Proposal for a Telugu Script Root Zone Label Generation Ruleset (LGR)

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# General Information/ Overview/ Abstract

This document lays down the Label Generation Rule Set for Telugu script. Three main components of the Telugu Script LGR, viz. Code point repertoire, Variants and Whole Label Evaluation Rules have been described in detail here. [All these components have been incorporated in a machine-readable format in the accompanying XML file named "Proposal-LGR-Telu-20180531.xml". In addition, a document named “Telu\_Test\_Labels\_20180531.txt” has been provided.

# Script for which the LGR is proposed

ISO 15924 Code: Telu
ISO 15924 Key N°: 340
ISO 15924 English Name: Telugu
Latin transliteration of native script name: telɯgɯ
Native name of the script: తెలుగు
Maximal Starting Repertoire [MSR] version: 3
The Unicode Standard, Version 6.3
Telugu Range: 0C00–0C7F

# Background of the Script and Principal Languages Using It

The Telugu language uses the script called the Telugu script which is written in the form of sequences of orthographic syllables. Each orthographic syllable is formed of one or more Telugu characters or their variants placed from left to right and top to bottom. Telugu is one of the 22 scheduled languages of India. The Telugu script is immediately related to Kannada and closely related to the Sinhala script.

## 3.1 The Evolution of the Script

The origins of the Telugu script can be traced to the Brahmi alphabet of ancient India, often known as Asokan Brahmi. Historically the script is derived from the Southern Brahmi or Bhattiprolu Brahmi alternatively known as the Telugu Brahmi alphabet of 3rd century BCE. Later, by 5th century during the Chalukyan period, it developed into a common alphabet used for Telugu and Kannada. The Telugu-Kannada common alphabet split into two separate alphabets during the 12th and 13th centuries AD. to be called the Telugu and Kannada scripts. ~~This common origin is ultimately why GP propose such a large proportion of the characters in the two scripts (just over 50%) as cross-script variants (in section 6, Type 2-1).~~ In addition to the common origin and a longer period of shared political and cultural confederation of the Telugu and Kannada speaking regions has ultimately resulted in the considerable proportion of the shared identical character signs between the two scripts (34 out of 63 characters, see Table-10) .

 The earliest known inscriptions containing Telugu words appear on the bilingual coins of Satavahanas that date back to 2nd century AD [104].. The first inscription entirely in Telugu was made in 575 AD and was probably made by Renati Cholas, who started writing royal proclamations in Telugu instead of Sanskrit. Telugu developed as a poetical and literary language during the 11th century. Until the 20th century Telugu was written in granthic style very different from the colloquial language. During the the second half of the 20th century, a modern written style emerged based on the modern colloquial language. In 2008 Telugu was designated as a classical language by the Indian government.

 



 Fig-1

## 3.2 Notable features

The Telugu orthography superficially appears as a series of circles and semi-circles. Most consonants carry a tick mark called ‘talakattu’. The writing system is classified as abugida type that employs alpha-syllabaries. The alphabet consists of vowels, consonants and modifiers. Each of these vowels and consonants have one or more secondary allographs. The secondary allographs always appear as dependent symbols on the first character of a syllable. Each syllable is formed of a single standalone vowel or one or more consonants. Each of these consonants may occur with an inherent vowel or modified by a secondary vowel. A Consonant cluster may be formed with a single standalone character followed by one or more secondary forms of consonants. The direction of writing is from left to right. The order of composition of syllabaries do not match with the reading order. There are rules to learn to read orthographic sequences into phonetic sequences whether simple or complex syllables.

## 3.3 The Telugu (తెలుగు) Language

The Telugu language is a Dravidian language spoken by about 75 million (ca. 2001) people mainly in the southern Indian states of Andhra Pradesh and Telangana where it is the official language. It is also spoken in such neighboring states as Karnataka, Tamil Nadu, Orissa, Maharashtra and Chattisgarh, and is one of the 22 scheduled languages of India. There are also quite a few Telugu speakers in Canada, the USA, South Africa, Malaysia, Mauritius, Myanmar, Sri Lanka and Réunion

## 3.4 Languages that use the Telugu script

The script is also used for ten other languages, viz. Gondi, Koya, Konda, Kuvi, Kolavar or Kolami, Yerukala, Banjara or Lambadi, Savara or Sora, Adivasi Odiya and also Sanskrit.

In the Telugu speaking region, the tradition of writing Sanskrit in the Telugu script has remained a common practice. During the last few decades, a considerable number of publications in the form of text books, dictionaries and other reading material has been produced in the Telugu script in Gondi, Koya, Konda, Kuvi, Kolami, Yerukala, Banjara, Savara and Adivasi Odiya.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| no. | Name of the language (ISO639 Code) | Language family | status | EGIDS Scale |
| 1 | Telugu (tel) | Dravidian | Scheduled and Classical | 2 |
| 2 | Gondi (gon) | Dravidian | Modern Tribal | 5 |
| 3 | Koya (kff) | Dravidian | Modern Tribal |  5 |
| 4 | Konda (knd) | Dravidian | Modern Tribal |  6b |
| 5 | Kuvi (kxv) | Dravidian | Modern Tribal |  5 |
| 6 | Kolavar or Kolami (kfb) | Dravidian | Modern Tribal |  5 |
| 7 | Yerukala (yeu) | Dravidian | Modern Tribal |  6 |
| 8 | Banjara or Lambadi (lmn) | Indo-Aryan | Modern Tribal |  5 |
| 9 | Savara or Sora (srb) | Austro-Asiatic | Modern Tribal |  5 |
| 10 | Adivasi Odiya (ort) | Indo-Aryan | Modern Tribal |  5 |
| 11 | Sanskrit (san) | Indo-Aryan | Scheduled and Classical  |  4 |

Table 1: Main languages considered under Telugu LGR

## 3.5 [The structure of written Telugu](#_Appendix_B:_Syllable)

The writing system of Telugu as it is used for the Telugu language consists of a total of 72 characters comprising sixteen-character signs representing vowels that can stand alone and fifteen dependent signs corresponding to sixteen vowels excepting /a/ అ which does not exist as a dependent explicit symbol but can be found as an inherent sound with the consonants. Besides these, there are six more dependent symbols which (except for ్ 0C4D) always occur with the vowels as extensions. This could be summed up as in the following:

### 3.5.1 The vowels and vowel modifiers

There are fourteen vowel characters viz. అ [a], ఆ [ā], ఇ [i], ఈ [ī], ఉ [u], ఊ [ū], ఋ [r̥], ఌ [l̥], ఎ [e], ఏ [ē], ఐ [ai], ఒ [o], ఓ [ō], ఔ [au], in the common inventory for all the languages specified above and two (ౠ [r̥̄], ౡ [ḹ] ) to write Sanskrit loans. There are fourteen vowel characters viz. అ, ఆ, ఇ, ఈ, ఉ, ఊ, ఋ, ఌ, ఎ, ఏ, ఐ, ఒ, ఓ, ఔ, in the common inventory and two (ౠ, ౡ) which are obsolete. Each member of the common inventory has one to many secondary variants depending on the size and shape of the consonant that functions as an anchor. There are six modifiers for vowels: ఁ [~], ం [ ṃ], ః [ḥ], ँ [~] a special symbol not common in standard Telugu writings, the symbol avagraha ఽ [:.] is used as a common symbol to indicate doubling the vowel length and follows only long vowels, and finally the symbol ్ [H] when appended to consonants it deducts the inherent vowel /a/ from the consonant. The halant sign has the same characteristic as that of a secondary vowel sign in that both of them delete the inherent vowel [a] when added to consonants .

R1. Inherent vowel deletion rule: An inherent vowel of a consonant gets deleted either before a *matra* sign or before the *halant* sign.

C[ca] + M [ా, ి …] | ్ [H] -> C [cా, ి] | ్

C[ca] + M [0C3E-3F, 0C40-44, 0C62-63, 0C46-48, 0C4A-4C]|[0C4D] ->

C[c]M [0C3E-3F, 0C40-44, 0C62-63, 0C46-48, 0C4A-4C]|[0C4D]

C = Consonant, ca= a consonant with an inherent ‘a’, M =Secondary vowel;

| No. | Independent vowelsPrimary allographsWith code points | Dependent vowelsSecondary allographsWith code points |
| --- | --- | --- |
| 1.  | అ 0C05 | No explicit signrecognized or encoded |
| 2.  | ఆ 0C06 | ా 0C3E |
| 3.  | ఇ 0C07 | ి 0C3F |
| 4.  | ఈ 0C08 | ీ 0C40 |
| 5.  | ఉ 0C09 | ు 0C41 |
| 6.  | ఊ 0C0A | ూ 0C42 |
| 7.  | ఋ 0C0B | ృ 0C43 |
| 8.  | ౠ 0C60 | ౄ 0C44 |
| 9.  | ఌ 0C0F | ౢ 0C62 |
| 10.  | ౡ 0C61 | ౣ 0C63 |
| 11.  | ఎ 0C0E | ె 0C46 |
| 12.  | ఏ 0C0F | ే 0C47 |
| 13.  | ఐ 0C10 | ై 0C48 |
| 14.  | ఒ 0C12 | ొ 0C4A |
| 15.  | ఓ 0C13 | ో 0C4B |
| 16.  | ఔ 0C14 | ౌ 0C4C |

Table 2: Vowels and the corresponding dependent signs

|  |  |  |  |
| --- | --- | --- | --- |
| No. | Modifier signs  | code points | Common name |
| 1. | ँ  | 0C00 | candrabindu |
| 2. | ఁ  | 0C01 | arthānusvāra or arasunna |
| 3. | ం  | 0C02 | pūrnanusvāra or sunna |
| 4. | ః  | 0C03 | visarga |
| 5. | ఽ  | 0C3D | avagraha |
| 6. | ్  | 0C4D | halant |

Table 3: Vowel modifiers and the consonantal modifiers

### 3.5.2 The Anusvara or sunna (ం - U+0C02)

The Anusvara or *sunna* represents a homorganic nasal before the corresponding consonant and as a substitute to transcribe word final /mu/. Essentially it substitutes a cluster of a Nasal Consonant+Halant before a consonant. Writing alternatively with a nasal consonant + Halant + Consonant is rare and often occur while transcribing Sanskrit words. Otherwise the writing practice with nasal consonant + Halant + Consonant of the later type is virtually absent in Telugu.

|  |  |  |
| --- | --- | --- |
| No. | Homorganic nasal = Archiphoneme /M/ | Homorganic nasal+Halant |
| 1. | లంక /laMka/ | లఙ్క /laŋka/ ‘island’ |
| 2. | కంచె /kaMce/ | కఞ్చె [kaɲce] ‘fence’ |
| 3. | పంట /paMTa/ | పణ్ట /paNTa/ ‘harvest’ |
| 4. | కంత /kaMta/ | కన్త /kanta/ ‘hole’ |
| 5. | కంప /kaMpa/ | కమ్ప /kampa/ ‘thornybush’ |
| 6. | కంస /kaMsa/ | కమ్స /kansa/ ‘king Kansa] |
| 7. | సింహ /siMha/ | సిమ్హ /simha/ lion |
| 8. | కలం /kalaM/ | కలము /kalamu/ ‘pen’ |

Table 4: Homorganic nasal and Homorganic nasal + Halant

### 3.5.3 Nasalization: Candrabindu (ँ 0C00) or arasunna (ఁ 0C01)

Candrabindu denotes nasalization of the preceding vowel is used in the Prakrit texts transcribed in the Telugu script and the arasunna as in old Telugu తెలుఁగు /telũgu/ ‘telugu’. Present-day Telugu users do not use the candrabindu frequently unless to bring special emphasis as in hãã, hũũ, etc.

### 3.5.4 The Consonants

The Telugu consonants have an implicit vowel /a/ included in them. As per the traditional classification they are categorized according to their phonetic properties. There are 5 varga groups (classes) and one non-varga group. Each Varga corresponds to a particular set of stops characterised by particular place of articulation. Each varga contains four oral stops and one nasal stop ordered by the complexity of their manner from left to right as [-vd,-asp, -nas], [-vd, +asp, -nas], [+vd, -asp, -nas], [+vd, +asp, -nas], [+vd, -asp, +nas]. Each feature set defines the character by the varga. Each varga from top to bottom are defined by an additional place feature of articulation. The non-varga set are again divided into two subsets, each is characterized by absence or presence of sonority i.e. [+/- son]. The obstruents which are characterized by [-cont] i.e. non-continuous nature is further characterized by [–son] are fricatives, viz. శ[ś], ష [ṣs], స [s], హ [h] while the remaining carry the feature of sonority i.e. [+son].

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Place of Articulation | -asp-vd-nas | ISO | +asp-vd-nas | ISO | -asp+vd-nas | ISO | +asp+vd-nas | ISO | -asp+vd+nas | ISO |
| 1. | Velar | క | k | ఖ | kh | గ | g | ఘ | gh | ఙ | ṅ |
| 2. | Palatal | చ | c | ఛ | ch | జ | j | ఝ | jh | ఞ | ñ |
| 3. | Retroflex | ట | ṭ | ఠ | ṭh | డ | ḍ | ఢ | ḍh | ణ | ṇ |
| 4. | Dental | త | t | థ | th | ద | d | థ | dh | న | n |
| 5. | Bilabial | ప | p | ఫ | ph | బ | b | భ | bh | మ | m |

Table 5: classification of Stop consonants

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SonorantsFricatives | య | y | ర | r | ఱ | ṛ | ల | l | ళ | ḷ | వ | v |
| శ | ś | ష | ṣ | స | s | - |  | హ | h |

Table 6: Non-stop consonants

# 4. The Development Process and Methodology

The Neo-Brahmi Generation Panel involves a number of different scripts with distinct Unicode blocks. Each of these scripts usually will have a separate LGR. However, a common thread runs through the neo-Brahmi scripts in the process of LGR development.

 A number of guiding principles that are laid out will be used in the development of the scheme. As specified elsewhere, the NBGP adopts the following principles in the selection of code-points from the code-point repertoire for the Telugu language script. A principle, like the Inclusion principle, deals with whether the character is regularly used in the language, besides its unambiguous nature.

The second important principle, the exclusion principle deals with the use of the code point repertoire for root zone which does not allow each and every character that is recognized in the Unicode chart. Another special layer that is less restrictive is the Domain Name System which is governed by an additional protocol known as IDNA (Internationalized Domain Names in Applications). This domain may exclude some characters from the Unicode repertoire for the concerned language. However, Telugu does not have many such characters that shall be restricted as per this principle. One such character for example is, the Avagraha " ఽ" (U+oc3d) even if allowed by IDNA protocol, may not be permitted in the Root Zone Repertoire as per the MSR. Similarly, certain punctuation marks that were used in the traditional texts are not assigned any code points and hence not necessary to be included here. Other cases such as symbols and abbreviations are not permitted. In addition to the above, rare and obsolete Characters though recognized in the Unicode chart of Telugu will not be permitted in the root zone LGR.

4.1 Zero Width Joiner and Zero Width Non Joiner in Telugu domain names

 IDNA Protocol excludes invisible characters like Zero Width Non-Joiner (U+200C) and Zero Width Joiner (U+200D), as they require adhoc representation in different way. These are required in certain cases where a typical visual shape of an akshar is desired.

There are contrastive usages of written forms derived from the use of Zero Width Joiner (ZWJ) and Zero Width Non Joiner (ZWNJ). They have special roles in the writing system of Telugu.

ZWNJ is used in sequences like Consonant (C) + Halant (U+0C4D) + Consonant where the second C is prevented from taking the usual dependent allograph (*vattu*) form after (below) the first consonant as in the following example:

1.క (U+0C15) + ్ (U+0C4D) +స (U+0C38) + ్ (U+0C4D) +వ (U+0C35) +ా (0C3E) = క్స్వా– without using ZWNJ

Example: వాక్స్వాతంత్ర్యం

2. క (U+0C15) + ్ (U+0C4D) + ZWNJ (U+200C) +స (U+0C38) + ్ (U+0C4D) +

వ (U+0C35) +ా (0C3E) = క్‌స్వా– using the ZWNJ

Example: వాక్‌స్వాతంత్ర్యం

Both forms of the words though written with different graphic signs may mean the same and they are also same even in their pronunciation. Though the second form is not common in the olden days, its usage is gaining ground due to the influence of English and Hindi. It is frequently used in transcribing many English words into Telugu, such as software (సాఫ్ట్‌వేర్‌, using ZWNJ). The word software will become సాఫ్ట్వేర్‌ if ZWNJ is not used.

 **How to avoid duplicate domain names involving ZWJ and ZWNJ?**

ZWJ and ZWNJ are used mainly to write two distinct displays of the same consonant cluster or sequence which do not have any semantic and phonetic significance. When ZWJ and ZWNJs are allowed in domain names for Telugu, they create two distinct forms of the same domain name. To make the browsers and DNSs to treat them as equal, we have to ignore ZWJ and ZWNJs for comparing two words. The same procedure is usually followed by the spell-checkers of the language.

Accepting this as part of the ISDN protocol may create a perceptual difference between the two labels (with and without H) but creates confusion to a 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.

# 5. The Repertoire

Section ‎5.1 provides the section of the [MSR] applicable to the Telugu script on which the Telugu code point repertoire is based. Section ‎5.2 details the code point repertoire that the Neo-Brahmi Generation Panel [NBGP] proposes to be included in the Telugu LGR.

## 5.1 Telugu section of Maximal Starting Repertoire [MSR] Version 3

##

|  |  |
| --- | --- |
|  | **Color convention[[1]](#footnote-1):**All characters that are included in the [MSR] - Yellow backgroundPVALID in IDNA2008 but excluded from the [MSR] - Pinkish backgroundNot PVALID in IDNA2008, or are ineligible for the root zone (digits, hyphen) - White background |

Fig. 1. Telugu Code Page from [MSR]

## 5.2 Code points repertoire

In the following, the Telugu Script Unicode Code points have been presented and discussed with reference to the Principles that constrain the label generation rules. Issues Related to the Management of IDN Variant TLDs (IIR) and the Principles for Unicode Code Point Inclusion or exclusion in Labels in the DNS [IABCP] have several principles that constrain the development of the label generation rules for any zone, including the root zone. It’s important to note that, the purpose of this document is to state unambiguously the Telugu code points that can be used in the root zone repertoire.

The following table lists 63 code points for the Telugu LGR, out of a total number of 67 code points listed in MSR-3, excluding four code points which are obsolete.

| No. | Unicode Code Point |  Glyph | Character Name | EGIDS status | Indic Syllabic Category | Ref. |
| --- | --- | --- | --- | --- | --- | --- |
| 1.  | 0C02 | ం |  TELUGU SIGN A NUSVARA | 2 Tel4 San5 Others[[2]](#footnote-2) | ANUSVARA | 102, 103 |
| 2.  | 0C03 | ః |  TELUGU SIGN VISARGA | 2 Tel4 San5 Others | VISARGA | 102, 103 |
| 3.  | 0C05 | అ | TELUGU LETTER A | 2 Tel5 Others | Vowel | 102, 103 |
| 4.  | 0C06 | ఆ | TELUGU LETTER AA | 2 Tel5 Others | Vowel | 102, 103 |
| 5.  | 0C07 | ఇ | TELUGU LETTER I | 2 Tel5 Others | Vowel | 102, 103 |
| 6.  | 0C08 | ఈ | TELUGU LETTER II | 2 Tel5 Others | Vowel | 102, 103 |
| 7.  | 0C09 | ఉ | TELUGU LETTER U | 2 Tel5 Others | Vowel | 102, 103 |
| 8.  | 0C0A | ఊ | TELUGU LETTER UU | 2 Tel5 Others | Vowel | 102, 103 |
| 9.  | 0C0B | ఋ | TELUGU LETTER VOCALIC R | 2 Tel5 Others | Vowel | 102, 103 |
| 10  | 0C0E | ఎ | TELUGU LETTER E | 2 Tel5 Others | Vowel | 102, 103 |
| 11.  | 0C0F | ఏ | TELUGU LETTER EE | 2 Tel5 Others | Vowel | 102, 103 |
| 12.  | 0C10 | ఐ | TELUGU LETTER AI | 2 Tel5 Others | Vowel | 102, 103 |
| 13.  | 0C12 | ఒ | TELUGU LETTER O | 2 Tel5 Others | Vowel | 102, 103 |
| 14.  | 0C13 | ఓ | TELUGU LETTER OO | 2 Tel5 Others | Vowel | 102, 103 |
| 15.  | 0C14 | ఔ | TELUGU LETTER AU | 2 Tel5 Others | Vowel | 102, 103 |
| 16.  | 0C15 | క | TELUGU LETTER KA | 2 Tel5 Others | Consonant | 102, 103 |
| 17.  | 0C16 | ఖ | TELUGU LETTER KHA | 2 Tel5 Others | Consonant | 102, 103 |
| 18.  | 0C17 | గ | TELUGU LETTER GA | 2 Tel5 Others | Consonant | 102, 103 |
| 19.  | 0C18 | ఘ | TELUGU LETTER GHA | 2 Tel5 Others | Consonant | 102, 103 |
| 20.  | 0C19 | ఙ | TELUGU LETTER NGA | 2 Tel5 Others | Consonant | 102, 103 |
| 21.  | 0C1A | చ | TELUGU LETTER CA | 2 Tel5 Others | Consonant | 102, 103 |
| 22.  | 0C1B | ఛ | TELUGU LETTER CHA | 2 Tel5 Others | Consonant | 102, 103 |
| 23.  | 0C1C | జ | TELUGU LETTER JA | 2 Tel5 Others | Consonant | 102, 103 |
| 24.  | 0C1D | ఝ | TELUGU LETTER JHA | 2 Tel5 Others | Consonant | 102, 103 |
| 25.  | 0C1E | ఞ | TELUGU LETTER NYA | 2 Tel5 Others | Consonant | 102, 103 |
| 26.  | 0C1F | ట | TELUGU LETTER TTA | 2 Tel5 Others | Consonant | 102, 103 |
| 27.  | 0C20 | ఠ | TELUGU LETTER TTHA | 2 Tel5 Others | Consonant | 102, 103 |
| 28.  | 0C21 | డ | TELUGU LETTER DDA | 2 Tel5 Others | Consonant | 102, 103 |
| 29.  | 0C22 | ఢ | TELUGU LETTER DDHA | 2 Tel5 Others | Consonant | 102, 103 |
| 30.  | 0C23 | ణ | TELUGU LETTER NNA | 2 Tel5 Others | Consonant | 102, 103 |
| 31.  | 0C24 | త | TELUGU LETTER TA | 2 Tel5 Others | Consonant | 102, 103 |
| 32.  | 0C25 | థ | TELUGU LETTER THA | 2 Tel5 Others | Consonant | 102, 103 |
| 33.  | 0C26 | ద | TELUGU LETTER DA | 2 Tel5 Others | Consonant | 102, 103 |
| 34.  | 0C27 | ధ | TELUGU LETTER DHA | 2 Tel5 Others | Consonant | 102, 103 |
| 35.  | 0C28 | న | TELUGU LETTER NA | 2 Tel5 Others | Consonant | 102, 103 |
| 36.  | 0C2A | ప | TELUGU LETTER PA | 2 Tel5 Others | Consonant | 102, 103 |
| 37.  | 0C2B | ఫ | TELUGU LETTER PHA | 2 Tel5 Others | Consonant | 102, 103 |
| 38.  | 0C2C | బ | TELUGU LETTER BA | 2 Tel5 Others | Consonant | 102, 103 |
| 39.  | 0C2D | భ | TELUGU LETTER BHA | 2 Tel5 Others | Consonant | 102, 103 |
| 40.  | 0C2E | మ | TELUGU LETTER MA | 2 Tel5 Others | Consonant | 102, 103 |
| 41.  | 0C2F | య | TELUGU LETTER YA | 2 Tel5 Others | Consonant | 102, 103 |
| 42.  | 0C30 | ర | TELUGU LETTER RA | 2 Tel5 Others | Consonant | 102, 103 |
| 43.  | 0C32 | ల | TELUGU LETTER LA | 2 Tel5 Others | Consonant | 102, 103 |
| 44.  | 0C33 | ళ | TELUGU LETTER LLA | 2 Tel5 Others | Consonant | 102, 103 |
| 45.  | 0C35 | వ | TELUGU LETTER VA | 2 Tel5 Others | Consonant | 102, 103 |
| 46.  | 0C36 | శ | TELUGU LETTER SHA | 2 Tel5 Others | Consonant | 102, 103 |
| 47.  | 0C37 | ష | TELUGU LETTER SSA | 2 Tel5 Others | Consonant | 102, 103 |
| 48.  | 0C38 | స | TELUGU LETTER SA | 2 Tel5 Others | Consonant | 102, 103 |
| 49.  | 0C39 | హ | TELUGU LETTER HA | 2 Tel5 Others | Consonant | 102, 103 |
| 50.  | 0C3E | ా | TELUGU VOWEL SIGN AA | 2 Tel5 Others | Matra | 102, 103 |
| 51.  | 0C3F | ి | TELUGU VOWEL SIGN I | 2 Tel5 Others | Matra | 102, 103 |
| 52.  | 0C40 | ీ |  TELUGU VOWEL SIGN II | 2 Tel5 Others | Matra | 102, 103 |
| 53.  | 0C41 | ు |  TELUGU VOWEL SIGN U | 2 Tel5 Others | Matra | 102, 103 |
| 54.  | 0C42 | ూ | TELUGU VOWEL SIGN UU | 2 Tel5 Others | Matra | 102, 103 |
| 55.  | 0C43 | ృ |  TELUGU VOWEL SIGN VOCALIC R | 2 Tel5 Others | Matra | 102, 103 |
| 56.  | 0C44 | ౄ |  TELUGU VOWEL SIGN VOCALIC RR | 2 Tel5 Others | Matra | 102, 103 |
| 57.  | 0C46 | ె |  TELUGU VOWEL SIGN E | 2 Tel5 Others | Matra | 102, 103 |
| 58.  | 0C47 | ే |  TELUGU VOWEL SIGN EE | 2 Tel5 Others | Matra | 102, 103 |
| 59.  | 0C48 | ై |  TELUGU VOWEL SIGN AI | 2 Tel5 Others | Matra | 102, 103 |
| 60.  | 0C4A | ొ |  TELUGU VOWEL SIGN O | 2 Tel5 Others | Matra | 102, 103 |
| 61.  | 0C4B | ో |  TELUGU VOWEL SIGN OO | 2 Tel5 Others | Matra | 102, 103 |
| 62.  | 0C4C | ౌ |  TELUGU VOWEL SIGN AU | 2 Tel5 Others | Matra | 102, 103 |
| 63.  | 0C4D | ్ |  TELUGU SIGN VIRAMA | 2 Tel5 Others | Matra | 102, 103 |

Table 7: Included code points

## 5.3 Code points not included:

Referring to the principle in section 4, the code points to be excluded from the Repertoire are the following.

**The following code points are not in widespread use.**

* 0C00 ँ TELUGU LETTER CANDRABINDU
* 0C01 ఁ TELUGU LETTER ARASUNNA
* 0C0C ఌ TELUGU LETTER VOCALIC L
* 0C31 ఱ TELUGU LETTER RRA

**Various signs: Allographs of vowel diacritics /a:/ and part of a diacritic specific to particular consonant /h/. They need to be blocked.**

* 0C55 ౕ TELUGU LENGTH MARK
* 0C56 ౖ TELUGU AI LENGTH MARK

**Historic phonetic variants: Phonological variants shall not be permitted. They are not in MSR-3.**

* 0C58 ౘ TELUGU LETTER TSA
* 0C59 ౙ TELUGU LETTER DZA
* 0C5A ~~ద~~ TELUGU LETTER RRRA (letter for an alveolar consonant whose exact phonetic value is not known).

**The two additional vowels listed below to transcribe Sanskrit are not permitted. They are not in MSR-3.**

* 0C60 ౠ TELUGU LETTER VOCALIC RR
* 0C61 ౡ TELUGU LETTER VOCALIC LL

**The following two dependent vowels signs to transcribe Sanskrit sounds are not permitted. They are not in MSR-3.**

* 0C62 ౢ TELUGU VOWEL SIGN VOCALIC L
* 0C63 ౣ TELUGU VOWEL SIGN VOCALIC LL

Starting from the MSR-3, There are four code points to be excluded.

| No. | Unicode Code Point |  Glyph | Character Name | GC | EGIDS status | Indic Syllabic Category | Ref. | Current and wide-spread use?[Y/N] |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1.  | 0C0C | ఌ | TELUGU LETTER VOCALIC L | Lo | 2 Telu5 Gon6b other | Vowel | 103, 108, 109 | No |
| 2.  | 0C31 | ఱ | TELUGU LETTER RRA | Lo | 2 Telu5 Gon6b other | Consonant | 103, 108, 109 | No |
| 3.  | 0C55 | ౕ |  TELUGU LENGTH MARK | Mn | 2 Telu5 Gon6b other | Matra | 103, 108, 109 | Yes, but to be excluded by principle |
| 4.  | 0C56 | ౖ |  TELUGU AI LENGTH MARK | Mn | 2 Telu5 Gon6b other | Matra | 103, 108, 109 | No |

Table 8: Excluded code points

# 6. Variants

Standard Unicode encoded Telugu code points representing the basic simple standalone Characters and some dependent characters may enter into different combinations to form syllables. There are no characters in the Telugu Unicode chart that are either in simple or in combinations of the characters permitted as per the [MSR]  have any formal similarity. However, Telugu has a small number of variants that have identical values but derive from different character combinations. The NBGP categorizes these confusingly similar variants in two groups.

## 6.1 Type 1: Similarity within the script

Shared sound value but formally different due to the combinations of different code points
 Ex. i. Ca +e+u(:) -> ko(:)
 ii. Ca+o(:) -> ko(:)

Variation due to display and rendering differently of identical code points which are often confusing and of variable acceptance.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sr. No. | Character seq. [Ca+e+u] | -> Co <-  |  | Ca+o  |
| 1 | [ క +ె +ు] -> 0C15+0C46+0C41 | కెు Blocked  | కొ  | క+ొ0C15+0C4A |
| 2 | [ మ +ె +ు] -> 0C2E+0C46+0C41 |  మొ  | మ ొ Blocked | మ+ ొ0C2E +0C4A |
| 3 | [య +ె +ు] -> 0C2F+0C46+0C41 | యొ  | య+ ొ Blocked | య+ ొ0C2F +0C4A |
| 4 | [ ఝ +ె +ు] -> 0C1D+0C46+0C41 | ఝొ  | ఝ+ ొ Blocked | ఝ+ ొ0C1D +0C4A |
| 5 | [ ఘ +ె +ు] -> 0C18+0C46+0C41 | ఘొ  | ఘ+ ొ Blocked | ఘ+ ొ0C18+0C4A |

Table 9: Similarity within the script

Type 1 cases are proposed to be considered as variants. These cases are interesting in that they present no similarity in the form but have similar phonetic output. This is not unusual to find such regional variations and they are regularly used by Telugu users. These may not cause confusion but become annoying to learners and particularly problematic to the analyzers and generators.

## 6.2 Type 2. Shared similarity with the other related scripts.

There are many Brahmi derived scripts particularly in the Southern part of India, Sri Lanka, and South East Asia. Some of the characters of these scripts display formal similarity with each other. For example a number of characters of the Kannada script are almost similar to Telugu equivalents except for the flattened head-stroke in Kannada contrasting with a tick mark on the top of the character in Telugu. Out of the total there are 32 variant sets as shown in the following table.

### Type2-1 Cross-Script Variants for Telugu and Kannada Analysis

| **Variant Set**  | **Telugu Code Point**  | **Kannada Code Point** |
| --- | --- | --- |
| 1 | ం (0C02) | ಂ (0C82) |
| 2 | ః (0C03) | ಃ (0C83) |
| 3 | అ (0C05) | ಅ (0C85) |
| 4 | ఆ (0C06 ) | ಆ (0C86) |
| 5 | ఇ (0C07) | ಇ (0C87) |
| 6 | ఈ (0C08) | ಈ (0C88) |
| 7 | ఐ (0C10) | ಐ (0C90) |
| 8 | ఒ (0C12) | ಒ (0C92) |
| 9 | ఓ (0C13) | ಓ (0C93) |
| 10 | ఔ (0C14) | ಔ (0C94) |
| 11 | ఖ (0C16) | ಖ (0C96) |
| 12 | గ (0C17) | ಗ (0C97) |
| 13 | జ (0C1C) | ಜ (0C9C) |
| 14 | ఝ (0C1D) | ಝ (0C9D) |
| 15 | ఞ (0C1E) | ಞ (0C9E) |
| 16 | ట (0C1F) | ಟ (0C9F) |
| 17 | ఠ (0C20) | ಠ (0CA0) |
| 18 | డ (0C21) | ಡ (0CA1) |
| 19 | ఢ (0C22) | ಢ (0CA2) |
| 20 | ణ (0C23) | ಣ (0CA3) |
| 21 | థ (0C25) | ಥ (0CA5) |
| 22 | ద (0C26) | ದ (0CA6) |
| 23 | ధ (0C27) | ಧ (0CA7) |
| 24 | న (0C28) | ನ (0CA8) |
| 25 | బ (0C2C) | ಬ (0CAC) |
| 26 | భ (0C2D) | ಭ (0CAD) |
| 27 | మ (0C2E) | ಮ (0CAE) |
| 28 | య (0C2F) | ಯ (0CAF) |
| 29 | ర (0C30) | ರ (0CB0) |
| 30 | ల (0C32) | ಲ (0CB2) |
| 31 | ళ (0C33) | ಳ (0CB3) |
| 32 | ి (0C3F) | ಿ (0CBF) |
| 33 | ు (0C41) | ು (0CC1) |
| 34 | ృ (0C43) | ೃ (0CC3) |

Table 10: Cross-Script Variants for Telugu and Kannada Analysis

### Type2-2 Cross-Script Variants for Telugu and Devanagari Analysis

| **Devanagari Code Point**  | **Telugu Code Point** |
| --- | --- |
| ः (0903) | ః (0C03) |

Table 11: Cross-Script Variant for Telugu and Devanagari Analysis

Visarga is the only identical code point that exhibits shape similarity between the Telugu and Devanagari scripts. However, as there are no other variant code points between the two languages, it is not defined as a variant code point.

### Type2-3 Cross-Script Variants for Telugu and Gujarati Analysis

| **Gujarati Code Point**  | **Telugu Code Point** |
| --- | --- |
| ઃ (0A83) | ః (0C03) |

Table 12: Cross-Script Variant for Telugu and Gujarati Analysis

Visarga is the only identical code point that exhibits shape similarity between the Telugu and Gujarati scripts. However, as there are no other Gujarati code points between the two languages, it is not defined as a variant code point.

### Type2-4 Cross-Script Variants for Telugu and Oriya Analysis

There are the following code points that exhibit similarity between the Telugu and Oriya scripts.

| Telugu Code Point  | Oriya Code Point |
| --- | --- |
| ం(0C02) ANUSVARA | ଠ (0B20)  LETTER TTHA |
| ః (0C03) SIGN VISARGA | ଃ 0B03  SIGN VISARGA |
| ర (0C30) LETTER RA | ଠ (0B20) LETTER TTHA |

Table 13: Cross-Script Variant for Telugu and Oriya Analysis

The first two (0C02-0B20 and 0C03-0B03) are dependent signs and the 0C30 is the stand alone character in Telugu. NBGP discussions concluded that there is no need to recognize the cross-script variant code points between the Oriya and the Telugu scripts 0C30 and 0B20 are distinguishable as there are not enough other variant code points to form labels in each script that look the same. Therefore, these are not defined as variant code points.

### Type2-5 Cross-Script Variants for Telugu and Malayalam Analysis

| **Telugu Code Point**  | **Malayalam Code Point** |
| --- | --- |
| ం (0C02) | ം (0D02) |
| ః (0C03) | ഃ (0D03) |

Table 14: Cross-Script Variant for Telugu and Malayalam Analysis

The two code points, viz. the anusvara and the visarga are the only identical signs between the Telugu and Malayalam scripts. However, as there are not enough other variant code points to form labels with each script, they are not defined as variant code points between the two languages.

### Type2-5 Cross-Script Variants for Telugu and Sinhala Analysis

| **Telugu Code Point**  | **Sinhala Code Point** |
| --- | --- |
| ం (0C02) | ං (0D82) |
| ః (0C03) | ඃ (0D83) |
| ర (0C30) | ර (0D88) |

Table 15: Cross-Script Variants for Telugu and Sinhala Analysis

The pairs 0C02-0D82, 0C03-0D83 and 0C30-0DBB are identical between the Telugu and the Sinhala scripts. However, NBGP discussions decided 0C40 and 0D88 are distinguishable. As there are not enough number of variants such that they form labels, these are not to be recognized as variant code points.

6.3 Cross script variants of various *akshar* combinations

Cross script variants of various *akshar* combinations (consonant-consonant-dependent characters) common between the Telugu and Kannada scripts include the following:

| **Variant Set**  | **Telugu Code Point**  | **Kannada Code Point** |
| --- | --- | --- |
|  | ఖ (0C16) | ಖ (0C96) |
|  | గ (0C17) | ಗ (0C97) |
|  | జ (0C1C) | ಜ (0C9C) |
|  | ఝ (0C1D) | ಝ (0C9D) |
|  | ఞ (0C1E) | ಞ (0C9E) |
|  | ట (0C1F) | ಟ (0C9F) |
|  | ఠ (0C20) | ಠ (0CA0) |
|  | డ (0C21) | ಡ (0CA1) |
|  | ఢ (0C22) | ಢ (0CA2) |
|  | ణ (0C23) | ಣ (0CA3) |
|  | థ (0C25) | ಥ (0CA5) |
|  | ద (0C26) | ದ (0CA6) |
|  | ధ (0C27) | ಧ (0CA7) |
|  | న (0C28) | ನ (0CA8) |
|  | బ (0C2C) | ಬ (0CAC) |
|  | భ (0C2D) | ಭ (0CAD) |
|  | మ (0C2E) | ಮ (0CAE) |
|  | య (0C2F) | ಯ (0CAF) |
|  | ర (0C30) | ರ (0CB0) |
|  | ల (0C32) | ಲ (0CB2) |
|  | ళ (0C33) | ಳ (0CB3) |
|  | ి (0C3F) | ಿ (0CBF) |
|  | ు (0C41) | ು (0CC1) |
|  | ృ (0C43) | ೃ (0CC3) |
|  | ం (0C02) | ಂ (0C82) |
|  | ః (0C03) | ಃ (0C83) |

Table 16: Cross-Script Variants for Telugu and Kannada

There is a set of 34 code points involving 8 vowels (V), 3 *matras* (M), 21 consonants (C), 1 *anusvara* (B), and 1 *visarga* (X) . The code point referring to *halant* (H) though excluded from the common cross script variants (see, Table-10) it occurs in the formation of conjunct consonant combinations in Telugu and Kannada. Excluding the stand alone vowels from the total common *akshar* combinations of cross script variants, there are a set of 21 consonants (C), three vowel *matras* (M) and 2 vowel modifiers that enter into the formation of the following combinations:

|  |  |  |
| --- | --- | --- |
| Sl.No. | *akshar* combinations | number |
|  | CM  | = 21\*3=63 |
|  | CB  | = 21\*1=21 |
|  | CX  | = 21\*1=21 |
|  | CHCM | =21\*21\*3=1323 |
|  | CHCB  | =21\*21\*1=441 |
|  | CHCX | =21\*21\*1=441 |
|  | CHCMB | =21\*21\*3\*1=1323 |
|  | CHCMX | =21\*21\*3\*1=1323 |
|  | All combinations:  | =4956 |

 Table-17 total number of akshar combinations

There occur a total of 4956 conjunct consonant combinations modified by *matras* and vowel modifiers that are identical and can be labeled as confusable character combinations between Telugu and Kannada scripts. These can be referred to as "Whole Label confusable" variants across the Telugu and Kannada scripts. As variants mentioned in Table 16 and Table 17 can result in whole label variants of homoglyphs, that may be considered for "blocked".

There is no preference among these variants. Whichever label containing either of these variants is chosen earlier, the other one equivalent variant label should be blocked.

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# 7. Whole Label Evaluation Rules (WLE)

In this section we provide the WLEs that are required by the language. The rules have been formulated so that they can be adopted for LGR specification.
Below are the symbols used in the WLE rules, for each of the "Indic Syllabic Category" as mentioned in the Table 7: Code point repertoire. The details of syllable formation, see Appendix B.

C → Consonant
M → Matra
V → Vowel
B → Anusvara (Bindu)
X → Visarga

H → Halant / Virama

Rule 1. The sign for H i.e. the vowel deleting halant must be preceded only by a C and not anything else. (Ref. Appendix B: Syllable formation Rule 4

Rule 2. The sign for M, i.e. the secondary vowel signs must always be preceded only by a C and not anything else. (Ref. Appendix B: Syllable formation Rule 6

Rule 3. X, the visarga sign must always be preceded only by a V or M or C. (Ref. Appendix B: syllable formation rule 3c. , 5c and 7c.)

Rule 4. B, the anusvara sign must always be preceded only by a V or M or C. (Ref. Appendix B: syllable formation rule 3b., 5b. and 7b.)

8. Contributors

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# Appendix A: Code Points Similarity Analysis

## A-1. Telugu and Kannada

The following table defines Telugu and Kannada code points which are visually similar.

| No.  | Telugu | Kannada |
| --- | --- | --- |
| CP | Glyph | CP | Glyph |
| 1 | 0C35 |  వ | 0CB5 | ವ |
| 2 | 0C36 |  శ | 0CB6 | ಶ |
| 3 | 0C38 |  స | 0CB8 | ಸ |

## A-2. Telugu and Malayalam

Beside those identical code point defined as variants in Section 6, there is no similar code points between Telugu and Malayalam.

## A-3. Telugu and Sinhala

Beside those identical code point defined as variants in Section 6, there is no similar code points between Telugu and Sinhala.

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# Appendix B: Syllable formation in the Telugu Script

The Telugu script grammar allows us to state the nature and structure of  the graphic syllables in the formation of words. The extended notion of syllable is often used to characterize orthographies of South-Asian scripts especially Brahmi derived scripts where words are composed of sequences of one or more orthographic *aksharas* or syllables*.* These aksharas are again composed of sequences of certain characters from the alphabet. The Telugu alphabet has the following types of characters (encoded into the Unicode) that either on their own or by entering larger combinations form *aksharas* as shown here. There are 12 different types of syllables possible in Telugu:

The following Variables are involved in the formation of syllable [$]:

* C = Consonants, that are standalone characters or graphemes with an inherent vowel `a’ can function as syllables;

Stops:  క ఖ గ ఘ ఙ చ ఛ జ ఝ ఞ ట ఠ డ ఢ ణ త థ ద ధ న  ప ఫ బ భ మ;

Fricatives:  శ ష స హ

Sonorants: య ర ఱ ల ళ వ

* V = Vowels, that stand alone and represented by the graphic signs of the following may function as syllables;

అ ఆ ఇ ఈ ఉ ఊ ఎ ఏ ఐ ఒ ఓ ఔ ఋ

* M = Matras or the dependent vowel signs when occur with a consonant may function as syllables (characteristically delete the inherent vowel of the consonant);

Ex. కా కి కీ కు కూ కె కే కై కొ కో కౌ; etc.

* H = Halant or virama = ్; It may occur with one of the consonants represented by C to form CH syllables;

Ex. క్ ఖ్ గ్ ఘ్ ఙ్

* B= purnanusvara, the homorganic nasal and an Archiphoneme = ం, may occur with one of the C, V, and the combined CM to form CB, CMB, VB, and CH([HC]\*)B,
* X= visarga or the glottal check= ః, may occur with one of the C, V, and the combined CM to form CX, CMX, VX, and CH([HC]\*)X,

The operators used: The following four operators are employed to define the delimitation of the graphic syllables in Telugu.

|  |  |  |
| --- | --- | --- |
| No. | Symbol | Function; |
| 1. | | | Alternative; |
| 2. | [] | encloses optional elements; |
| 3. | \* | Variable occurrence; |
| 4. | () | The sequence cluster; |

Table C-1 symbols and functions

An Akshara in Telugu can be defined as any C or V and a combination of M (dependent vowels), and the vowel modifiers as in the following:

**The following syllable formation rules derive all possible graphic syllables in Telugu.**

 **1.** **The syllable formation rule-1, a $= V;**

Every standalone vowel character can function as a syllable, Ex.

అ, ఆ, ఇ, ఈ, ఉ, ఊ, ఎ, ఏ, ఐ, ఒ, ఓ, ఔ, ఋ;

After the exclusion of obsolete vowels 13 syllables are possible.

**2.** **The syllable formation rule-2, a $= C;**

Every standalone consonant character can function as a syllable, Ex.

క ఖ గ ఘ ఙ,

       చ ఛ జ ఝ ఞ,

 ట ఠ డ ఢ ణ,

       త థ ద ధ న,

       ప ఫ బ భ మ,

       య ర ఱ ల ళ వ,

 శ ష స హ;

There are 35 such syllables are possible.

**3. Syllable formation rule-3, $=VB|X; ex.**

3a=V+B=$; అం ఆం ఇం ఈం ఉం ఊం ఎం ఏం ఐం ఒం ఓం ఔం;

3b=V+X=$; అః ఆః ఇః ఈః ఉః ఊః ఎః ఏః ఐః ఒః ఓః ఔః;

In combination with V and one of the two B or X, a total 36 syllables are possible. Syllable combinations with vocalic R is not used.

**4.** **Syllable formation rule-4, a $= CH;**

A standalone consonant may be appended by the halant marker H to form the corresponding graphic syllables as shown here. Ex.

 క్ ఖ్ గ్ ఘ్ ఙ్

 చ్ ఛ్ జ్ ఝ్ ఞ్

 ట్ ఠ్ డ్ ఢ్ ణ్

 త్ థ్ ద్ ధ్ న్

 ప్ ఫ్ బ్ భ్ మ్

 య్ ర్ ఱ్ ల్ ళ్ వ్

 శ్ ష్ స్ హ్

There are 35 such graphic syllables are possible.

**5. Syllable formation rule-5, $=CB|X; Ex.**

Standalone consonants can take one of the three vowel modifiers and form the corresponding syllables as shown below: ex.

5a. $=CB:  కం ఖం గం ఘం ఙం చం ఛం జం ఝం ఞం టం ఠం etc.

5b. $=CX:  కః ఖః గః ఘః ఙః చః ఛః జః ఝః ఞః టః ఠః etc.

There are 2\*35=70 graphic consonant modifier syllables are possible.

**6.** **Syllable formation rule-6, $=CM;**

A consonant may get attached with a vowel modifier or the dependent vowel diacritic to form the corresponding syllables; Ex.

కా కి కీ కు కూ కృ క కె కే కై కొ కో కౌ; etc.

A total of 35\*13 consonant + vowel diacritic combinations may derive 455 graphic syllables in Telugu.

**7. Syllable formation rule-7, $=CMB|X;**

A consonant with a dependent vowel when followed by one of the three modifiers may derive the following graphic syllables; ex.

7a. కాం కిం కీం కుం కూం కెం కేం కైం కొం కోం కౌం

7b. కాః కిః కీః కుః కూః కెః కేః కైః కొః కోః కౌః

A total of 35\*12\*2 consonant plus a dependent vowel and one of the three modifiers derive 840 possible graphic syllables in Telugu.

**8.** **Syllable formation rule-8, $=CH[(C)C\*];**

Any consonant followed by the halant marker may combine with another consonant or consonants to form complex graphic syllables; Ex.

2 consonant clusters:  ఖ్ఖ గ్గ, ఘ్ఘ, ఙ్ఙ, చ్చ, ఛ్ఛ,  జ్జ, ఝ్ఝ, ఞ్ఞ, ట్ట, ఠ్ఠ, డ్డ, ఢ్ఢ, ణ్ణ, etc.

3 consonant clusters: ర్ద్ర,  ష్ట్ర, స్త్ర, న్ధ్ర, ఙ్ఘ్ర ష్ట్ల, త్ర్య, త్స్న etc.

4 consonant clusters:  త్స్న్య ;

A total of 35\*1\*35 =1225 CHC syllables involving two consonant clusters are possible; Further, a total of 35\*1\*35\*1\*35 =42,875 CHCHC syllables involving three consonant clusters are possible; Though four consonant clusters are extremely rare but theoretically possible as shown above.

**9. Syllable formation rule-9, $=CH(CH[CH])CM;**

Any consonant followed by the halant marker and a consonant or consonants may be appended by one of the dependent vowels to form complex graphic syllables involving two to three consonant clusters; Ex.

క్కు ఖ్ఖి గ్గొ, ఘ్ఘి, ఙ్ఙా, చ్చా, ఛ్ఛూ,  జ్జే, ఝ్ఝె, ఞ్ఞో, ట్టీ, ఠ్ఠూ, డ్డా, ఢ్ఢూ, ణ్ణా, etc.

ర్ద్రు,  ష్ట్రి, స్త్రీ, న్ధ్రి, ఙ్ఘ్రి ష్ట్లా, త్ర్యా, త్స్ను  etc.

త్స్న్యా

A total of 35\*1\*35\*1\*12= 14,700 complex syllables involving two consonant clusters followed by dependent vowels are possible.

A total of 35\*1\*35\*1\*35\*12= 5,14,500 complex syllables involving three consonant clusters followed by dependent vowels are possible.

The following is a summary of possible syllable types with the glyphs in Telugu:

$= V([B|X])|CM([B|X])|CH(CH[C])M([B|X])

As per our definition the following 21 subtypes of graphic syllables are possible which however can be grouped under 8 rules as discussed above.

$ = V|VB|VX|

C|CB|CX|CM|CH|

CHC|CHCB|CHCX|CHCMre CHCH|CHCHC|CHCHCB|CHCHCX|CHCHCM

Therefore, typologically 8 distinct types of graphic syllables   can be derived in the language.

1. This document needs to be printed in color for this to be read correctly. [↑](#footnote-ref-1)
2. Others are the EGIDS 5 languages, listed in Table 1: Main languages considered under Telugu LGR [↑](#footnote-ref-2)