sigma_n) = \varepsilon_1 \mathsf{S}(\sigma_1) \ldots \varepsilon_n \mathsf{S}(\sigma_n)$, where

- ε_i is the symbol grave, if σ_i is **ъ** or **ь**;

- ε_i is a vertical bar, if $i > 1$ and $\sigma_{i-1}\sigma_i$ is some of the abovementioned 9 digraphs;

- ε_i is the empty string, otherwise.

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[3]In the case of S, less than five changes in its table would not suffice for obtaining an invertible context-free transliteration, since one should change the transliteration of at least one letter from each of the sets $\{\mathbf{a}, \mathbf{ъ}\}$, $\{\mathbf{ж}, \mathbf{з}, \mathbf{х}\}$, $\{\mathbf{й}, \mathbf{ь}\}$, $\{\mathbf{с}, \mathbf{т}, \mathbf{ц}\}$, and if only one of the letters **й**, **ь** has its transliteration modified, then also at least one of the letters **y**, **ю** should be with changed transliteration too. If one requires in addition that the 18 uniformly transliterated letters retain their traditional transliterations, then at least six changes would be necessary. Indeed, the letters **ъ** and **ц** should be with changed transliterations in that case, one should also change the transliteration of at least one letter from each of the sets $\{\mathbf{ж}, \mathbf{х}\}$, $\{\mathbf{й}, \mathbf{ь}\}$, $\{\mathbf{ш}, \mathbf{щ}\}$, and if only one of the letters **й**, **ь** is with changed transliteration, then the letter **я** should have its transliteration modified too.

The invertibility of the transliteration Ti is established in the following section. Notice that the plain streamlined transliteration word form could be retrieved from its invertible variant by simply removing the additional symbols ` and | .

8. Invertibility

For the sake of technical convenience, we give an alternative definition of Ti. Namely, let $\mathsf{S}' : \Sigma \to \Delta^+$, $\mathsf{S}'(\mathbf{ъ}) = {}$`$\mathbf{a}$, $\mathsf{S}'(\mathbf{ь}) = {}$`$\mathbf{y}$, and $\mathsf{S}'(\sigma) = \mathsf{S}(\sigma)$ otherwise. Take $\mathsf{R} : \Sigma^2 \to \Delta^+$ ($\mathsf{R}(\sigma, \rho)$ is 'the transliteration of ρ if preceded by σ') defined as follows: $\mathsf{R}(\sigma, \rho) = \varepsilon\mathsf{S}'(\rho)$, where $\varepsilon = |$, if $\sigma\rho \in \{\mathbf{зх}, \mathbf{йа}, \mathbf{йу}, \mathbf{сх}, \mathbf{тс}, \mathbf{тш}, \mathbf{тщ}, \mathbf{шт}, \mathbf{шц}\}$, and ε is the empty string otherwise.

Definition 8.1. The *invertible variant* $\mathsf{Ti} : \Sigma^+ \to \Delta^+$ is introduced by the equality $\mathsf{Ti}(\sigma_1 \ldots \sigma_n) = \mathsf{S}'(\sigma_1)\mathsf{R}(\sigma_1, \sigma_2) \ldots \mathsf{R}(\sigma_{n-1}, \sigma_n)$ for all $\sigma_1, \ldots, \sigma_n \in \Sigma$.

Definition 7.1 and Definition 8.1 of the mapping Ti are easily seen to be equivalent.

In order to prove that the mapping Ti is indeed injective, we introduce some auxiliary notions first.

Definition 8.2. For any letter σ of Σ, the string $\mathsf{S}'(\sigma)$ is *the basic code of σ*, and any of the strings $\mathsf{S}'(\sigma)$, $|\mathsf{S}'(\sigma)$ is *a code of σ*.

Clearly, $\mathsf{R}(\sigma, \rho)$ is a code of ρ for any two letters σ, ρ in Σ. It is easy to see that whenever a string from Δ^+ is a code of any two letters of Σ, these two letters coincide. Indeed, in such a case the two letters will have one and the same basic code (since no basic code starts with $|$); however, different letters have different basic codes.

Definition 8.3. *The code of a letter ρ of Σ after a string s of letters of* Σ is the basic code $\mathsf{S}'(\rho)$ of ρ, if the string s is empty, and is the string $\mathsf{R}(\sigma, \rho)$, if s is non-empty and its last letter is σ.

Evidently, the code of ρ after s is a code of ρ, and for any non-empty finite sequence $\sigma_1, \sigma_2, \ldots, \sigma_n$ of letters from Σ, the string $\mathsf{Ti}(\sigma_1\sigma_2 \ldots \sigma_n)$ has the form $\sigma_1^*\sigma_2^* \ldots \sigma_n^*$, where σ_i^* is the code of σ_i after the string $\sigma_1\sigma_2 \ldots \sigma_{i-1}$ for $i = 1, \ldots, n$.

Theorem. *Let $\sigma_1, \sigma_2, \ldots, \sigma_n$ be a finite sequence of letters from Σ, and let σ_i^* be the code of σ_i after the string $\sigma_1\sigma_2 \ldots \sigma_{i-1}$ for $i = 1, \ldots, n$. Then for $i = 1, \ldots, n$, the string σ_i^* is the longest one among the beginnings of the string $\sigma_i^*\sigma_{i+1}^*\sigma_{i+2}^* \ldots \sigma_n^*$, which are codes of letters from Σ after the string $\sigma_1\sigma_2 \ldots \sigma_{i-1}$.*

P r o o f. [4] Suppose that a letter σ from Σ has a code σ^* after the string

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[4]The statement of the theorem can be derived also from a result proved in [21].

$\sigma_1\sigma_2\ldots\sigma_{i-1}$, such that σ^* is a beginning of the string $\sigma_i^*\sigma_{i+1}^*\sigma_{i+2}^*\ldots\sigma_n^*$, and σ^* is longer than σ_i^*. Then surely $i<n$. In addition, σ_i^* is a proper beginning of σ^*, therefore $\sigma^*=\sigma_i^*u$ for some non-empty beginning u of the string $\sigma_{i+1}^*\sigma_{i+2}^*\ldots\sigma_n^*$. Let ξ be the first symbol of u. Clearly ξ will be the first symbol also of σ_{i+1}^*. The string σ_i^* is the basic code of the letter σ_i or the basic code of σ_i supplemented with a vertical bar in front of it. Due to this and to the fact that the basic codes of the letters from Σ are non-empty strings not beginning with a vertical bar, the equality $\sigma^*=\sigma_i^*u$ implies that $\mathsf{S}'(\sigma)=\mathsf{S}'(\sigma_i)u$. Therefore, $\mathsf{S}'(\sigma)$ has a length greater than 1, and $\mathsf{S}'(\sigma_i)\xi$ is a beginning of $\mathsf{S}'(\sigma)$. Clearly $\mathsf{S}'(\sigma)$ could be none of the strings **ch**, **`u**, **`a**, for this would imply that $\mathsf{S}'(\sigma_i)\in\{\,\mathbf{c},\mathbf{`}\,\}$. Thus only some case among those in the table below could be present:

$\mathsf{S}'(\sigma)$	**zh**	**ts**	**sh**	**sht**	**sht**	**yu**	**ya**
$\mathsf{S}'(\sigma_i)$	**z**	**t**	**s**	**s**	**sh**	**y**	**y**
ξ	**h**	**s**	**h**	**h**	**t**	**u**	**a**
σ_i	**з**	**т**	**с**	**с**	**ш**	**й**	**й**
σ_{i+1}	**х**	**с, ш** or **щ**	**х**	**х**	**т** or **ц**	**у**	**а**

However, all these cases are impossible, since, in each of them, σ_{i+1}^* should begin with | rather than the corresponding ξ.   ■

     Corollary. *Under the assumptions of the above theorem, the sequence* $\sigma_1,\sigma_2,\ldots,\sigma_n$ *can be retrieved from the string* $\mathsf{Ti}(\sigma_1\sigma_2\ldots\sigma_n)$ *by consecutively retrieving the letters* σ_1, σ_2, ..., σ_n *on the basis of the equality*

$$\mathsf{Ti}(\sigma_1\sigma_2\ldots\sigma_n)=\sigma_1^*\sigma_2^*\ldots\sigma_n^*$$

and the characterization of σ_i^* *given in the theorem.*

     The above corollary shows that the transliteration Ti is indeed invertible and, moreover, its inversion can be performed by means of the so-called longest match strategy.

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