Proposal for a Bangla (or Bengali) Script Root Zone Label Generation Ruleset (LGR)

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# General Information

This document lays down the Label Generation Rule Set (LGR) for the Bangla (or ‘Bengali’)[[1]](#footnote-2) script under the general rubric of the Neo-Brahmi Writing System. Three main components of the Bangla Script LGR i.e. (i) Code point repertoire, (ii) Variants and (iii) Whole Label Evaluation Rules which have been described in detail here, having given a brief historical background of the Script under Section 3.

All these components will be incorporated in a machine-readable format in an XML file named "proposal-bangla-lgr-02apr19-en.xml". Labels for testing can be found in the accompanying text document “bangla-test-labels-02apr19-en.txt”.

# Script for Which the LGR Is Proposed

ISO 15924 Code: Beng

ISO 15924 Key N°: 325

ISO 15924 English Name: Bengali (Bangla)

Latin transliteration of native script names [in IPA]: bɑːŋlɑː, ôxômiya

Native names of the script: বাংলা, অসমীয়া

Maximal Starting Repertoire (MSR) version: MSR-4

# Background on Script & Principal Languages Using It

## 3.0. Introduction

‘Bangla’ (or Bengali) is historically and genealogically regarded as an eastern Indo-Aryan language with around 178.2 million speakers in Bangladesh (98% speakers), and 83.4 million speakers in the Indian states of West Bengal (68.37 million), Tripura (2.15 million), South Assam (7.3 million), Odisha (0.49 million) and Delhi (0.21 million) as well as in the Andaman and Nicobar Islands (close to a hundred thousand) - accounting for 8.3% of India. It is a major language in Jharkhand (2.6 million), too and a language with a sizable population in Bihar (0.44 million). Apart from these there are a huge number of Bangla-speaking diasporas spread all over the world. It is the seventh largest spoken and written language in the world. Bangla is the national and official language of Bangladesh, and one of the 22 Official languages in India (listed in the 8th Schedule of the Indian Constitution). It is also one of the official languages of Sierra Leone. The script is also called Bangla [102] which is an eastern variety of the ‘Brāhmī’ Writing System, written from left to right. Historically it derives from the Brāhmī alphabet as used in the Ashokan inscriptions (269-232 BC).

In order to understand the genesis of Bangla language, one could consider Suniti Kumar Chatterji’s [103, pp 16] suggestion of dividing the Indo-Aryan family of Speech into three broad periods considering the main phonetic changes and morphological trends. They are as follows:

(i) The *Old Indo-Aryan* (OIA) during which the language was most copious in both its sound and forms. The OIA period begins from the composition of the Vedic Hymns, i.e. from around 1500/1200 B.C. to the 557-477 B.C., the time immediately preceding Gautama Buddha.

(ii) The *Middle Indo-Aryan* (MIA) during which there was a movement towards simplification of older consonant groups, and a general curtailment or simplification of grammatical forms. The MIA period (600 BC-1000 AD) is further subdivided into an early, a second and a late stage, with a transitional stage between the early and the second stage. The early MIA is attested by inscriptional ‘Prākṛt’ and ‘Pāli’. The second MIA stage is represented by literary Prākṛts, and the late MIA stage by ‘Apabhraṅśa’ and ‘Avahaṭṭha’.

(iii) The *New Indo-Aryan* (NIA) is the third stage starting from roughly 1000 AD, when the total character of the language underwent many changes, and the vernaculars of modern Indo Aryan began to spring up. Bangla is said to have evolved from ‘Māgadhī Apabhraṅśa-Avahaṭṭha’ along with Asamiyā (or Assamese), Odia (often spelt as ‘Oriya’), Magahi, Maithili, and Bhojpuri. Bangla belongs to the earlier group of the Magadhan sub-family along with Asamiyā and Odia [104].

Bangla and its cognate languages, as mentioned above, together form a linguistic group known as the Eastern New Indo-Aryan (NIA). There is a gross inadequacy of the inscriptions and manuscripts in the Eastern Apabhraṅśa or ‘Avahaṭṭha’ except for small inscriptions and the manuscripts of the Tantric Buddhist text titled ‘*Caryyācaryyaviniścaya*’ or the *Caryā-Pada* [114] dating back to the 9th-11th century. As a result, there is not much epigraphic evidence for the development of its writing system. However, what evidence is available of the genesis of Bangla writing system is discussed in the section 3.1 [109].

Historically, the Bangla language is divided into three periods as evident from various sources:

(i) Firstly, Old Bangla Period (roughly 950/1000 to A.D.1200/1350) of which three specimens are found: (a) 47 Caryā songs composed by the Sahajiyā Buddhists (Cf. Shastri 1916) - the *Caryyācaryyaviniścaya* , the *Dohākōṣa* of Saraha and the *Dohākōṣa* of Kānha (mostly in Apabhraṅśa), and the *Ḍākārṇava* (in a variety of Prākṛt), (b) Old Bangla specimens of over 300 words in a commentary on the *Amara-kōśa* dated 1159 AD, and finally (c) the *Rāmacaritam* of Sandhyākara Nandī (1084-1155 AD), attesting some place names [141].

(ii) Then there is Middle Bangla Period - 1200-1800 AD, again divided into three stages:

(a) Transitional Middle Bangla (1200-1300 A.D): No genuine specimens are found, except for the legends of Gopīcandra, Behulā-Lakhindara, Khullanā-Dhanapati, Phullarā-Kālaketu, Lāusena, etc. which were dealt with in great poems in subsequent centuries (e.g. *Gopīcandrer Gāna* by an anonymous poet, *Gopīcandrer Pā̃cāli* by Bhavānī Dāsa, *Gopīcandrer Sanyās* by Sākur Mamud, *Caṇḍīmaṅgalas* of Mānika Datta/Dvija Mādhava/Kavikankana Mukunda, etc., *Manasāmaṅgalas* of Vipradāsa Piplāi/Vijaya Gupta, etc.) [147],

(b) Early Middle Bangla (1300- 1500 A.D) with classics such as the *Śrī-Kṛṣṇakīrttana* of Caṇḍidāsa (born 1408 AD) or various Bangla translations of *Bhāgavata*, the *Rāmāyaṇa* (e.g. Bangla *Rāmāyaṇa* of Kṛttivāsa Ojhā, 1381-1461) and the *Mahābhārata* (Bangla translation by Parameśvar Dāsa aka *Parāgalī Mahābhārata*), and

(c) Late Middle Bangla (1500-1800 A.D) which is attested by the development of Vaiṣṇava literature under the influence of Śrī Caitanya Deva (1486-1534 AD) and his disciples.

(iii) Finally, after 1800 AD, we find the Modern or New Bangla, marked by the introduction of written prose [109] in the books of Fort William College (established in 1800; books published—*Rājā Pratāpāditya Caritra* by Rāmarāma Basu, *Batriśa Siṅhāsana* by Mrityuñjaya Vidyālaṅkāra, etc.) Christian missionaries, or in the works of Raja Ram Mohan Roy (1772-1833), Ishwar Chandra Vidyasagar (1820-1891), Bankimchandra Chattopadhyay (1838-1894), Michael Madhusudan Datta (1824-1873), Rabindranath Tagore (1861-1941), and Sarat Chandra Chattopadhyay (1876-1938) [149]. The colloquial variety of Bangla based on the speech variety of Calcutta (called ‘Kolkata’ now) made its first appearance through the *Hutōm Pẽcāra Nakśā* (1862) by Peari Chand Mitra. The influence of English in the vocabulary, idioms, and expressions as well as in the writing styles of Bangla is significant by this time. The fonts and types for Bangla developed during this time also spread to all parts of Bangla speech community [101, 120]. The same fonts with some extensions were also used for the neighbouring languages deploying this writing system.

Bangla prose had developed two literary styles during the 19th-20th Century: The *Sādhubhāṣā* (সাধুভাষা - "Elegant Language or Style") and the *Calitabhāṣā* (চলিতভাষা "Current Language, or Modern Style"). The former is the traditional literary style based on Middle Bangla of the sixteenth century, while the latter is a basically 20th century creation and is based on the speech of elites and the educated people in and around Calcutta or Kolkata and Dhaka [115]. It is the latter style that is prevalent today in written prose. With the *Calitabhāṣā* came many spelling and script reforms [118] before 1947 as well as in both Kolkata and Dhaka after independence. In the dialogues of plays and fiction, as also in certain experiments as the sole descriptive medium, the dialects of Dhaka-Mymensingh and other places are being extensively used.

#### Following the British colonial rule, the two separate nations of Pakistan and Bangladesh became an integrated nation, as West and East Pakistan being its two distant wings, ramified by India appeared on the world map on 14th August 1947. “The political developments in East Bengal after the partition did not exactly follow the trends set out by pre-partition politics…Even before the creation of Pakistan in August 1947, there was demand to make Bangla the national language…while the new born state was beset with so many other vital problems, it was unexpectedly the peripheral language question which was taken up by the top leadership as a major policy line for the state.”[[2]](#footnote-3) Urdu was announced the federal language of Pakistan in 1948 by the then Governor-General Muhammad Ali Jinnah. The language of the majority of the people of eastern wing of Pakistan, was Bangla which had a well-heeled heritage of literature of more than a thousand years. There was a lot of incongruity between the culture of the Bengalis and that of the people of the western wing of Pakistan. When in 1952, the central leaders and the Urdu-speaking intellectuals of Pakistan declared that Urdu and only Urdu would be the state language of Pakistan, the people of East Pakistan started preparing themselves up for an unrest. Urdu was seen to be historically in extensive use only in the north, central, and western region of the subcontinent; however, in East Bengal, the native language was Bangla. There was a petition from the people of East Bengal that their language be given a federal status alongside Urdu and English. The civil society started raising their voices against various problems pertaining to the issue of language. The Language Movement in its true form, began in 1948, as civil society dissented to the elimination of the Bangla script from currency and stamps, which were in use since the British Raj. The movement reached its pinnacle in 1952, when on 21 February the police fired on remonstrating students and civilians, triggering numerous injuries and deaths. Later, following the Language movement, on 27 April 1952, the All Party National Language Committee decided to demand establishment of an organisation for the promotion of Bengali language. During the 1954 parliamentary elections, the United Front's 21-point manifesto stated that, "The prime minister from the United Front will dedicate the Bardhamāna House for establishing a research centre for the Bengali language." Bangla Academy was established in December 3 of 1955. Bangla Academy right from its inception has been engaged in promoting and fostering Bangla as the *lingua franca* of the country before and after independence from Pakistan in 1971. Through the various commissions and committees constituted by the Government of Bangladesh (Bāṅlādeśa Jātīya Śikṣā Kamiśana in 1972, Jātīya Śikṣā Upadeṣṭā Pariṣad in 1979, Bāṅlā Bhāṣā Bāstabāyana Sela in 1982, Bāṅlā Bhāṣā Kamiṭi in 1983, etc.[[3]](#footnote-4)) after independence in 1971 Bangla was made the primary medium of instruction/communication in all Governmental and educational activities. Through a great struggle and bloodshed, the Bengalis established Bangla as an official language of the state. The struggle that vouched for the stand to maintain the right to speak and write in their mother tongue formed the foundation for boundless conceit and encouragement among Bengalis all around the world today[[4]](#footnote-5).

As a symbol of profound veneration towards the people who instilled the feeling and also to show reverence to the martyrs of the cause, the UN declared Ekuśe February (21st February) as the International Mother Language Day at the UNESCO General Conference in Paris on 17 November 1999 “in recognition of the sanctity and preservation of all vernacular languages in the world.”[[5]](#footnote-6)[[6]](#footnote-7)

## 3.1. Written Bangla

The ‘Bangla alphabet’ (বাংলা লিপি - Bānglā lipi, ISO 15924) is derived from the Brāhmī writing system, which is related to the Nāgarī (*also known as* Devanāgarī[[7]](#footnote-8)) script [108] as well as to Tirhutā writing system [106]. Considered to be fifth most widely used writing system in the world, this combined Bangla-Asamiyā-Maṇipuri Script (showing some variations for Asamiyā and Meitei or Biṣṇupriyā Man̼ipuri) (130), was used in the eastern Indian Sanskrit manuscripts too. For Chākmā in India and Bangladesh and for Kokborok in Tripurā, it was and still is one of the scripts used. A close variant, called *Tirhutā* (123; now available also in UNICODE 10.0 as 11480 114DF; See 110) or *Mithilākṣara* was used for Maithili from the 14th Century until the early-20th century [106]. In this context, one finds a mention of ‘Sylheti Nāgarī lipi’ or ‘Siloṭi’ (added to the Unicode Standard in March 2005 with the release of version 4.1) the details of which could be of interest only to historians and historical linguists (See 137 and 144). But Sylheti Bangla is generally written by many in the modern-day Bangla script now for all practical purposes. Originally, during the reign of the Pāla dynasty (750-1154 AD) in the eastern India, and even earlier, perhaps during the Malla period (694 AD onwards), the present-day Bangla writing system got a shape comparable to the modern-day ones [111, 119]. A pictorial description of Brāhmī to Modern Bangla Script could be presented here in a tabular form:



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Modern | ক | জ | ম | র | স | অ |
|  | k | j | m | r | s | a |

Table 1: Pictorial depiction of Evolution of Brāhmī to Bangla

The inscriptional evidence in Brāhmī is found in the Archaic Brāhmī from the 3rd century B.C. to the 1st century B.C, and in Middle Brāhmī – soon after (1st-3rd Century A.D.) and then on in the Late Brāhmī (4th-6th Century A.D.). This evidence could be seen in both Bangladesh and West Bengal [108] by 1) The Mahāsthānagaṛa (Bogra district, Bangladesh — the ancient name being Puṇḍranagara or Pauṇḍravardhanapura) inscriptions, 2) Brāhmī (and Kharoṣṭhī) inscriptions from the lower ‘Gangetic Bengal’ and (3) Copper plate inscriptions of the Imperial Guptas from Northern part of West Bengal and North-West Bangladesh — in the areas under Dharmāditya, Gopachandra and Samācāradeva (about whom one only knows from five Copper-plates found in Kotālipāṛā in the Faridpur district in Bangladesh, one in Mallasārul in the Burdwan district (West Bengal), and one in Jayrāmapura (Balleśvara district, now in Odisha).

These epigraphs from the eastern part of Undivided India (dating back to the 4th-6th Centuries A.D.) showed some characteristic features of letters (especially in ম ‘ma’, ল ‘la’, শ ‘śa’, স ‘sa’ and হ ‘ha’), which led to the development of eastern variety of Gupta script. Epigraphic records from Bangladesh demonstrate remarkable developments in Eastern Brāhmī. In this context, the Tippera copper plate inscription of the ‘Samataṭa’ rulers (139, pp 265) such as Lokanātha (dated 7th Century A.D., during the latter half), the Kailan inscription of Śridharaṇa Rāta as well as the Astafpur copper plates. The letters seem to hang down from wedge shaped solid triangles with right hand verticals bending down at the bottom, because of which it was described by Prinsep and Fleet as *Kuṭila-lipi* (literally, ‘Cursive writing style’), whereas the term *Siddhamātrikā* (as a mātrā or bar is placed over each of the letters) was used by Al Biruni (973-1048) to designate the script of Northern India. The next stage of development is illustrated by the 9th Century copper plate inscriptions from Khalimpur of the reign of Dharmapāla, from Monghyr and Nālandā of the time of Devapāla in Bihar, and from Jagjīvanpura (Malda) of the reign of Mahendrapāla. The Siddhamātrikā (mentioned as ‘Siddham’ in Chinese sources) is said to have been prevalent also in this region up to the end of the tenth century. Also called the Gauri (i.e. Gandi) in Pūrvadeśā or the Eastern country, it was regarded as the same script to which is given the appellative Proto-Bangla characteristics in rudimentary forms, in the period between A.D. 875 and A.D. 1025.

In some epigraphs it is considered as belonging to the second quarter of the eleventh century A.D. Flattening of head-marks becomes prominent in comparison to the wedge-shaped serifs. An important landmark in the development of the Bangla script is the Rāmagañja copper plate inscription of Mahāmāṇḍalika in the last quarter of the eleventh century A.D. It is the earliest document from this entire region which bears the letter m, with a tick rising upwards. The full vowel i develops a tick at the right end of the upper horizontal bar above and a curved hook below. Initial e approaches the modern Bangla character. A mature form of Proto-Bangla, the immediate precursor of Bangla script, is illustrated in the inscriptions of the Varmaṇa, Sena and Deva rulers of the twelfth and thirteenth centuries [104].

The evolution of the Bangla script (Cf. 136) is aligned with the story of advancement of printing technology. The first “Movable type” scripts technically created and used while printing Nathaniel Brassey Halhed's (1751-1830) 1778-book titled, '*A Grammar of the Bengal Language*'. In 1785, Governor-General Warren Hastings (1732-1818) requested another civilian, Charles Wilkins (1749-1836) to cut punches for Bangla printing characters. The current printed form of Bangla script appeared soon after. It is generally agreed that Wilkins developed Bangla print script [111]. He passed on this knowledge to Pañcānana Karmakāra (?-1804), a renowned artist in Bengal. Later it was Karmakar and his family that became famous in Bangla printing technology. Shepherd was another assistant of Wilkins in this designing of script, which became more angular with sharper turns and edges [133]. A few archaic letters were modernised during the 19th century. It was standardized by Pandit Ishwar Chandra Vidyasagar when the Bangla type fonts were to be used to publish on a large scale under the Calcutta School Book Society [116 for several references].

Much later, in 1935, the Linotype technique, invented by Ottmar Mergenthaler (1854-1899) in 1886, was introduced into Bangla printing in 1935, by the efforts of Suresh Chandra Majumdar (1888-1954), Rajsekhar Basu (1880-1960), Jatindra Kumar Sen (1882-1966) and his disciple, Sushil Kumar Bhattacharya and had begun being used by the Ānandabāzara Patrikā group, later followed by others. Within a few years the more advanced monotype technology came to be used in Bangla printing. However, in Bangla printing culture, monotype has a very limited acceptance and linotype held stage till, eventually, the digital technology came in to replace all earlier techniques.

All these could be presented in a table:

| **PERIOD** | **DESCRIPTION** | **NAMES** |
| --- | --- | --- |
| 3rd Millennium B.C. | During the Harappan civilization, the script was developed which was partly pictographic, and perhaps written from right to left, and also in a manner of ‘boustrophedon’ (literally *Ox-writing*), i.e. bi-directionally, where every other line is reversed. The attempts are still on to unravel the mystery of this script and its characters. | Indus Valley Script |
| 3rd Century B.C. | Use of Brāhmī and Kharoṣṭhī scripts begin in the subcontinent. Brāhmī was widely used during the Mauryan King, Aśoka. In one theory, Brāhmī is based on North Semitic alphabet but suitably modified to fit the need of local languages. It is currently believed to have been an independent development. | Brāhmī |
| 1st-3rd Century AD | The Kuṣāṇa script, named after the Kuṣāṇa royal dynasty. | Kuṣāṇa script |
| 4th-5th Century AD | The next stage of its evolution was into the Gupta script, named after the Gupta royal dynasty. | Gupta script |
| 7th Century AD | Epigraphic records from Bangladesh demonstrate remarkable developments in Eastern Brāhmī, giving rise to the *Kuṭila-lipi* | Kuṭila-lipi |
| 8th Century AD | Some copper plate inscriptions are found in the Khalimpur, Bangladesh during the reign of Dharmapāla, from Monghyr and Nālandā in Bihar, of the time of Devapāla, and from Jagjīvanapura in West Bengal of the reign of Mahendrapāla. | *Siddhamātikā* |
| 9th Century AD until 1025 AD | Proto-Bangla characteristics in rudimentary forms develops. An important landmark in the development of the Bangla script is the Rāmagañja copper plate inscription of Mahāmāṇḍalika found in the last quarter of the eleventh century A.D. | Proto-Bangla Script & Language |
| 12th-13th Century AD | A mature form of Proto-Bangla, the immediate precursor of Bangla script, is found in the inscriptions of the Varmaṇa, Sena and Deva rulers of the twelfth and thirteenth centuries. | Matured Proto-Bangla |
| 14th-15th Century AD | The characteristics of typical Bangla script began to develop, as could be seen in the copper plate inscription of Vijayamāṇikya-I of Tripura dated 1478 AD - also Illustrates forms of Bangla letters in the fifteenth century A.D. | Modern Bangla Script era begins (See Ross 1999) |
| 16th-17th Century AD | The chart of the Bangla alphabet, appended to the China Monuments, published from Amsterdam in 1667 and *The code of Gentoo law*, published from London in 1776, both show a chart of the Bangla alphabet. They show 16 Vowel letters, including the Long ‘ৡ’ ‘l̥̄i’, Anusvāra and *Visarga*, and 34 Consonants. | Printed Charts of Bangla |
| 18th-19th Century AD | Charles Wilkins develops printing in Bangla in 1778 and Vidyasagar reforms it. | Bangla Type Fonts |

Table 2: Development of the Bangla Writing System

The overall development of Bangla Script from the Kuṭila-lipi period to Modern Bangla could be seen here in Table 3 ([102 and 146] and also see the web-page in 147).



Table 3: Bangla Script in Different Centuries

## 3.2. Languages Considered

Below is the tabular representation of the languages using Bangla script that are placed on EGIDS Scale 1-6 (See 117 for details). Some languages under EGIDS 5 and 6 have also developed their own scripts for printing and publishing. Some had used Bangla script earlier (such as Bodo), or used it in West Bengal at some point of time (Santali) but have later shifted to another writing system. Bodo is now written in Nāgarī or Devanāgarī and for Santali one uses both Nāgarī Devanāgarī and *Ol-chiki* (145). For the purposes of the Bangla LGR, languages belonging to the EGIDS scale 1 to 4 only have been considered. Consider the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EGIDS Scale 1** | **EGIDS Scale 2** | **EGIDS**  **Scale 3** | **EGIDS Scale 4** | **EGIDS**  **Scale 5** | **EGIDS 6** |
| Bangla  (Bengali) |  |  |  | Santali, Bodo,  Riang, Khumi, Mru(ng), Asho | Lepcha  Pnar, Koda/ Kora, Chak |
|  | Asamiyā (Assamese) |  |  | Koch or Rājabaṅśī | Mālto or Mālpāhāṛiyā |
|  | Maṇipuri or Meitei |  | Biṣṇupriyā Maṇipuri,  Kok-Borok (Tripura & Bangladesh) | Chākmā, Hājong, Muṇḍāri &  Kurux (of Bangladesh) | Toto,  Rohingyā,  Tippera,  Megam,  Tanchangya |
|  |  |  | Usoi | Limbu, Sadri or Oraon | Bhumij or Muṇḍāri, Bawm, Chin |

Table 4: Main languages in India and Bangladesh

that use Bangla Script on the EGIDS Scale

## 3.3. Notable Features [150]

* The Bangla script is an alpha-syllabic writing system in which writing of all consonants are assumed to contain an accompanying ‘inherent’ vowel (theoretically before or after each consonant). It varies between /ɔ/ and /o/ depending on the position of the consonant in the word. At times, these assumed or ‘inherent’ vowels are not pronounced at all [142].
* Vowels can be written as independent letters, or by using a variety of diacritical marks which are written above, below, before, after or both of the last two positions the consonant they follow in pronunciation [105].
* All Bangla consonants when pronounced in isolation are uttered with an inherent vowel - / ɔ/; hence ক ‘k’, খ ‘kh’ or গ ‘g’ are usually pronounced as [kɔ], [khɔ], or [gɔ], etc. Phonologically, Bangla vowel - / ɔ/ corresponds to the Hindi schwa /ə/
* When consonants occur together in clusters, special conjunct letters are formed. In printed Bangla, a large number of these consonantal clusters or conjoined consonants are in use. The letters for the consonants other than the final one in the group are generally reduced. But there are a few special conjunct characters which are compounds of the consonant characters, e.g. ক্+ষ=ক্ষ, ঞ্+জ=ঞ্জ, জ্+ঞ=জ্ঞ, হ্‌+ম=হ্ম. There are other issues also—র as the second member of a cluster is reduced to a secondary symbol, e.g. প্+র=প্র, ষ্+ট্+র=ষ্ট্র (as in উষ্ট্র); য, when used as a primary symbol, represents /jɔ/ in Bangla. But its secondary symbol (allograph) jɔ-phalā has two phonetic values. When added to the initial consonant in a word, it is a vowel /æ/ (as in শ্যামল, র‌্যাপার, etc.). But after a non-initial consonant, it just doubles it in pronunciation (as in কার্য, ধার্য, etc.). The র্+য combination has two physical manifestations—র‌্য and র্য. In case of দ্+ধ, গ্+ধ, ন্+ধ the shape of the second member is changed—e.g. দ্ধ, গ্ধ, and ন্ধ respectively. The solitary example of র্‌+ঋ=র্ঋ (as in নৈর্ঋত) – used mostly in cases of Classical borrowings, shows the use of secondary symbol of a consonant followed by the primary symbol of a vowel. The inherent vowel only applies to the final consonant of the cluster.
* In consonant clusters, many consonants took a completely different form. Some typical examples are ক্ত (kt), ক্র (kr), ক্ষ (kṣ), গ্ধ (gdh), জ্ঞ (jñ), ঞ্চ (ñc), ঞ্জ (ñj), ট্ট (ṭṭ), ন্ত (nt), ন্ধ (ndh), ব্ধ (bdh), ভ্র (bhr), ম্ব (mb), স্ত (st) etc. র has two allographs, apart from this full shape : one is ‘repha’, as found in র্ক (rk), র্প (rp); and another is ra- phalā, as in প্র (pr), ক্র (kr). ষ্ণ (ṣ+ṇ) is another one, where the cerebral nasal consonant sign takes a queer shape. [151]
* The Bangla script has at least fifty-two primary symbols and quite a few allographs (positional variants of them), corresponding to forty-four (7 oral and 7 nasal vowels and 30 consonants) phonemes (150) or functional speech sounds, with some obvious redundancies, although in one of the first phonemic analysis, the number was thought to be thirty-five phonemes [140].
* As mentioned above, in Bangla, several graphemic symbols have secondary shapes, technically called ‘allographs’ with a complementary distribution in each case. These graphs or markings are generally added to the following positions of the primary symbol [113] in the following manner:

1) Below (e.g. কু, ন্ত, কূ, হ্র, etc.)

2) Above (e.g. চঁ, র্ক, etc.)

3) Right side (e.g. কা, কং, etc.)

4) Left side (e.g. কে)

5) Left Side and above simultaneously (e.g. কৈ, কি etc.)

6) Right side and above simultaneously (e.g. কী)

7) Right side and left side simultaneously (e.g. কো)

8) Right side, left side and above simultaneously (e.g. কৌ).

* Besides some simple Vowel Modifiers called ‘K ārs’ in Bangla (also referred to as Mātrā in the other LGR documents of Neo-Brahmi) there are some combinatory modifiers of Bangla Vowels with certain consonants. For example, whereas

আ U+0986 BENGALI LETTER AA is substituted by

া U+09BE BENGALI VOWEL SIGN AA,

ই U+0987 BENGALI LETTER I is substituted by

pre-posed ি U+09BF BENGALI VOWEL SIGN I,

ঈ U+0988 BENGALI LETTER II is substituted by

ী U+09C0 BENGALI VOWEL SIGN II or

উ U+0989 BENGALI LETTER U is substituted by

ু U+09C1 BENGALI VOWEL SIGN U by marking below the primary grapheme, there are some special vowel modifiers of উ as in the following combined letters:

গু gu, rather than writing as গ + ু

রু ru, rather than writing as র + ু

শু śu, rather than writing as শ+ ু

হু hu, rather than writing as হ + ু

ন্তু/ন্তু/ন্তু ntu, rather than writing as ন্+ত+ু

Similarly, there could be vowel modifiers of ঊ or ‘(Long) ū’ as well; e.g.

ভ্+র (ভ্রূ), শ্+র (শ্রূ), ঋ after হ (হৃ), etc.

* The global Bangla-speaking diaspora using Bangla script (and language) live in a number of countries, including in the UK, USA, Canada, the Middle East, Japan, South Korea, Malaysia, Pakistan, Singapore, Sierra Leone and Italy and some other countries of Europe.

There have been many notable contributions in simplifying and modifying Bangla spellings and combinatory techniques, especially by scholars such as Pabitra Sarkar (1992) [134]. In this there has been an attempt to reduce the number of allographs of both vowels and consonants in clusters, and it has been widely accepted in the printing of school texts in both Bangladesh and West Bengal [151, 152]. As of now, two systems, the old (traditional), and the new, go on side by side, operative in different domains.

However, in preparation of this LGR document, the aim has been to consider the widely used and usable sequences and combinations and their variations across the sister scripts belonging to the basket of Brāhmī writing systems.

Bangla Academy, Dhaka published Standard Bangla Spelling Rules in 1992 following the recommendations of a committee constituted through a workshop jointly organized by the Jātīya Śikṣākrama and Pāṭhyapustaka Board in 1988. A throughly revised edition of the Rules was published in September 2012.[[8]](#footnote-9)

After the establishment of Bāṅlā Ākādemi of West Bengal in 1986, its first President, Annadasankar Ray (1904-2002), in his inaugural address, gave a direction for standardization of Bangla alphabet, script, the spelling system and clearly argued that they would not blindly follow the Sanskritic model of conventional grammar. A broad list of proposals was sent to experts on Bangla, and a broad agreement was reached for ‘homogenization of Bangla spelling’ by 1988. Based on opinions received from different quarters, a unanimous list of ‘rules’ was agreed upon. This was published by a ‘Spelling Dictionary’ titled, *Ākādemi Bānāna Abhidhāna* (1997), which was obviously more comprehensive than ‘The University of Calcutta proposals’, made in 1936. Along with the ‘rationalization’ of spellings, another step was taken make the writing system easier to read, by making the symbols used, both single and combined ones, more ‘transparent’. These reforms were originally suggested by Sarkar (1987, first published in 1978) [134] [153] where he used the terms *Swaccha* (‘Transparent’) and *Aswaccha* (‘Opaque’ or non-transparent), even adding *Ardha Swaccha* (‘half transparent) in between the two. Some sample examples are:

**Transparent:** ন্ন, প্ত, স্ত, where both member of the cluster can be recognized.

**Opaque:** where neither of the two could be (easily) recognized—ক্ষ (ক্‌ + ষ), জ্ঞ (জ্‌ + ঞ), ঙ্গ (ঙ্ + গ ), হ্ম (হ্‌ + ম).

**Semi-transparent:** প্র, র্প where one symbol is recognizable and the other is not. In case of three-term clusters, at least one symbol will not be transparent, e.g. স্ত্র (স্+ত্+র), ষ্ট্র (ষ্+ট্+র), etc.

There were, in fact, two types of proposals.  One concerned the shape of the letters, those of consonant + vowel (CV) combinations and conjuncts, which is consonant + consonant combinations.  There were further complex shapes, i.e. those of consonant + consonant+ (consonant+) vowel (CC(CV) signs, as in প্রু, or স্ক্রু. Some decisions in this area were necessary because a few of the CC(C) symbols represented complexities that made learning them difficult for the children. The other dealt with the spellings of words only, without any reference to the shapes of letters in which they were written.  The basic objective here was ‘one word, one spelling’, to the greatest extent that was possible. [151]

Below we place a statement of the most salient changes that affect the consonant + vowel combinations. [153]

1. The variants of the short u (হ্রস্ব উ-কার) vowel sign have been brought down to one, i.e., ু. So গু is now গ‍ু. Similarly রু > র‍ু, শু > শ‍ু, হু >হ‍ু.and therefore, cluster + short u sign : ন্তু > ন্ত‍ু (ন+্+ত+উ), স্তু >স্ত‍ু (স+্+ত+উ)
2. The variants of long u (দীর্ঘ ঊ-কার) have also been reduced. রূ > র‍ূ; ভ্রূ > ভ্র‍ূ (ভ+্+র+ঊ); দ্রূ > দ্র‍ূ (দ+্+র+ঊ); শ্রূ > শ্র‍ূ (শ+্+র+ঊ)
3. The variants of ঋ-কার have been brought down to one: হৃ > হ‍ৃ

Regarding consonant + consonant + (consonant)…+ (vowel) clusters Paschimbanga Bangla Akademi proposed transparent or semi-transparent shapes for clusters to the extent admissible in Bangla writing system. Some examples will clarify the proposal (A slash will mean that the traditional cluster-shape precedes it, while the Bangla Akademi innovation follows.) [153]

ব্ধ/ব্‍ধ (ব্‌ + ধ), দ্ধ/দ্‍ধ (দ্+ধ), ন্থ/ন্‍থ, ন্থ (ন্+থ), ঞ্চ/ঞ্চ, ঞ্‍চ (ঞ্+চ), ঞ্ছ/ঞ্ছ, ঞ্‍ছ (ঞ্+ছ), ঞ্জ/ঞ্জ, ঞ্‍জ (ঞ্+জ), ক্ত/ক্ত, ক্‍ত (ক্+ত), ক্র/ক্র (ক্+র), গ্ধ/গ্ধ, গ্‍ধ (গ্+ধ), ঙ্ক/ঙ্‍ক (ঙ্+ক), ঙ্গ/ ঙ্‍গ (ঙ্+গ), ষ্ণ/ষ্ণ (ষ্+ণ), ন্ধ্র/ন্ধ্র, ন্‍ধ্র (ন্+ধ্+র), ণ্ড্র/ণ্ড্র (ণ্+ড্+র), ক্ত্র/ক্ত্র (ক্+ত্+র)

### 3.3.1 The Consonants

As per traditional classification Bangla Consonants are categorized according to their phonetic properties, especially in terms of place and manner of articulation [107]. There are Five ‘Varga’ (pronounced as ‘Barga’ in Bangla) or Groups (sets or classes) distinguished by Place of Articulation, and one Non-’varga’ group [105]. Each Varga, which corresponds to Stops at a certain place of articulation, contains a series of five consonants classified as per their phonetic qualities (i.e. manner of articulation), beginning from Unvoiced and Unaspirated to Voiced and Aspirated (in the fourth column), finally ending with a Homorganic or Corresponding nasal [107]. Consider the following table:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **‘Varga’ or Sets** | **Unvoiced** | | **Voiced** | | **Nasal** |
|  | -Asp | +Asp | -Asp | +Asp |  |
| **Velar** | ক ‘K’  U+0995 | খ ‘KH’  U+0996 | গ ‘G’  U+0997 | ঘ ‘GH’  U+0998 | ঙ ‘NG’  U+0999 |
| **Palatal** | চ ‘C’  U+099A | ছ ‘CH’  U+099B | জ ‘J’  U+099C | ঝ ‘JH’  U+099D | ঞ ‘NY’  U+099E |
| **Retroflex** | ট ‘TT’  U+099F | ঠ ‘TTH’  U+09A0 | ড ‘DD’  U+09A1 | ঢ ‘DDH’  U+09A2 | ণ ‘NN’  U+09A3 |
| **Dental** | ত ‘T’  U+09A4 | থ ‘TH’  U+09A5 | দ ‘D’  U+09A6 | ধ ‘DH’  U+09A7 | ন ‘N’  U+09A8 |
| **Bilabial** | প ‘P’  U+09AA | ফ ‘PH’  U+09AB | ব ‘B’  U+09AC | ভ ‘BH’  U+09AD | ম ‘M’  U+09AE |

Table 5: Varga classification of Bangla consonants

(Falling into a Pattern of Five Sets of Unvoiced Unaspirated, Unvoiced Aspirated, Voiced Unaspirated, Voiced Aspirated and Nasals, called five ‘Varga’)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Non-**  **Varga** | য ‘Y’  U+09AF | য় ‘YY’  U+09DF | র ‘R’  U+09B0 | ড় ‘RR’  U+09DC | ঢ় ‘RH’  U+09DD |
| ল ‘L’  U+09B2 | শ ‘SH’  U+09B6 | ষ ‘SS’  U+09B7 | স ‘S’  U+09B8 | হ ‘H’  U+0939 |

Table 6: Non-Varga consonants (Not falling into any of the five categories)

### 3.3.2 The Implicit Vowel Killer: Hasanta (called ’Halant’ or ‘Halanta’ in other Brāhmī-based scripts)

As stated earlier, all consonants are pronounced in isolation with an implicit vowel (central back /-ɔ/ in Bangla as the neutral vowel) assumed to be associated with them [121]. The ‘Hasanta’ (=’ Halant’ or ‘Halanta’ in other Brāhmī-based scripts) or the term ‘*Virāma*’[[9]](#footnote-10) (=’Dā̃ri’ in Bangla) as preferred in UNICODE (cf. Unicode 3.0 and above) have been used in this report as terms that have been used to denote the character that mark the absence of this inherent vowel. Because a special sign is needed whenever this implicit vowel is stripped off, the symbol is known as the *Hasanta* (= *Halant*) "्" (U+09CD). By placing the *Hasanta* under the first consonant of a combination or cluster, one could – in common parlance, “kill” its vowel, and create conjuncts. In this manner, conjunct characters can be generally done by joining two to four consonant combinations. In rare cases, this process can join up to five consonants. However, the notion of maximum number of consonants joining to form one *akṣara[[10]](#footnote-11)* is to be empirically seen. It is an observation based on the CIIL-Emille Corpora of Bangla words [132 & 133] as seen in print till date. Given the mixture of scripts and languages happening on the web, the possibility that one may want a generic Top Level Domain [gTLD] which may have more than the observed maximum cannot be ruled out. This can be the case when a foreign language word, which admits a large number of consonants, is transliterated into Bangla. Hence, in the Bangla LGR work, this limit will not be enforced.

### 3.3.3 Vowels

Separate symbols exist for all ‘*Swara*’ or Vowels in Bangla, which are pronounced independently either at the beginning of the word or after another vowel or consonant sound. To indicate a Vowel sound other than the implicit one, a Vowel sign, called *‘kāra’ /kar/* in Bangla or *Mātrā* in Nāgarī (although the term ‘Mātrā‘ in Bangla stands for an altogether different concept, viz.the top bar placed over a letter – typically available in Hindi and Bangla but missing in Gujarati) is attached to the consonant. Since the consonant has this built in neutral vowel at the end, there are equivalent kāras (Mātrās) for all vowels except the অ (pronounced /-ɔ/). The correlation is shown as follows:

| **Vowel** | **Corresponding vowel sign (kāras (Mātrās)** |
| --- | --- |
| অ ‘A’ U+0985 |  |
| আ ‘AA’ U+0986 | া U+09BE |
| ই ‘I’ U+0987 | ি U+09BF |
| ঈ ‘II’ U+0988 | ী U+09C0 |
| উ ‘U’ U+0989 | ু◌ U+09C1 |
| ঊ ‘UU’ U+098A | ূ◌ U+09C2 |
| ঋ Vocalic ’R’ U+098B | ৃ◌ U+09C3 |
| ৠ Vocalic ‘RR’ U+09E0 | ৄ◌ U+09C4 |
| ঌ Vocalic ‘L’ U+098C | ৢ◌ U+09E2 |
| ৡ Vocalic ‘LL’ U+09E1 | ৣ◌ U+09E3 |
| এ ‘E’ U+098F | ে U+09C7 |
| ঐ ‘AI’ U+0990 | ৈ U+09C8 |
| ও ‘O’ U+0993 | ো U+09CB |
| ঔ ‘AU’ U+0994 | ৌ U+09CC |
| - | ৗ U+09D7 |
| Could appear on top of অ ‘A’ U+0985 or  any other vowel | ঁ U+0981 Candrabindu |
| Could appear after অ ‘A’ U+0985 or  any other vowel | ং U+0982 Anusvāra |
| Could appear after অ ‘A’ U+0985  or any other vowel | ঃ U+0983 *Visarga* |
| After any consonant | ্ U+09CD (Hasanta ) |
| - | ঽ U+09BD Avagraha |

Table 7: Bangla Vowels with corresponding **kāras**

3.3.4 The Anusvāra /onuʃʃar/ (ং - U+0982)

The Anusvāra or /onuʃʃar/ in Bangla at times represents a homorganic nasal but not always. It replaces a conjunct group of a ‘Nasal Consonant+Hasanta +Consonant’ where the second consonant belongs to the Velar *varga* or set as in লংকা. But it often appears also for such combinations involving non-velars appearing as the last member of the combination as in ল্যাংটা, or ল্যাংচা. Before a non-*varga* consonant, the Anusvāra represents a nasal sound that may have an alternative conjoined writing symbol representing the corresponding nasal consonant of the particular set. Although Modern Hindi, Marathi and Konkani prefer the anusvāra to the corresponding Half-nasal, in Bangla it is clearly demarcated as to where one must use the Anusvāra and where it has to be a conjunct cluster with a nasal as the first or the second component.

### 3.3.5 Nasalization: Candrabindu (ँ - U+0981)

Candrabindu denotes nasalization of the preceding vowel as in চাঁদ /cā̃d/ ‘moon’ (U+099A U+09BE U+0981 U+09A6). This sign with a dot inside the half-moon mark is used as nasalization marker in many Brāhmī-based scripts. [143]

### 3.3.6 Nukta (़ - U+09BC)

The nukta sign does not exist in Bangla orthography. It is predominantly used in many Brāhmī derived scripts, such as Devanāgarī (for Hindi, Bodo, Maithili, Santali, Kashmiri and Sindhi. The term and the concept of *nukta* are borrowed in Bangla.

There could be sporadic attempts or cases of writing Muslim names, Urdu poetic words and Perso-Arabic loan words with *nukta* under ক, খ, গ, জ and ফ only for the sake of correct pronunciation and for maintaining the sanctity of the loan word. It is, however, not in use in Bangla writing in printing. Moreover, the characters ড়, ঢ় and য় are deemed as atomic characters exisitng in the Bangla writing system, on par with the already atomic character - র (U+09B0). Therefore, the existence of nukta character is ruled out completely in Bangla LGR.

Even though UNICODE requires, following its character table for Bangla that য় YYA (U+09DF), ড় RRA (U+09DC) and ঢ় RRHA (U+09DD) are to be viewed and used in Bangla LGR as made up of “য”YA (U+09AF)+”়”Nukta (U+09BC), "ড"DDA (U+09A1)+”়” Nukta (U+09BC) and "ঢ"DDHA (U+09A2)+”়” Nukta (U+09BC), this is being dropped here as use of ‘Nukta’ is completely unnatural in Bangla.

It is noted that in the current Unicode Standard chart, these characters are listed as additional consonants. The standard also prescribes methods to produce these three characters both as atomic characters (for example, 09DC for ড়, 09DD for ঢ়, and 09DF as য় as single key stroke). Writing these characters as conjunct characters and then allocating codes for these in the Unicode Bengali Block do not go with the basic principle of Unicode ofusing atomic consonant representations

### 3.3.7 *Visarga /biʃɔrgo/* (ঃ - U+0983) and Avagraha (ঽ - U+09BD)

The Visarga /biʃɔrgo/U+0983 is frequently used in Bangla loanwords borrowed from Sanskrit and represents a sound very close to /h/. One could quote, as an example: দুঃখ /dukkho/ sorrow, unhappiness (U+0926 U+0941 U+0983 U+0916).

The Avagraha "ঽ" (U+09BD) is mainly used in Sanskrit, Pāli, Prākṛt or Maithili texts written in Bangla. It is gradually being replaced by an upper comma (e.g. নরোঽপরাণি>নরো’পরাণি). It is rarely used now even in other languages using Bangla script. In case of LGR, the Avagraha is not part of the repertoire. It has been decided, therefore, not to retain Avagraha (ঽ) (U+09BD) because it is blocked in TLDs as per the Maximal Starting Repertoire (MSR).

Please see Appendix II under 11. for a complete list of Bangla consonants and their allographs.

### 3.3.8 Zero Width Non-joiner (U+200C) and Zero Width Joiner (U+200D)

This note is pertinent to the use of Zero Width Joiner (ZWJ) and Zero Width Non Joiner (ZWNJ) as used in Bangla. It needs to be noted that Nepali, Konkani and Hindi use these two signs in a different manner.

ZWJ (U+0200D) and ZWNJ (U+0200C) are code points that have been provided by the Unicode standard to instruct the rendering of a string where the script has the option between joining and non-joining characters. Without the use of these control codes, the string may be rendered in an alternate form from what is intended.

**Use of ZWJ**

* Insofar as Bangla is concerned ZWJ is used for the proper rendering of characters such as *khaṇḍa-ta* /ৎ/ as in কৎবেল and সৎ. This is typed as following

ta+Hasanta +ZWJ (U+0200D)

* However, ZWJ is more important where same combination of consonantal characters is represented differently depending upon the contexts. E.g. র+্+য have two representations in Bangla—as র্য and as র‍্য. To get the form র্য one has to type in the following manner—র+্+য, but for র‍্য the sequence would be র+ZWJ+্+য. [154]. In other words, ZWJ is used in the rendering of words demanding *ya-phalā* after *ra* which is otherwise not possible to type (render) due to the same order of *ra*+*hasanta*+*antastha ja* in the medial and/or final position. Interestingly, *ra*+*hasanta*+*antastha ja* is used to type *repha* on the consonant - *antastha ja* as in কার্য (kaarjo). In order to get a *ya-phalā* after the consonant -*ra* it is therefore obligatory to use ZWJ after -*ra* as in র‌্যাপার (wrapper), র‌্যাশ (rash), র‌্যালি (rally) etc. The typing sequence is given below:

*ra* (র) + ZWJ + *hasanta* (্) + *antastha* *ja* (য) = র‌্য

**Use of ZWNJ**

* The use of ZWNJ in Bangla is used to represent the *explicit Hasanta* or *Halant*. In order to avoid conjunct formation in cases where there is an explicit hasanta before the succeeding consonant the ZWNJ is used.

Consonant + hasanta + ZWNJ + consonant = explicit hasanta

Example: প্রাক্‌কথন (prākkathana /prakkɔtʰon)

The use of ZWJ/ZWNJ have been ruled out from the root zone by the [Procedure]. Used in Bangla, to create alternate renderings, the insertion of these two signs can affect searching as well as NLP.

The Zero Width Non-joiner (ZWNJ) is an invisible character used in certain cases (after Hasanta) where default conjunct formation is to be explicitly restricted and the Hasanta joining the two consonants participating in the conjunct formation needs to be explicitly shown.

### 3.3.9 Ya-phalaa Sequence

Ya-Phalaa sequences are two instances in Bangla where Hasanta is preceded by a full vowel (U+0985 অ - BENGALI LETTER A and U+098F এ - BENGALI LETTER E).

* অ্যা 0985 09CD 09AF 09BE

BENGALI LETTER A + BENGALI SIGN VIRAMA +

BENGALI LETTER YA + BENGALI VOWEL SIGN AA

* এ্যা 098F 09CD 09AF 09BE

BENGALI LETTER E+ BENGALI SIGN VIRAMA + BENGALI LETTER YA + BENGALI VOWEL SIGN AA

For rendering *Ya-phalā* followed by অ and এ, it is necessary to type U+09CD Hasanta plus U+09AF *ya* preceded by the said vowels. This is a purely ligatural entity and the addition of *Ya-phalā* and ā kar is used to elicit the /æ/ sound as in English ‘bat’, ‘fat’ etc. The Brahmi script, by nature does not have Hasanta after a vowel. Hasanta is generally described as ‘vowel killer’, although it actually indicates absence of a vowel after the marked consonant. Only the consonants can have the Hasanta marked. But as we see here, Bangla ends up with a deviant feature in the orthography here in which Hasanta comes immediately after a vowel in ligatures অ্যা and এ্যা (Cf Unicode 10.0 p. 473 [100]).

### 3.3.10 Ra-phalaa and Ref Sequences

This case refers to the formation of *repha* and *ra-phalā* as follows:

Ra-Hasanta = (C2 H)

where C2 is either

09B0 (র - BENGALI LETTER RA) or

09F0 (ৰ - ASSAMESE LETTER RA/ Unicode name:

BENGALI LETTER RA WITH MIDDLE DIAGONAL)

H is 09CD (্ - BENGALI SIGN VIRAMA)

Owing to co-occurrence with HASANTA , RA either loses its own implicit vowel (REPHA), or suppresses the implicit vowel of the preceding consonant (RA-PHALĀ). For instance, repha = *ra* + Hasanta + C (e.g. র্ক i.e. *ra* + Hasanta + *ka*, as in অর্ক *arko*); *ra-phalā*= C + Hasanta + *ra* (e.g. ক্র i.e. *ka* + Hasanta + *ra*, as in চক্র *chakro*). The point is in both the cases the slot for *ra* could be Bangla *ra* র (U+09B0) or the Assamese *ra* ৰ (U+09F0), followed/ preceded by the common Hasanta (U+09CD), whereas the shapes of *repha* and *ra-phalā* in both the cases remain the same.

# Overall Development Process and Methodology

The Neo-Brahmi Generation Panel (NBGP) has been formed by members having experience in Linguistics (especially in NLP/Computational linguistics), Literature, Language History and Epigraphy. Under the Neo-Brahmi Generation Panel, Bangla and eight other scripts belonging to separate Unicode blocks are being taken up to assign a separate LGR for each. However, an attempt is made to ensure that the fundamental philosophy behind building those LGRs consistent with all other Brāhmī-derived scripts. The present LGR will cater to multiple languages belonging to EGIDS scale 1 to 4 (see Table 4) that use Bangla script.

The following guiding principles are used in making decisions about Bangla LGR Code-points:

## Guiding Principles

The NBGP adopts following broad principles for selection of code-points in the code-point repertoire across the board for all the Neo-Brahmi scripts within its ambit.

### Inclusion Principles

#### Modern Usage

Every character proposed should be in the everyday usage of a particular linguistic community. The characters, which have been encoded in the Unicode for transcription purposes only or for archival purposes, will not be considered for inclusion in the code-point repertoire.

#### Unambiguous Use

Every character proposed should have unambiguous understanding among linguists about its usage in the language.

### Exclusion Principles

The main exclusion principle is that of External Limits on Scope. These consist of protocols or standards, which are prerequisites to the Label Generation Rule-sets. All further principles are in fact subsumed under these limitations but have been spelt out separately for the sake of clarity.

#### External Limits of Scope

The code point repertoire for root zone being a very special case, at the top of protocol hierarchies, the canvas of available characters for selection as a part of the Root Zone code point repertoire is already constrained by various protocol layers beneath it. The following three main protocols/standards act as successive filters:

i. *The Unicode Chart*

Out of all the characters that are needed by the script in question, if a particular character is not encoded in Unicode, it cannot be incorporated in the code point repertoire. Such cases are quite rare, and especially so in Bangla-Asamiyā-Maṇipuri Writing System, given the elaborate and exhaustive character inclusion efforts made by the Unicode consortium.

ii. *IDNA Protocol*

Unicode being the character-encoding standard for providing the maximum possible representation of a given script/language, it has encoded as far as possible all the possible characters needed by the script. However, the Domain name being a specialized case, it is governed by an additional protocol known as IDNA (Internationalized Domain Names in Applications). The IDNA protocol excludes some characters out of Unicode repertoire from being part of the domain names.

*iii. Maximal Starting Repertoire (MSR)*

Since the Root-zone LGR being is the repertoire of characters which are going to be used for creation of the Root-zone TLDs, which in turn constitute an even more specialized case of domain names, the ROOT LGR procedure introduces additional exclusions on the IDNA’s allowed set of characters.

Example: Bangla Sign Avagraha "ঽ" (U+093D) even if allowed by IDNA protocol, is not permitted in the Root Zone Repertoire as per the MSR.

To sum up, the restrictions start off with admitting only such characters as are part of the code-block of the given script/language. The IDNA Protocol further narrows this down and finally an additional filter in the form of Maximal Starting Repertoire restricts the character set associated with the given language even more.

#### No Punctuation Marks

The TLDs being identifiers, punctuation markers present in Brāhmī-based scripts will not be included.

#### No Symbols and Abbreviations

Abbreviations, weights and measures and other such iconic characters like BANGLA ISSHAR "৺" (U+09FA), BANGLA CURRENCY DENOMINATOR SIXTEEN "৹" (U+09F9) etc. will also not be included.

#### No Rare and Obsolete Characters

There are characters which have been added to Unicode to accommodate rare forms such as Sanskritic VOCALIC RR "ৠ" (U+09E0) and VOCALIC L “ঌ” (U+098C) as well as VOCALIC LL "ৡ" (U+09E1) and the allographic –kāra forms of the latter two symbols - VOWEL SIGN VOCALIC L "ৢ" (U+09E2) and VOWEL SIGN VOCALIC LL “ৣ" (U+09E3). All such characters are excluded, which complies with the Conservatism principle as laid down in the Root Zone LGR procedure. However, in Bangla, the -kāra corresponding to VOCALIC RR "ৠ" (U+09E0) which is VOWEL SIGN VOCALIC RR “ৄ” (U+09C4) is still in active use in certain limited borrowed or Sanskritic words, and are, therefore, retained.

#### No Stress Markers of Classical Sanskrit and Vedic

Stress markers for classical Sanskrit will not be included. This is also in consonance with the Letter principle as laid down in the Root Zone LGR procedure.

#### ABNF

The Augmented Backus-Naur Formalism (ABNF) is described in Section 5.3.1 and Appendix (Section 10.1).

# Repertoire

The Bangla Writing System is represented in UNICODE using the Bengali (Bangla) script name as enumerated in ISO 15924 corresponding to languages such as Asamiyā (Assamese), Bangla (Bengali) and Maṇipuri. The BENGALI block used for Bangla-Asamiyā-Maṇipuri in the UNICODE has 93 entries. This section details the code-point repertoire that the Neo-Brahmi Generation Panel [NBGP] proposes to be included in the Bangla LGR.

It may be mentioned here that the Government of Assam has submitted a proposal to Bureau of Indian Standards (BIS) on 26th February 2016 for dis-unification of Bangla and Asamiyā Scripts. The BIS in its 8th Meeting of Indian Language Technologies and Products Sectional Committee, LITD 20, held on 23rd Aug 2017, and  decided  to refer the proposal for recognition of Assamese script in ISO/IEC 10646 to ISO. Until the UNICODE Consortium takes any further action, it will be assumed that the Code Point Repertoire under Table 11 will be valid for all the three languages as above.

For each of the code points, language references have been given in the last column titled "Reference" under Table 8 titled the “Code Point Repertoire”. For entire coverage of Bangla code points, references of Bangla, Asamiyā (Assamese), Maṇipuri (Meitei), and Bishnupriya are given. Kokborok, written in Bangla script, is not known to have introduced many new complications, except for one particular character. Though only a few representative languages under EGIDS Scale 1-4 have been chosen for referencing, they together cover all the code-points required for all the languages that NBGP has considered as given under Bangla Unicode Points (as given in UNICODE 6.3).

However, before the details are presented, it is ideal to take a look at the Bangla Code Point Chart from Maximal Starting Repertoire [MSR] Version 3. It may be noted that the shapes of the reference glyphs given below in the code charts are based on one of the many fonts designed, and are not prescriptive, because there could be some variations in actual fonts – both UNICODE-compatible and True-Type ones. Consider the following Code point table:

|  |  |
| --- | --- |
| Picture 8  Figure 1: Bangla Code Page from [MSR] for  Bangla- Asamiyā -Maṇipuri | **Colour convention:**  All characters that are included in the [MSR] - Yellow background  PVALID in IDNA2008 but excluded from the [MSR] - Pinkish background  Not PVALID in IDNA2008, or are ineligible for the root zone (digits, hyphen) - White background |

Given the Bangla Unicode Block as in Figure 1, for the code points those are included in the MSR, the following symbols will need a separate treatment:

ৎ U+09CE Bangla Letter Khaṇḍa-Ta

ৰ U+09F0 Asamiyā -Bangla Letter Ra With Middle Diagonal

ৱ U+09F1 Asamiyā -Bangla Letter Ra With Lower Diagonal

## Code Point Repertoire Inclusion

| **No.** | **Unicode Code Point** | **Glyph** | **Character Name** | **Category** | **Language(s), with EGIDS Value** | **References** |
| --- | --- | --- | --- | --- | --- | --- |
| 1. | U+0981 | ঁ | BENGALI SIGN CANDRABINDU | Candra- bindu | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [111], [112], [113], [119], [120], [121], [122], [125], [127], [128] |
| 2. | U+0982 | ং | BENGALI SIGN ANUSVARA | Onushshar (Anusvāra) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [111], [112], [113], [119], [120], [121], [122], [125], [127], [128] |
| 3. | U+0983 | ঃ | BENGALI SIGN VISARGA | *Biśarga*  (Visarga) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [111], [112], [113], [119], [120], [121], [122], [125], [127], [128] |
| 4. | U+0985 | অ | BENGALI LETTER A | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 5. | U+0986 | আ | BENGALI LETTER AA | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 6. | U+0987 | ই | BENGALI LETTER I | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 7. | U+0988 | ঈ | BENGALI LETTER II | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 8. | U+0989 | উ | BENGALI LETTER U | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 9. | U+098A | ঊ | BENGALI LETTER UU | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 10. | U+098B | ঋ | BENGALI LETTER VOCALIC R | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 11. | U+098F | এ | BENGALI LETTER E | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 12. | U+0990 | ঐ | BENGALI LETTER AI | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 13. | U+0993 | ও | BENGALI LETTER O | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 14. | U+0994 | ঔ | BENGALI LETTER AU | Vowel | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 15. | U+0995 | ক | BENGALI LETTER KA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 16. | U+0996 | খ | BENGALI LETTER KHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 17. | U+0997 | গ | BENGALI LETTER GA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 18. | U+0998 | ঘ | BENGALI LETTER GHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 19. | U+0999 | ঙ | BENGALI LETTER NGA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 20. | U+099A | চ | BENGALI LETTER CA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 21. | U+099B | ছ | BENGALI LETTER CHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 22. | U+099C | জ | BENGALI LETTER JA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 23. | U+099D | ঝ | BENGALI LETTER JHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 24. | U+099E | ঞ | BENGALI LETTER NYA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 25. | U+099F | ট | BENGALI LETTER TTA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 26. | U+09A0 | ঠ | BENGALI LETTER TTHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 27. | U+09A1 | ড | BENGALI LETTER DDA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 28. | U+09A2 | ঢ | BENGALI LETTER DDHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 29. | U+09A3 | ণ | BENGALI LETTER NNA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121], [122], [125], [127], [128] |
| 30. | U+09A4 | ত | BENGALI LETTER TA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 31. | U+09A5 | থ | BENGALI LETTER THA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 32. | U+09A6 | দ | BENGALI LETTER DA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 33. | U+09A7 | ধ | BENGALI LETTER DHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 34. | U+09A8 | ন | BENGALI LETTER NA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121], [122], [125], [127], [128] |
| 35. | U+09AA | প | BENGALI LETTER PA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 36. | U+09AB | ফ | BENGALI LETTER PHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121] |
| 37. | U+09AC | ব | BENGALI LETTER BA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 38. | U+09AD | ভ | BENGALI LETTER BHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 39. | U+09AE | ম | BENGALI LETTER MA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 40. | U+09AF | য | BENGALI LETTER YA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121] |
| 41. | U+09B0 | র | BENGALI LETTER RA | Consonant | 1 Bangla,  2 Maṇipuri | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121] |
| 42. | U+09B2 | ল | BENGALI LETTER LA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 43. | U+09B6 | শ | BENGALI LETTER SHA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [118], [119], [120], [121], [122], [125], [127], [128] |
| 44. | U+09B7 | ষ | BENGALI LETTER SSA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [118], [119], [120], [121], [122], [125], [127], [128] |
| 45. | U+09B8 | স | BENGALI LETTER SA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [118], [119], [120], [121], [122], [125], [127], [128] |
| 46. | U+09B9 | হ | BENGALI LETTER HA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121] |
| 47. | U+09BE | া | BENGALI VOWEL SIGN AA | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 49. | U+09BF | ি | BENGALI VOWEL SIGN I | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 50. | U+09C0 | ী | BENGALI VOWEL SIGN II | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121], [122], [125], [127], [128] |
| 51. | U+09C1 | ু | BENGALI VOWEL SIGN U | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121], [122], [125], [127], [128] |
| 52. | U+09C2 | ূ | BENGALI VOWEL SIGN UU | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121], [122], [125], [127], [128] |
| 53. | U+09C3 | ৃ | BENGALI VOWEL SIGN VOCALIC R | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121], [122], [125], [127], [128] |
| 54. | U+09C4 | ৄ | BENGALI VOWEL SIGN VOCALIC RR | Kāra  (Mātrā) | 1 Bangla,  2 Assamese | [101], [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121], [122], [128] |
| 55. | U+09C7 | ে | BENGALI VOWEL SIGN E | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 56. | U+09C8 | ৈ | BENGALI VOWEL SIGN AI | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 57. | U+09CB | ো | BENGALI VOWEL SIGN O | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 58. | U+09CC | ৌ | BENGALI VOWEL SIGN AU | Kāra  (Mātrā) | 1 Bangla,  2 Maṇipuri, 2 Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| 59. | U+09CD | ্ | BENGALI SIGN VIRAMA | Hasanta (=Halant)/ Virāma (=Dā̃ri) | 1 Bangla,  2 Assamese  2 Maṇipuri | [101], [102], [103], [104], [105], [107], [108], [109], [111], [112], [113], [114], [119], [120], [121], [122], [126], [128] |
| 60. | U+09CE | ৎ | BENGALI LETTER KHANDA TA | Consonant | 1 Bangla,  2 Maṇipuri, 2 Assamese | [101], [102], [103], [104], [105], [107], [111], [112], [113], [114], [119], [120], [121], [125], [127] |
| 61. | U+09F0 | ৰ | BENGALI LETTER RA WITH MIDDLE DIAGONAL | Consonant | 2 Assamese | [102], [103], [111], [121], [122], [124], [126], [128] |
| 62. | U+09F1 | ৱ | BENGALI LETTER RA WITH LOWER DIAGONAL | Consonant | 2 Assamese  2 Maṇipuri | [102], [103], [111], [121], [122], [124], [125], [126], [127], [128] |

Table 8: Bangla Code-Point Repertoire

Apart from the above individual code-points, the Neo-Brahmi Generation Panel also proposes some specific sequences which enable conditional inclusion of the "Bangla LETTER A and E" followed by Bangla SIGN VIRAMA and Bangla LETTER YA again followed by Bangla VOWEL SIGN AA in the repertoire for enabling inclusion of /æ/ sound as in English ‘bat’, ‘cat’ etc.

| **Sr. No.** | **Unicode Code Points** | **Sequence** | **Character Names** | **Example languages using the code-point (Not exhaustive list)** | **Reference** |
| --- | --- | --- | --- | --- | --- |
| S1. | 0985  09CD  09AF  09BE | অ্যা | BENGALI LETTER A  BENGALI SIGN VIRAMA  BENGALI LETTER YA  BENGALI VOWEL SIGN AA | Bangla, Assamese | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |
| S2. | 098F  09CD  09AF  09BE | এ্যা | BENGALI LETTER E  BENGALI SIGN VIRAMA  BENGALI LETTER YA  BENGALI VOWEL SIGN AA | Bangla | [102], [103], [104], [105], [107], [111], [112], [113], [114], [121], [122], [125], [127], [128] |

Table 9: Sequences

## Code Point Repertoire Exclusion

There are some characters of the Bangla script that find place in the Unicode but have not been included in the repertoire in the LGR proposal. The reasons for excluding ঌ (U+098C) and ৗ (U+09D7) is that they are rare and obsolete characters.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **Code Points** | **Glyph** | **Character Names** | **Note** |
| 1. | U+098C | ঌ | BENGALI LETTER VOCALIC L | Limited or declining use |
| 2. | U+09BC | ় | BENGALI SIGN NUKTA | See 3.3.6 |
| 3. | U+09D7 | ৗ | BENGALI AU LENGTH MARK | Limited or declining use |

Table 10: Excluded Code Points

## The Basis of Present IDN

The present LGR has also benefited from the earlier work on IDN for Bangla (different versions) done for .भारत or .ভারত drafted between 20.11.2009 and 18.07.2013.

### The ABNF Variables

The Augmented Backus-Naur Formalism (ABNF) began with the following variables:

C → Consonant

V → Vowel

M → kāra (Mātrā)

B → Anusvāra (/onuʃʃar/)

D → Candrabindu

X → Visarga (/biʃɔrgo)

H → Hasanta /Virāma

Z → Khaṇḍa Ta

The Augmented Backus-Naur Formalism (ABNF) will use the following Operators:

|  |  |  |
| --- | --- | --- |
| Sr. Number | Operator | Function |
| 1 | “ | “ | Alternative |
| 2 | “[ ]” | Optional |
| 3 | “ \* ” | Variable Repetition |
| 4 | “( )” | Sequence Group |

Table 11: The ABNF Formalism

## In what follows, the Vowel Sequence and the Consonant Sequence pertinent to Bangla are given to facilitate understanding.

### The Vowel Sequence

In what follows, the Vowel Sequence and the Consonant Sequence pertinent to Bangla are given. To facilitate understanding of other Brāhmī script users, equivalents in Devanāgarī are provided, wherever necessary.

A vowel sequence is made up of a single vowel. It may be followed but not necessarily (optionally) by an Anusvāra /onuʃʃar/ (B), Candrabindu (D) or a Visarga (X). The number of D, B or X which can follow a V in Bangla may not be restricted to one.

The possibility of a Visarga or Anusvāra (/onuʃʃar/) following a Candrabindu exists in Bangla. Vowel can optionally be followed by a combination of Hasanta / Virāma [H], Consonant [C] to form a Ya-phalā. “Ya-phalā is a presentation form of U+09AF Bangla letter য or ‘ya’. Represented by the sequence < U+09CD, i.e. ্ BENGALI SIGN VIRAMA ,Bangla SIGN Hasanta or VIRĀMA, U+09AF - য BENGALI LETTER YA>, Ya-phalā has a special form: য়. Again, when combined with U+09BE া BENGALI VOWEL SIGN AA, (i.e. ‘aa’(ā)), it is used for transcribing [æ] as in the “a” in the English word “bat” written in Bangla as ব্যাট.

A Vowel-sequence admits the following combinations:

### A Single Vowel

Examples: V অ अ

### A Vowel with Conditions

A Vowel can optionally be followed by Anusvāra [B] or Candrabindu [D] or *Visarga* [X] or Candrabindu+ Anusvāra [DB] or Candrabindu+ *Visarga* [DX] or combination of Hasanta (or Virama) [H] followed by Consonant [C] followed by kāra (Mātrā) [M].

Examples:

VB অং अं

VD অঁ अँ

VX অঃ अः

VDB অঁং अँंं

VDX অঁঃ अँंः

VHCM অ্যা /এ্যা

### VHCM Sequence

A VHCM sequence can optionally be followed by Anusvāra [B] or Candrabindu [D] or Visarga [X] or Candrabindu+ Anusvāra [DB] or Candrabindu+ *Visarga*  [DX].

Examples:

VHCMB অ্যাং/এ্যাং

VHCMD অ্যাঁ/এ্যাঁ

VHCMX অ্যাঃ/এ্যাঃ

VHCMDB অ্যাঁং/এ্যাঁং

VHCMDX অ্যাঁঃ/এ্যাঁঃ

### The Consonant Sequence

### A Single Consonant (C)

Example: C ক क

### A Consonant with Conditions

A Consonant optionally followed by dependent vowel sign / kāra (Mātrā) [M] or Anusvāra [B] or Candrabindu [D] or Visarga [X] or Hasanta (also known as Virāma) [H] or Candrabindu+ Anusvāra [DB] or Candrabindu+ *Visarga* [DX]

Example:

CM কি/ কৃ कि/ कृ

CB কং कं

CD কঁ कँ

CX কঃ कः

CH ক্ क् (Pure consonant)

CDB কঁং कँं ं

CDX কঁঃ कँः

### CM Sequence

A CM sequence can be optionally followed by B, D, X, DB or DX.

Example:

CMB কীং/ কৃং कीं/ कृं

CMD কাঁ काँ

CMX বীঃ वीः

CMDB কাঁং काँ ं

CMDX কাঁঃ काँः

### Sequence of Consonants

A sequence of consonants (up to 4) joined by Hasanta (also known as Virama).

\*3(CH)C

Example:

CHC ন্ত → ন্ + ত न् + त

CHCHC ন্ত্র → ন্ + ত্ + র न् + त् + र

CHCHCHC ন্ত্র্য → ন্ + ত্ + র্ + য় न् + त् + र् + य

### Subsets:

While considering its subsets, as a representative example, we will consider the combination CHC only, however the same is equally applicable to CHCHC and CHCHCHC.

**[A].** The combination may be followed by M, B, D, X, DB or DX.

Example:

CHCM ক্কী →ক ্ ক ী क्की → क ् क ী

CHCB ক্কং →ক ্ ক ং क्कं → क ् क ंं

CHCD ক্কঁ →ক ্ ক ঁ क्कँ→ क ् क ंँ

CHCX ক্কঃ →ক ্ ক ঃ क्कः → क ् क ঃ

CHCDB ক্কঁ ং →ক ্ ক ঁ ং क्कँंं→ क ् क ंँ ं

CHCDX ক্কঁঃ →ক ্ ক ঁ ঃ क्कँंः→ क ् क ंँ ः

**[B].** \*3(CH)CM may further be followed by a B, D, X, DB or DX

Example:

CHCMB ক্কীং → ক ্ ক ী ং क्कीं → क ् क ी ं

ক্কৃং → ক ্ ক ৃ ং क्कृं → क ् क ृ ं

CHCMD ক্কাঁ → ক ্ ক া ঁ क्काँ → क ् क ा ंँ

CHCMX ক্কীঃ → ক ্ ক ী ঃ क्कीः → क ् क ी ः

CHCMDB ক্কাঁং→ ক ্ ক া ঁ ং क्काँ→ क ् क ा ँ ं

CHCMDX ক্কাঁঃ → ক ্ ক া ঁ ঃ क्काँः → क ् क ा ंँ ः

### The Khaṇḍa-Ta sequence

### A single ‘Khaṇḍa’-Ta (Z)

Example: Z ৎ = ত্

### A Khaṇḍa Ta Combination[[11]](#footnote-12)

A Khaṇḍa Ta can be preceded by a consonant and Hasanta (also known as Virāma)

[CH]Z

Example:

র + ্ + ৎ = র্ৎ as in ভর্ৎসনা

Note: The conditions in this context of KHANDA TA are that the C should be either RA U+09B0 (র) (used in Bangla) or Ra U+09F0 (ৰ) (used in Assamese).

### Special Cases S and P

Two special cases involving Sequences (referred to as S and P in Table 16 under Section 7) could be described briefly here. Let us take up S at the first instance. It is noteworthy that there are two instances in Bangla where Hasanta is preceded by a full vowel (U+0985 অ - BANGLA LETTER A and U+098F এ - BANGLA LETTER E). For rendering *Ya-phalā* followed by অ and এ, it is necessary to type U+09CD Hasanta plus U+09AF *ya* preceded by the said vowels. This is a purely ligatural entity and the addition of *Ya-phalā* and ā kāra is used to elicit the /æ/ sound as in English ‘bat’, ‘fat’ etc. The Brāhmī script, by nature does not have Hasanta after a vowel. Hasanta is generally described as ‘vowel killer’, although it actually indicates absence of a vowel after the marked consonant. Only the consonants can have the Hasanta marked. But as we see here, Bangla ends up with a deviant feature in the orthography here in which Hasanta comes immediately after a vowel in ligatures অ্যা and এ্যা (Cf Unicode 10.0 p. 473 [100]).

Another case refers to the formation of *repha* and *ra-phalā* in the said script and mentioned in the table above as P. Owing to co-occurrence with HASANTA, RA either loses its own implicit vowel (REPHA), or suppresses the implicit vowel of the preceding consonant (RA-PHALĀ). For instance, repha = *ra* + Hasanta + C (e.g. র্ক i.e. *ra* + Hasanta + *ka*, as in অর্ক *arko*); *ra-phalā*= C + Hasanta + *ra* (e.g. ক্র i.e. *ka* + Hasanta + *ra*, as in চক্র *cakra*). The point is in both the cases the slot for *ra* could be Bangla *ra* র (U+09B0) or the Assamese *ra* ৰ (U+09F0), followed/ preceded by the common Hasanta (U+09CD), whereas the shapes of *repha* and *ra-phalā* in both the cases remain the same.

# Variants

This section talks about the variants in the Bangla script. The NBGP categorizes these confusingly variants in two groups.

**Group 1:** Confusing due to pure visual similarity

**Group 2:** Confusing due to deviation from normally perceived character formations by larger linguistic community.

For Group 1, any identical code points are defined as variants. The confusable, but not identical, cases are not proposed, as there is another panel (String similarity assessment panel) entrusted to deal with such cases. However, cases which belong to Group 2 are proposed to be considered as variants. These cases are not of mere visual similarity as they involve some deviations from the widely accepted norms of Bangla Akshar formations. These can cause confusion even to a careful observer and hence being proposed as variants.

The variants are generated in a script when two or more forms are formed with different storage or code points. In Bangla the *e*-kāra, *ā*-kāra and the *o*-kāra have different code points. One can type o with a consonant at one go and the same by typing *e*-kāra and *ā*-kāra as two separate keys getting the same results. A reader cannot differentiate between the two *ko* (কো), one typed with a single key and the other one typed with two different keys. Moreover, this will not be considered as a case of variant because a kāra followed by a kāra is not allowed.

## In Script Variants

However, we propose two cases of true in-script variants in Bangla script.

**CASE I:**

As far as true variants in Bangla are concerned, we may draw our attention to cases wherein Hasanta with (U+09A5) থ (*tha*) appears as conjunct with (U+09B8) স (*sa*) and (U+09A8) ন (*na*).

1. স + Hasanta + থ (U+09B8 + U+09CD + U+09A5) versus  
 স + Hasanta + হ (U+09B8 + U+09CD + U+09B9)

2. ন + Hasanta + থ (U+09A8 + U+09CD + U+09A5) versus  
 ন + Hasanta + হ (U+09A8 + U+09CD + U+09B9)

The above combinations, if written in traditional orthography, could be little confusing, where the থ (*tha*) in conjunct appears like a হ (*ha*). The conjunct could be in the initial, medial or final positions (as shown below in e.g. no 1). It could be typed wrong as well, thinking it was a হ (*ha)* U+09B9, increasing the chances of risks in label writing and identification.

Examples:

1. স্থ and স্হ (as in স্থান sthāna, স্থূল sthūla, স্বাস্থ্য svāsthya, অস্থায়ী asthāyī)

2. ন্থ and ন্হ (as in গ্রন্থ grantha)

The fonts which represent traditional Bangla writing system could tend to create this problem. Therefore, these may be taken as cases of variants in Bangla.

**CASE II:**

Another interesting example of variant is encountered in *ra* + *Hasanta* and *Hasanta* + *ra* combinations in writing labels in the Bangla script (for languages such as Bangla, Assamese and Maṇipuri). The variant cases arise in typing ‘***repha***’ (involving *ra* + *Hasanta*) and ‘***ra-phalā***’(involving *Hasanta*  + *ra*).

‘Repha’ could be formed by two sequences (mainly because both Assamese and Bangla find place in the same UNICODE points, and ‘B\_RA’ as well as ‘A\_RA’ refer to the same phonetic element). Here, the final ligatures look the same, and will be as follows:

1. B\_RA + H + C
2. A\_RA + H + C

Where

B\_RA = U+09B0 BENGALI LETTER RA (র) or

A\_RA = U+09F0 BENGALI LETTER RA WITH MIDDLE DIAGONAL (ৰ)

H = U+09CD BENGALI SIGN VIRAMA (্)

C = any consonant (theoretically)

Example:

|  |  |  |  |
| --- | --- | --- | --- |
| Sequence1  (Using Bangla RA) | Ligature 1 | Sequence2  (Using Assamese RA) | Ligature  2 |
| U+09B0 (র) U+09CD (্)U+0995 (ক) | র্ক | U+09F0 (ৰ) U+09CD (্) U+0995 (ক) | ৰ্ক |
| U+09B0 (র) U+09CD (্)U+09A0 (ঠ) | র্ঠ | U+09F0 (ৰ) U+09CD (্) U+09A0 (ঠ) | ৰ্ঠ |

Table 12: Example of Repha

Note: As Bangla and Assamese ক and ঠ look exactly the same, the resultant combinations with 'Repha' look identical. Addition of 'Repha' does not make any difference.

‘Ra-phalā’ could be formed by two sequences on similar grounds, and the final ligatures would look the same

1. C1 + H + B\_RA
2. C1 + H + A\_RA

Where

C1 = any consonants except Khaṇḍa-ta

Example:

|  |  |  |  |
| --- | --- | --- | --- |
| Sequence1  (Using Bangla RA) | Ligature 1 | Sequence2  (Using Assamese RA) | Ligature  2 |
| U+0995 (ক) U+09CD (্) U+09B0 (র) | ক্র | U+0995 (ক) U+09CD (্) U+09F0 (ৰ) | ক্ৰ |
| U+09A8 (ন) U+09CD (্) U+09B0 (র) | ন্র | U+09A8 (ন) U+09CD (্) U+09F0 (ৰ) | ন্ৰ |

Table 13: Example of Ra-phalā

As the Assamese and Bangla Repha and Ra-phalā conjunct forms look the same, this could cause confusability to the end-users. Hence, the repha and ra-phalā cases need to be defined as variants.

NBGP concluded to define র and ৰ as variant code points, where only one variant set between র and ৰ could cover all cases. But this will create blocked variant labels, e.g. if someone registers “র র র” the variant label “ৰৰৰ” will be generated as variant and will be blocked and vice versa. However, it is only blocked at the label level, if someone else needs to register other labels e.g. ৰৰ or ৰৰৰৰ, it is still possible.

## Cross Script Variants

A crisp cross script study for Bangla has been done with respect to sister scripts such as Devanāgarī, Gurmukhī and Odia[[12]](#footnote-13) (formerly Oriya) keeping in mind the visual and technical confusions they may cause as labels on the web domain. Moreover, there is no in-script variant in Bangla as far as the orthography is concerned. The following characters are being proposed by the NBPG as variants. Although there are certain characters which are somewhat similar they but have not been included here. They have been provided in the Appendix (10.2) for reference.

1. Bangla and Nāgarī /Devanāgarī Script

|  |  |
| --- | --- |
| Bangla | Devanāgarī |
| **ম**  U+09AE | म  U+092E |
| **ি**  U+09BF | ि  U+093F |

Table 14 - Bangla and Devanāgarī cross-script variant code point

1. Bangla and Gurmukhi Script

|  |  |
| --- | --- |
| Bangla | Gurmukhī |
| ম  U+09AE | ਸ  U+0A38 |
| ি  U+09BF | ਿ  U+0A3F |

Table 15 - Bangla and Gurmukhī cross-script variant code point

# Whole Label Evaluation Rules (WLE)

This section provides the WLEs that are required by all the languages mentioned in section ‎3.2 when written in Bangla[[13]](#footnote-14) Script. The rules have been drafted in such a way that they can be easily translated into the LGR specifications.

Below are the symbols used in the WLE rules, for each of the "Indic Syllabic Category" as mentioned in the table provided in Code point repertoire (Section 5.1).

|  |  |  |
| --- | --- | --- |
| C | → | Consonant |
| M | → | Kāra (Mātrā) |
| V | → | Vowel |
| B | → | Anusvāra |
| D | → | Candrabindu |
| X | → | Visarga |
| H | → | Hasanta |
| Z | → | Khaṇḍa Ta |
| S | → | S1, S2 (from Table 9)  or  (a/e) *Ya-phalā* (V1 H C1 M1)  where  V1 is either 0985 (অ - BENGALI LETTER A)  or 098F (এ - BENGALI LETTER E)  H is 09CD (্ - BENGALI SIGN VIRAMA)  C1 is - 09AF (য - BENGALI LETTER YA)  M1 is - 09BE (া - BENGALI VOWEL SIGN AA) |
| P | → | Ra-Hasanta (C2 H)  where  C2 is either 09B0 (র - BENGALI LETTER RA)  or 09F0 (ৰ - ASSAMESE LETTER RA/ Unicode name: BENGALI LETTER RA WITH MIDDLE DIAGONAL)  H is 09CD (্ - BENGALI SIGN VIRAMA) |

Table 16 - Symbols used in WLE rules

It is also perhaps ideal to mention here that in Bangla, the consonant letters (or graphemes) are physically joined to form “clusters” that could theoretically conjoin from two to four consonants and combine to create new shapes. Dash and Chaudhuri (1998) state that there are “nearly 380 unique consonant...clusters” out of which Bi-consonantal combinations are 290, three-letter combinations account for another 80 and the rarer ones with four letters number 10 more [136, Pg 4]. More details of such combinations could be seen in Pabitra Sarkar (1993) [135].

## Final Set of WLE Rules

The prevalent patterns in Bangla, and various restrictions, below are the specific WLE rules that need to be implemented. The rule wise examples also provided, including both attested and hypothetical examples.

1. H: must be preceded by C

Example: ক্

1. M: must be preceded by C

Example: **কা,**

1. D: must be preceded by either of V, C, or M

Example: **আঁ, খঁ, খাঁ,**

1. X: must be preceded by either of V, C, M or D

Example: উঃ, খঃ, বঃ, াঃ, দুঁঃ

1. B: must be preceded by either of V, C, M or D

Example: আং, ইং, কং

1. Z: must be preceded by V, C, M, D, B, X, S or P  
   Example: ইৎ, কৎ, , াৎ, াঁৎ, র্পৎ, প্রৎ
2. V: CANNOT be preceded by H

Details in 7.1.1 Case of V preceded by H

Now let us elaborate each rule with examples from the script keeping in mind the Bangla, Assamese and Maṇipuri communities. Some combinations of characters may seem unrealistic or rare in usage but there is no harm is adding such ligatures because they are simply possible to create but may not be attested combinations.

Case of V Preceded by H:

There could be cases involving multi-word domains where V may need to be allowed to follow an H

e.g. ব্যাঙ্কঅফ্ইন্ডিয়া /bæŋk ʌv ɪndiə / (U+09AC U+09CD U+09AF U+09BE U+0999 U+09CD U+0995 U+0985 U+09AB U+09CD U+0987 U+09A8 U+09CD U+09A1 U+09BF U+09DF U+09BE) (meaning: *Bank of India*)

This is the case where two different words are joined together first of which ends with a H (অফ্) and the second word begins with a V (ইন্ডিয়া). Some sections of the linguistic community require the explicit presence of H for full representation of the sound intended. However, by and large, the form of the first word without a H is considered enough for full representation of the sound intended for the first word.

This is a unique situation necessitated by the lack of hyphen, space or the Zero Width Non-joiner character in the permissible set of characters in the Root zone repertoire. Otherwise, V is never required to be allowed to follow an H. Permitting this may create a perceptive similarity between two labels (with and without H) for majority of the linguistic community, hence this is explicitly prohibited by the NBGP.

In future if required, depending on the prevailing requirements by the community, the future NBGP may consider revisiting this rule.

## Additional Examples from Bangla ABNF:

Below are some of the examples which help one understand some of the rules ABNF puts in place. These are just given for reference purposes and are not meant to be comprehensive.

1. H, M, B, D or X cannot occur in the beginning of a Bangla IDN. Example:

্ক ्क

াক ाक

ংক ंंक

ঁক ंँक

ঃক ःक

As can be seen such combination will result automatically in a “golu” marking it as an invalid formation. This is an intrinsic property of the Indian language syllable and is quasi automatically applied wherever supported by the OS.

2. H is not permitted after V, B, D, X, M

Example:

অ্ अ्

অং্ कं ्

কঁ্ कँ ्

কঃ্ कः्

কি্ कि्

3. Number of B, D or X permitted after Consonant or Vowel or a kāra (Mātrā) is restricted to one thus the following combinations are invalidated.

Example:

কংং कं ंं

কঁ ঁ कँ ंँ

কঃঃ कःः

কাঁ ঁ काँ ँ

কীঃঃ कीःः

অংং अंंं

অঁ ঁ अँ ँ

অঃঃ अःः

4. Number of M permitted after Consonant is restricted to one.

Example:

কীী कीी

5. M is not permitted after V.

Example:

ইা/ ঈৌ ईा/ ईौ

6. The combinations of Anusvāra+ *Visarga* as well as *Visarga* + Anusvāra are not permissible.

Example:

কংঃ कं ः

কঃং कः ं

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# Appendix I

## Augmented Backus-Naur Formalism (ABNF)

The Augmented Backus-Naur Formalism (ABNF) is generic in nature and when applied to a specific language/script, certain restriction rules apply. In other words, in a given language some of the Formalism structures do not necessarily apply. To take care of such cases restriction rules are set in place. These restrictions will help to fine-tune the ABNF.

In case of Bangla[[14]](#footnote-15) in particular the following rules apply:

1. *Khaṇḍa ta* (ৎ) is NOT allowed at the beginning of an IDN label. The same applies to ঞ and the velar nasal ঙ in the Bangla Scheme of five-fold ‘*varga*’ (as defined under Table 5). Moreover, Bangla does not allow *ya* (য়) in the beginning of a word either but we can cite a couple of native examples, for example, the word য়্যাব্বড়ো (yæbbɔRo) from the poem ‘Lichuchor’ written by Kazi Nazrul Islam. However, there are instances of it being used in names, mostly of foreign origin such as Yaqub which may be written with ya (য়) in the beginning as in য়াকুব). In very recent times, while transliterating some Chinese and Japanese names in Bangla, one does come across the possibility of *Khaṇḍa* *ta* (ৎ) followed by *sa* (স) in the beginning of a word, for example ত্সেরিং (Tsering).

2. CH can come with Khaṇḍa Ta in only the case where C is *ra* (র) (09B0).

র্ৎ as in ভর্ৎসনা

3. Only following combinations with VHCM will be allowed.

→ অ্যা (together pronounced as æ) as in অ্যাসিড (acid)

→ এ্যা (together also pronounced as æ) as in এ্যাসিড, এ্যাসোসিয়েশান

(acid, association)

## ‘Sylheti Nāgarī lipi’ or ‘Siloṭi’

This version of Bangla script resembles the ‘Kaithī’ script (ISO 12954) used by the Accountants (perhaps by the Kāyastha community) in Eastern Uttar Pradesh and Bihar – widely in use during the 1880s. There were several other names of Sylheti Nāgarī or Siloti (129) – such as ‘Jālālābāda Nāgarī’, ‘Fula (flower) Nāgarī’, ‘Muslim Nāgarī’, or ‘Muhāmmad Nāgarī’. It is said that Shāh Jālāla had brought the script with him in 13th-14th Century in Sylhet (138), although some suggested that it was an invention by the Afghan rulers of Sylhet (137). Some ascribe the credit to the Buddhist Bhikkhus from Nepal. Purely for historical reasons, the details of the script with 32 symbols are reproduced here (138):

A screenshot of a cell phone

Description generated with high confidence

Table 17 – The Script Table of Sylheti Nāgarī or Siloṭi

## Confusable code points

The following code points were analysed and concluded that they are either (a) distinguishable or (b) confusable but not enough to be defined as variant code points.

### Bangla and Nāgarī or Devanāgarī

|  |  |  |
| --- | --- | --- |
| **Bangla** | **Devanāgarī** | **NBGP Decision** |
| ঃ U+0983 | ः U+0903 | Confusable |
| ও U+0993 | उ U+0909 | Confusable |
| ঘ U+0998 | घ U+0918 | Confusable |
| ঁ U+0981 | ॅ U+0945 | Confusable |

Table 18: Bangla and Devanāgarī confusable code points

### Bangla and Gurmukhi

|  |  |  |
| --- | --- | --- |
| **Bangla** | **Gurmukhi** | **NBGP decision** |
| ঘ U+0998 | ਬ U+0A2C | Confusable |
| ঁ U+0981 | ੱ U+0A71 | Confusable |

Table 19: Bangla and Gurmukhi confusable code points

|  |  |  |
| --- | --- | --- |
| **Bangla** | **Gurmukhi** | **NBGP decision** |
| ও U+0993 | ਤ U+0A24 | Distinguishable |
| শ U+09B6 | ਅ U+0A05 | Distinguishable |
| ম U+09AE | ਮ U+0A2E | Distinguishable |
| বা U+09AC and U+09BE | ਗ U+0A17 | Distinguishable |

Table 20 – Bangla and Gurmukhī distinguishable code points

### Bangla and Oriya (Odia)

|  |  |  |
| --- | --- | --- |
| **Bangla** | **Oriya (Odia)** | **NBGP Decision** |
| ও U+0993 | ଓ U+0B13 | Confusable |

Table 21 – Bangla and Oriya distinguishable code points

|  |  |  |
| --- | --- | --- |
| **Bangla** | **Oriya (Odia)** | **NBGP Decision** |
| ঘ U+0998 | ସ U+0B38 | Distinguishable |

Table 22 – Bangla and Oriya distinguishable code points

# Appendix II

Bengali consonants and their allographs

| Consonants | Phonetic Value | Allographs | |
| --- | --- | --- | --- |
| Clusters | Transparent Form |
| প | /p/ | প্ত (প্+ত), প্ন (প্‌ + ন), প্প (প্‌ + প), প্য (প্‌ + য), প্র (প্‌ + র), প্ল (প্‌ + ল), প্স (প্‌ + স)  স্প/স্প (স্+প), ল্প (ল্+প) |  |
| ফ | /pʰ/ | ফ্র (ফ্‌+ র), ফ্ল (ফ্‌ + ল)  স্ফ/স্ফ (স্+ফ) |  |
| ব | /b/ | ব্জ (ব্‌ + জ), ব্দ (ব্‌ + দ), ব্ধ (ব্‌ + ধ), ব্ব (ব্+ব), ব্য (ব্+য), ব্র (ব্+র), ব্ল (ব্+ল), ব্ভ (ব্+ভ)  স্ব (স্+ব), হ্ব (হ্+ব) | ব্ধ (ব্+ধ)  হ্ব (হ্+ব) |
| ভ | /bʱ/ | ভ্য (ভ্+য), ভ্র (ভ্+র), ভ্ল (ভ্+ল) |  |
| ত | /t/ | ত্ত (ত্+ত), ত্ত্য (ত্+ত্+য), ত্ত্ব (ত্+ত্+ব), ত্থ (ত্+থ), ত্ন (ত্+ন), ত্য (ত্+য), ত্ম (ত্+ম), ত্ম্য (ত্+ম্+য), ত্ব (ত্+ব), ত্র (ত্+র)  প্ত (প্+ত), ক্ত (ক্+ত), ক্ত্ব (ক্+ত্+ব), ন্ত (ন্+ত), ন্ত্র্য (ন্+ত্+র্+য), স্ত্র (স্+ত্+র)  There is a marked form of ত+্=ৎ, র্ৎ (র্+ত্/ৎ) | ক্ত (ক্+ত) |
| থ | /tʰ/ | থ্য (থ্+য), থ্র (থ্+র)  স্থ (স্+থ), ত্থ (ত্+থ), ন্থ (ন্+থ) | ন্থ (ন্+থ), স্থ (স্+থ) |
| দ | /d/ | দ্গ (দ্+গ), দ্ঘ (দ্+ঘ), দ্দ (দ্+দ), দ্ধ (দ্+ধ), দ্য (দ্+য), দ্ব (দ্+ব), দ্ভ (দ্+ভ), দ্র (দ্+র)  ব্দ (ব্+দ), ন্দ (ন্+দ), ন্দ্র (ন্+দ্+র), র্দ্র (র্+দ্+র) | দ্গ (দ্+গ), দ্ধ (দ্+ধ) |
| ধ | /dʱ/ | ধ্ন (ধ্+ন), ধ্ম (ধ্+ম), ধ্য (ধ্+য), ধ্র (ধ্+র)  গ্ধ (গ্+ধ), দ্ধ (দ্+ধ), ব্ধ (ব্+ধ), ন্ধ (ন্+ধ) | গ্ধ (গ্+ধ), দ্ধ (দ্+ধ), ব্ধ (ব্+ধ), ন্ধ (ন্+ধ) |
| ট | /ʈ/ | ট্ট (ট্+ট), ট্য (ট্+য), ট্ব (ট্+ব), ট্র (ট্+র)  ক্ট (ক্+ট), ষ্ট (ষ্+ট) |  |
| ঠ | /ʈʰ/ | ঠ্য (ঠ্+য)  ণ্ঠ (ণ্+ঠ), ষ্ঠ (ষ্+ঠ) |  |
| ড | /ɖ/ | ড্ড (ড্+ড), ড্য (ড্+য), ড্র (ড্+র) |  |
| ঢ | /ɖʱ/ | ঢ্য (ঢ্+য)  ণ্ঢ (ণ্+ঢ) |  |
| চ | /t͡ʃ/ | চ্চ (চ্+চ), চ্ছ (চ্+ছ), চ্ছ্র (চ্+ছ্+র), চ্ঞ (চ্+ঞ), চ্য (চ্+য)  ঞ্চ (ঞ্+চ), শ্চ (শ্+চ) | ঞ্চ (ঞ্+চ) |
| ছ | /t͡ʃʰ/ | ছ্র (ছ্+র)  চ্ছ (চ্+ছ), ঞ্ছ (ঞ্+ছ), শ্ছ (শ্+ছ) | ঞ্ছ (ঞ্+ছ) |
| জ | /dʒ/ | জ্জ (জ্+জ), জ্জ্ব (জ্+জ্+ব), জ্ঝ (জ্+ঝ), জ্ঞ (জ্+ঞ), জ্য (জ্+য), জ্র (জ্+র)  ঞ্জ (ঞ্+জ) | ঞ্জ (ঞ্+জ) |
| ঝ | /dʒʱ/ | (not privileged enough to have clusters as a first member)  জ্ঝ (জ্+ঝ), ঞ্ঝ (ঞ্+ঝ) |  |
| ক | /k/ | ক্ক (ক্+ক), ক্ট (ক্+ট), ক্ত/ক্ত (ক্+ত), ক্ত্র (ক্+ত্+র), ক্ত্ব (ক্+ত্+ব), ক্ন (ক্+ন), ক্ব (ক্+ব), ক্ম (ক্+ম), ক্য (ক্+য), ক্র (ক্+র), ক্ষ (ক্+ষ), ক্ষ্ণ (ক্+ষ্+ণ), ক্ষ্ম (ক্+ষ্+ম), ক্ষ্ব (ক্+ষ্+ব), ক্ষ্য (ক্+ষ্+য), ক্স (ক্+স)  ঙ্ক (ঙ্+ক), স্ক্র (স্+ক্+র) | ক্ত (ক্+ত), ক্ত্র (ক্+ত্+র), ক্ত্ব (ক্+ত্+ব), ক্র (ক্+র)  ঙ্ক (ঙ্+ক), স্ক্র (স্+ক্+র) |
| খ | /kʰ/ | (not privileged enough to have clusters as a first member)  ঙ্খ (ঙ্+খ) |  |
| গ | /g/ | গ্গ (গ্+গ), গ্দ (গ্+দ), গ্ধ (গ্+ধ), গ্ন (গ্+ন), গ্ব (গ্+ব), গ্ম (গ্+ম), গ্য (গ্+য), গ্র (গ্+র), গ্ল (গ্+ল)  ঙ্গ (ঙ্+গ), র্ঙ্গ (র্+ঙ্+গ) | গ্ধ (গ্+ধ)  ঙ্গ (ঙ্+গ), র্ঙ্গ (র্+ঙ্+গ) |
| ঘ | /gʱ/ | ঘ্ন (ঘ্+ন), ঘ্য (ঘ্+য), ঘ্র (ঘ্+র)  ঙ্ঘ (ঙ্+ঘ) |  |
| ঞ | This letter does not have any particular phonetic value, but mostly pronounced as /n/. | ঞ্চ (ঞ্+চ), ঞ্ছ (ঞ্+ছ), ঞ্জ (ঞ্+জ), ঞ্ঝ (ঞ্+ঝ)  জ্ঞ (জ্+ঞ), | ঞ্চ (ঞ্+চ), ঞ্ছ (ঞ্+ছ), ঞ্জ (ঞ্+জ), ঞ্ঝ (ঞ্+ঝ) |
| ণ | /n/ | ণ্ট (ণ্+ট), ণ্ঠ (ণ্+ঠ), ণ্ড (ণ্+ড), ণ্ড্র (ণ্+ড্+র), ণ্ঢ (ণ্+ঢ), ণ্ন (ণ্+ণ), ণ্য (ণ্+য), ণ্ব (ণ্+ব)  ক্ষ্ণ (ক্+ষ্+ণ), ষ্ণ (ষ্+ণ), হ্ণ (হ্+ণ) | ণ্ড (ণ্+ড), ণ্ড্র (ণ্+ড্+র)  ষ্ণ (ষ্+ণ) |
| ঙ/ং | /ŋ/ | ঙ্ক (ঙ্+ক), ঙ্ক্র (ঙ্+ক্+র), ঙ্খ (ঙ্+খ), ঙ্গ (ঙ্+গ), ঙ্ঘ (ঙ্+ঘ), ঙ্ক্ষ (ঙ্+ক্+ষ), (In some contexts ঙ্ is replaced by ং )  কং, অং | ঙ্ক (ঙ্+ক), ঙ্গ (ঙ্+গ), ঙ্ঘ (ঙ্+ঘ) |
| ম | /m/ | ম্ল (ম্+ল), ম্প (ম্+প), ম্প্র (ম্+প্+র), ম্ভ (ম্+ভ), ম্ভ্র (ম্+ভ্+র), ম্ম (ম্+ম), ম্র (ম্+র),  ত্ম (ত্+ম), ধ্ম (ধ্+ম), হ্ম (হ্+ম), ক্ষ্ম (ক্+ষ্+ম) | হ্ম (হ্+ম) |
| ন | /n/ | ন্ট (ন্+ট), ন্ট্র (ন্+ট্+র), ন্ঠ (ণ্+ঠ), ন্ড (ন্+ড), ন্ড্র (ন্+ড্+র), ন্ত (ন্+ত), ন্ত্র (ন্+ত্+র), ন্ত্র্য (ন্+ত্+র্+য), ন্থ (ন্+থ), ন্দ (ন্+দ), ন্দ্র (ন্+দ্+র), ন্ধ (ন্+ধ), ন্ধ্র (ন্+ধ্+র), ন্দ্ব (ন্+দ্+ব), ন্ন (ন্+ন), ন্ম (ন্+ম), ন্য (ন্+য), ন্স (ন্+স)  হ্ন (হ্+ন) | ন্থ (ন্+থ), ন্ধ (ন্+ধ), ন্ধ্র (ন্+ধ্+র) |
| শ | /ʃ/ | শ্চ (শ্+চ), শ্ছ (শ্+ছ), শ্ন (শ্+ন), শ্ম (শ্+ম), শ্র (শ্+র), শ্ল (শ্+ল), শ্য (শ্+য) |  |
| ষ | /ʃ/ | ষ্ক (ষ্+ক), ষ্ট (ষ্+ট), ষ্ঠ (ষ্+ঠ), ষ্ণ (ষ্+ণ), ষ্প (ষ্+প), ষ্প্র (ষ্+প্+র), ষ্ফ (ষ্+ফ), ষ্ট (ষ্+ট), ষ্ট্র (ষ্+ট্+র), ষ্ঠ (ষ্+ঠ), ষ্ণ (ষ্+ণ), ষ্য (ষ্+য)  ক্ষ (ক্+ষ), ক্ষ্ণ (ক্+ষ্+ণ), ক্ষ্ম (ক্+ষ্+ম) | ষ্ণ (ষ্+ণ) |
| স | /s/ & /ʃ/ | স্ক/স্ক (স্+ক), স্ট (স্+ট), স্প (স্+প), স্ফ (স্+ফ), স্ত (স্+ত), স্থ (স্+থ), স্ট (স্+ট), স্ক (স্+ক), স্খ (স্+খ), স্য (স্+য), স্র (স্+র), স্ল (স্+ল)  ক্স (ক্+স) | স্থ (স্+থ) |
| হ | /h/ | হ্ণ (হ্+ণ), হ্ন (হ্+ন), হ্ম (হ্+ম), হ্য (হ্+য), হ্র (হ্+র), হ্ল (হ্+ল) | হ্ম (হ্+ম) |
| ড় | /ɽ/ | ড়্গ (ড়্+গ) |  |
| ঢ় | /ɽʱ/ | (not privileged enough to have clusters) |  |
| য | /dʒ/  The secondary symbol (allograph) jɔ-phalā has two phonetic values. When added to the initial consonant in a word, it is a vowel /æ/ (as in শ্যামল, র‌্যাপার, etc.). But after a non-initial consonant, it just doubles it in pronunciation (as in কার্য, ধার্য, etc.). The র্+য combination has two physical manifestations—র‌্য and র্য. | ক্য (ক্+য), স্য (স্+য), র‌্য (র্+য) [Just র‍্য is never used in Bangla orthography. র‍্যা is, but then its last two symbols, Ya-phalā ā-kāra, constitute a vowel sign, representing the vowel অ্যা.] |  |
| র | /r/ | Two manifestations—   1. রেফ /repʰ/ as the first member of a cluster, e.g., র্প, র্ৎ, র্দ্র, র্য, র্ধ্ব (র্+ধ্+ব) (earlier র্দ্ধ্ব=র্+দ্+ধ্+ব, a four-term cluster), etc. (placed over the following consonant) 2. র-ফলা /rɔ-pʰɔla/ as the second/third member of a cluster, e.g., ম্র, স্ত্র, etc. (placed under the consonant it follows) |  |
| ল | /l/ | ল্গ (ল্+গ), ল্প (ল্+প), ল্ব (ল্+ব), ল্ম (ল্+ম), ল্ট (ল্+ট), ল্ড (ল্+ড), ল্ক (ল্+ক), ল্গ (ল্+গ), ল্দ (ল্+দ), ল্য (ল্+য)  গ্ল (গ্+ল), ভ্ল (ভ্+ল), ম্ল (ম্+ল) |  |
| ঃ | /h/ word finally, word medially it doubles the pronunciation of the following consonant. | অঃ, কঃ |  |
| ঁ | / ̃/ | অঁ, বঁ |  |

1. The term ‘Bangla’ is used in the descriptive text and the term ‘Bengali’ is used in the normative part of this proposal. [↑](#footnote-ref-2)
2. Umar, Badruddin. 2007. “Language Movement”. In Islam, Sirajul (ed.), 2007. *History of Bangladesh 1704-1971: Political History*, Vol. 1, Dhaka: Asiatic Society of Bangladesh. Pp. 352-382. [↑](#footnote-ref-3)
3. Bāṅlā Bhāṣā Kamiṭi. 1983. *Bāṅlā Bhāṣā Kamiṭi Riporṭ* (Report of the Bangla Bhasha Committee). Dhakaː Śikṣā, Dharma, Krīṛā O Saṅskṛti Mantraṇālaya, Peoples Republic of Bangladesh. [↑](#footnote-ref-4)
4. Chakraborty, Rajib. 2018. *The Fishermen’s Community: A Language-Culture Interplay (A Study of Post-1971 Select Bangla Novels)*. Unpublished Ph.D. Dissertation, Visva-Bharati. [↑](#footnote-ref-5)
5. Bashir Al Helal. 2012. “Language Movement”. In Islam, Sirajul (ed.), Banglapedia: National Encyclopedia of Bangladesh. 2nd Edition. Retrieved from its official home page at <http://en.banglapedia.org/index.php?title=Language_Movement> on 30.07.2018

   Islam, Sirajul. 2012. “International Mother Language Day”. In Islam, Sirajul (ed.), Banglapedia: National Encyclopedia of Bangladesh. 2nd Edition. Retrieved from its official home page at <http://en.banglapedia.org/index.php?title=International_Mother_Language_Day> on 30.07.2018. [↑](#footnote-ref-6)
6. Bashir Al Helal. 2012. “Language Movement”. In Islam, Sirajul (ed.), Banglapedia: National Encyclopedia of Bangladesh. 2nd Edition. Retrieved from its official home page at <http://en.banglapedia.org/index.php?title=Language_Movement> on 30.07.2018

   Islam, Sirajul. 2012. “International Mother Language Day”. In Islam, Sirajul (ed.), Banglapedia: National Encyclopedia of Bangladesh. 2nd Edition. Retrieved from its official home page at <http://en.banglapedia.org/index.php?title=International_Mother_Language_Day> on 30.07.2018. [↑](#footnote-ref-7)
7. William Dwight Whitney in his *Sanskrit Grammar* unequivocally said, “This name (Devanāgarī) is of doubtful origin and value” (Whitney, William Dwight. 1994 reprint. *Sanskrit Grammar*. New Delhiː Motilal Banarasidass Publishers, p. 1) [↑](#footnote-ref-8)
8. Bangla Academy. 2012. *Bāṅlā Ekaḍemī Pramita Bāṅlā Bānānera Niyama* (Bangla Academy Standard Bangla Spelling Rules). Dhakaː Bangla Academy. [↑](#footnote-ref-9)
9. *Virāma*, as used here, is also a misnomer according to the Indian grammatical traditions. Virāma in *Taittirīya Prātiśākhya* is divided into four kinds—

   R̥gvirāma (pause at the end of a foot or a verse equal to three mātrās or moras)

   Padavirāma (pause between two words of duration equal to two mātrās)

   Vivr̥ttivirāma (pause between two words the preceding one of which ends in a vowel and the following begins with a vowel, the vowels being not euphonically combined; this pause has a duration of one mātrā)

   Samānapadavivr̥ttivirāma (pause between two vowels inside a word which is a rare occurrence; this has a duration of half a mātrā)

   (R̥gvirāmah padavirāmo vivr̥ttivirāmah samānavivr̥ttivirāmastrimātro dvimātra ekamātrordhamātra ityānupūvyeṇa—Taittirīya Prātiśākhya, XXXII. 13)

   Pāṇini describes it as ‘virāmoåvasānam‘, which was explained in Siddhāntakaumudī as ‘varṇānāmabhāvovasānasañjah syāt‘.

   No where mere absence of a vowel is marked as virāma. Hasanta just marks the absence of a vowel, nothing else. It has nothing to do with the killing of a vowel. [↑](#footnote-ref-10)
10. This term needs to be disambiguated. Akṣara also means ‘syllable‘ in Indian grammatical treaditions [↑](#footnote-ref-11)
11. Refer to Rule P in Section 7, Table 16. [↑](#footnote-ref-12)
12. Unicode uses Oriya for the script, although Odia is now the official term used. [↑](#footnote-ref-13)
13. As used by the Unicode, denoting and including both Assamese and Maṇipuri. [↑](#footnote-ref-14)
14. This section specifically takes up issues of restrictions pertaining to Bangla (Bengali) language. Assamese and Maṇipuri have not been covered in this section. [↑](#footnote-ref-15)