Czech (TₑX) and Phonetic Devanāgarī (देवनागरी) Keyboard Layouts for **xkb**, v. 1.0

Zdeněk Wagner

`http://icebearsoft.euweb.cz`

Improper and/or careless use of this software can damage settings of your computer so that the graphical subsystem will no longer start. The instructions written in this manual will help you to overcome all problems. Please read the manual before trying the software. You have been warned.

Contents

Built on January 21, 2013 from file Id: cze_dvng_xkb.tex 1384 2013-01-20 23:31:49Z zw

1 License

These files are not considered as software. They are merely configuration files for `xkb` and thus cannot be copyrighted. The files are provided freely and can be freely used and redistributed either alone or as a part of any collection. They may become a part of Linux distribution. The files may also be a source for a derived work.

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2 No warranty

The files are distributed AS IS in the hope that thay may be useful for someone. There is no warranty for any damage of any kind. However, the installation instructions explain how to revert to the original configuration should these files cause any problems. **Do read the manual before trying the files.**

3 Preface

The author developed the first Czech `xkb` layout years ago. After the first attempt new characters were added. The keyboard served at the beginning for writing the Czech TEX files. Later the author realized that X⅃TEX allows to input all characters directly without the need to use TEX sequences. It is therefore better to have them available on the keyboard. Moreover, in such a case the characters can be used when writing XML and HTML files.

After the success of the first Czech `xkb` layout Devanāgarī came into mind. It is possible to use a transliterated input in X⅃TEX but such a file is less readable. More serious problem is that such transliterations cannot be easily used in XML and HTML files. Spell checkers are available for Hindi as well as other Indian languages but they do not accept a trasliterated text. The `xkb` layout was developed by applying the same method learned during the development of the Czech layout.

You may ask why these layouts have ever come into life? Are the existing layouts not sufficient? From the author's point of view they are not. Explanation will be given in the next section.

As written above, both layouts were developed using the very same design principles. Although the languages are unrelated, the design is analogous and the installation instructions equal. This is the reason why both layouts are distributed together in the same package. However, the package is structured in such a way that you can easily install just one of the layouts.

The layouts were verified in several Linux distributions but anything may happen and the settings of your graphical subsystem can be damaged so that it will no longer start. The manual contains the steps needed to restore your original settings. Do read the manual before you start installation. You have been warned…

4 Introduction

In the *typewriter age* minimization of the number of keys was important in order to reduce the size of the machines. Some typewriters did not even contain digits *0* and *1*. Letters *O* and *l* were used instead. Mathematical symbols were not available at all. Layout of the keys on the Czech typewriters was prepared for easy typing the Czech texts.

In the beginning of the *computer age* the computers were used for programming and data processing only. The enhanced keyboards came with numeric keypads. Only US ASCII was supported. The programmers got accustomed to the US keyboard layout used on the punching machines.

Later on operating systems became localized. The only normalized national keyboard was the one used on old typewriters. This is the reason why this layout was implemented. However, a lot of characters are missing. They were put to other locations that could be reached usually via AltGr. However, such typing is uncomfortable. If a user types a program on a US keyboard and a text on a national keyboard, he or she easily makes mistakes. The design goal is to make the utmost of the `xkb` features and prepare a layout that contains all symbols at the very same places as on the US keyboard yet it offers easy typing of the Czech text.

In the *pre-UNICODE age* the Devanāgarī texts could not be typeset directly. Several systems [1] were developed. Frans Velthuis developed a system [2] similar to transliterations used in textbooks and dictionaries. Later the transliteration was modified probably by inspiration from ITRANS [3]. The system is phonetic so that users can easily find the characters on the US keyboard. Traditional Indian typewriters followed another scheme. This scheme is implemented in operating systems but it is not comfortable for western users.

The idea was to implement the Devanāgarī `xkb` layout that would be as close to the Velthuis transliteration as possible. A few modifications had to be accepted. Some characters were added later, for instance the Rupee (₹) sign.

The exact layout will be given in the later sections.

5 Layout principles

The original idea arised from the previous work on the Czech/Slovak keyboard for eComStation [4]. The possibility of having one dead key was originally invented by Jiří Kolafa in his unpublished keyboard driver for MS-DOS. This driver hides just one character that is not so important in Czech and Slovak TeX files. Unfortunatelly it cannot be easily implemented in the `xkb` system. Closest alternative was therefore searched for.

The US keybord makes use of one modifier key, the Shift, that is used to switch between lowercase and uppercase characters. In addition, the `xkb` system offers Level 3 modifier key. Usually it is AltGr but it may be configured. By using this feature each key may represent four characters. The number of available characters can thus be doubled. This allows not only to type all characters easily but even to support a great many UNICODE characters.

Since the layout was intended for writing mathematical texts in TeX, not only the backslash but also characters as #, $, %, ^, &, _ as well as all types of braces must be easily available and preferably at the same positions as on the US keyboard. The digits on the upper row are not important because they can be entered via the numeric keypad. Later the author arrived at a conclusion that the digits may be important mainly on notebooks where the numeric keypad is not present. The digits are therefore accessible using the L3 (Level 3) modifier key. Both layouts distributed in this package keep the same standard symbols on the digit keys as the US keyboard if Shift is pressed. The layout is given in Table 1.

Table 1: Symbols on the digit keys

1	2	3	4	5	6	7	8	9	0
!	@	#	$	%	^	&	*	(	)

5.1 Czech/Slovak `xkb` layout

The intention was to design the Czech/Slovak layout in such a way that the user will not have to switch to the US keyboard unless a very special demand arises. All keys have therefore the same characters with

an exception of the digit keys on the upper row. Their asignment almost copies the Czech typewriter. The layout is given in Table 2. Shift-L3 in combination with the digit keys produces uppercase characters and so does their use with Caps Lock.

Table 2: Characters on the upper digit row

1	2	3	4	5	6	7	8	9	0
ů	ě	š	č	ř	ž	ý	á	í	é

The combining diacritical marks needed for Czech are accessible by L3 and Shift-L3 but should rarely be needed because all composed accented characters are directly available. The keyboard layout was prepared for Czech but other languages were taken into consideration: Slovak, German, Danish, Norwegian, Swedish, partially French and Polish. For characters of these languages combining diacritical marks will often be needed. Only characters such as Æ, Ø, Œ or Ł are directly accessible because they cannot be composed from a separate accent. All accented letters obey Caps Lock. Finally a few symbols were added so that it is possible to write angles as 15°25′12″ or dimensions as ±2 µm. The complete layout is given in Table 3.

Table 3: Czech/Slovak keyboard layout, only assigned keys are reported; combining diacritical marks are printed with magenta colour, Czech quotes are printed with green colour

Key	L3	Shift+L3	Key	L3	Shift+L3
a	æ	Æ	o	ø	Ø
c	©	℃	p	œ	Œ
d	ď	Ď	q	¿	¡
e	€	§	r	®	™
f		℉	s	ß	ß
h	ħ	Ħ	t	ť	Ť
i	ı	I	u	′	″
l	ł	Ł	x	‰	‰₀
m	±	µ	y	°	⅟
n	ň	Ň	z	«	»
` ~	ˋ	˜	; :	˚	ˆ
- _	˗	˘	' "	ˏ	ˮ
= +	ˊ	ˇ	, <	˛	˓
\ |	¨	˝	. >	"	"
[{	ú	Ú	/ ?	–	—
] }	ó	Ó	␣	␣	…

As will be explained in sections 8.3 and 8.4, some fonts do not contain all characters, especially ℃ and ℉ may be missing. The Czech right quote entered as Shift-L3-" has to be replaced with the English left quote entered via L3->.

5.2   Phonetic Devanāgarī (देवनागरी) layout

The Devanāgarī (देवनागरी) keyboard layout is inspired by the Velthuis transliteration [2]. It is intended for users accustomed to latin scripts and tries to be as intuitive as possible. It enables to enter all Devanāgarī characters used in nowaday's Hindi as well as a few special letters. The author hopes that it can also be used for Sanskrit, Marathi, Rajasthani[1], and Nepali.

Each key on the keyboard can be pressed alone, together with a shift, with a level 3 modifier or with both of them. Each key can thus produce up to four diferent characters.

When entering the Devanāgarī text you must have in mind that you enter what you see [5, 6]. Different characters are used for dependent and independent vowels. Thus आ and ा in आसान have diferent codes in UNICODE. Short *a* is not entered and conjuncts are produced with viramas. For instance, पुस्तक would be written as if you wrote पुस्तक. The same holds for repha. Thus प्रकार is entered as प्रकार and चर्चा is entered as चर्चा. If the font contains a ligature, it is automatically used. Therefore शक्ति will always be displayed. If you wish to use the half form, i. e. शक्ति, you must follow the virama by zero-width-joiner. Using zero-width-nonjoiner forces displaying the full consonant with a virama.

As a side note it should be written that some programs allow selection of a set of conjuncts used according to the language. This is the case of X∃TEX. The polyglossia package for X∃LATEX is very useful for this purpose. Firefox v. 17 (distributed e. g. with Fedora 17) can also distinguish Hindi and Sanskrit conjuncts without the need of using zero-width-joiner.

The keyboard layout follows a few rules. Short dependent vowels are entered as lowercase letters, long dependent vowels as uppercase letters, i. e. with a shift. Independent vowels are entered with L3. The only difference is lowercase *a*. Since short dependent *a* is not used in UNICODE, this key produces avagraha (ऽ). Keys R and L are used for corresponding consonants. Vocalic r (ऋ) is assigned to W and vocalic l (ऌ) to X. Anusvara is entered as M, candrabindu as L3+m, and visarga as H. English *o* (ऑ) is assigned to L3+y and ॐ to uppercase Q.

Zero-width-joiner (ZWJ) is entered as +, zero-width-nonjoiner (ZWNJ) as =. Characters + and = are produced with L3.

Dental unaspirated consonants are represented by lowercase characters, retroflex consonants by characters with L3. Aspirated characters are entered as uppercase. There are just a few exceptions. Although ञ is not used alone in nowaday's Hindi, it forms an important conjunct ज्ञ. It was therefore placed to an uppercase N. Letter *na* with nukta (ऩ) is entered as V and its underlined variant (ऴ) as L3+v.

Eyelash repha (ऱ) is produced as a half form of र according to the UNICODE standard. You will therefore type it as र followed by a virama. If you need an explicit half form of any consonant, add ZWJ after the virama.

Some puctuation characters and accents (svarita, anudatta, grave, acute, nukta) are included. Characters used for transliteration of other languages are available too but their position is not mnemonic at all. They were put to empty places.

Numbers in the upper row are used to write Devanāgarī numerals. Arabic digits are entered with L3. Combination with Shift-L3 is used for entering special characters. The assigments on the upper digit keys are summarized in Table 4.

The full Devanāgarī layout is shown in detail in Table 5. Special characters are distinguished by colour. Notice that important English characters as a question mark, exclamation mark, quotes and long dashes are also included.

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[1]Some linguists consider Rajasthani a language, other consider it as a dialect of Hindi. It is added here because it has ISO 639-2 and ISO 639-3 codes.

Table 4: Devanāgarī numerals and special characters

1	2	3	4	5	6	7	8	9	0
१	२	३	४	५	६	७	८	९	०
ॲ	ऐ	ऍ	ऐ	ॕ	॔	ऽ	ऑ	ॖ	ौ

Table 5: Devanāgarī (देवनागरी) keyboard layout; combining diacritical marks (including nukta) are printed with magenta colour, glottal stop, anudatta and svarita are printed with green colour, names of symbols are printed with blue colour

Key	LC	Shift	L3	Shift+L3	Key	LC	Shift	L3	Shift+L3
a	ऽ	ा	अ	आ	n	न	ञ	ण	ङ
b	ब	भ	ब़	आ	o	ो	ौ	ओ	औ
c	च	छ	अॅ	अॅ	p	प	फ		
d	द	ध	ड	ढ	q	क़	ॐ	ॠ	Rs
e	ॆ	�	ए	ऐ	r	र	ॄ	ड़	ढ़
f	फ़	ॅ	ॕ	ॕ	s	स	श	ष	
g	ग	घ	ग़		t	त	थ	ट	ठ
h	ह	:	ʔ		u	ॖ	ॗ	उ	ऊ
i	ि	ी	इ	ई	v	व	ऩ	ऴ	य़
j	ज	झ			w	ॢ	ॣ	ऋ	ॠ
k	क	ख	ख़	ख़	x	॒	॑	ऌ	ॡ
l	ल	ळ	ऴ	ऴ	y	य	य़	ॉ	ऑ
m	म	ॕ	ॕ	ᳵ	z	ज़	ज़	ज़	
`~	ॅ	~	`	ᳶ	;:	;	:	'	"
-_	-	_	–	—	'"	'	†	अ	आ
=+	ZWNJ	ZWJ	=	+	,<	,	<	,	<
|	।	॥	\	| (bar)	.>	०	>	.	ॕ
[{	[	{	ॖ	ॕ	/?	/	?	"	"
]}	]	}	ॕ	ॕ	␣	␣	␣	␣	.

6   Notes on the **xkb** system

The authoritative information on the xkb system is not easy to find. Internet search returns quite a lot of pages most of which are very old. Since that time the xkb system has evolved and some configuration files are no longer used although they are still distributed. If you follow old instructions, your setting will not get corrupted but your layouts will not be found by the system. At least the old layouts will continue to work. The goal of this section is to give you the brief information on the xkb evolution.

Originally the layouts were configured in xorg.lst which was a plain text file. Later it was replaced by xorg.xml with the XML syntax. Both files were present but it seems that only xorg.xml was used. Afterwards the name changed, the plain text file was renamed to base.lst and the XML file was renamed to base.xml but the previous files xorg.lst and xorg.xml exist as symlinks.

Recently another change has been introduced. The files are named `evdev.lst` and `evdev.xml` but the old files including the symlinks are still present.

The directory has changed too. Originally the files resided below `/etc/X11/xkb`, in Fedora 17 the files are below `/usr/share/X11/xkb`. Symlinks between files in these directories existed in some previous distributions. The location of the files may vary in different distributions.

7   Installation

This section describes the manual instalation procedure. The author tried to prepare an installation script but it was found that distributions evolve and thus development of a universal installation script is near to impossible. Instead of supplying a script that will work on some computers only and may sometimes even be harmful the author finally decided to describe manual installation steps only.

It has already been noted that the settings can be damaged in such a way that the graphical subsystem wil not work properly or even will not start. There are ways how to recover from that situation. Remember that you will not be able to read any instructions if your graphical subsystem does not work. You must know in advance what to do. Do read the manual before you proceed. You have been warned…

The installation requires basically two steps:

1. The files have to be copied to the system directory and configuration files have to be modified.

2. The new layouts have to be enabled in the desktop environment.

Copying the files to the system directory thus does not mean that the layouts are known by your system. It should not be harmful if you just copy the layout definition files.

7.1   Preinstallation steps

The purpose of this subsection is to explain the prerequisites needed as well as the methods of rescue after possible damage. Although the installation procedure and the keyboard layout files have been checked on several Linux distributions, anything may happen.

In order to install the layouts as well as to rescue after damage, *root* access is mandatory. Some desktop environment do not allow *root* login. It is, however, sufficient to get the *root* privileges by `su` in a terminal, `sudo` is not sufficient.

If anything wrong happens, you will have to restore several important files from copies. If the graphical subsystem runs somehow and allows you to open a terminal, you can simply type `su` to become *root*, copy the files and restart Xorg. However, things may be more difficult.

It may happen that Xorg starts but does not work properly. In such a case Linux offers four text consoles. In older distributions they were accessible via Ctrl-Alt-F1 to Ctrl-Alt-F4 and Ctrl-Alt-F5 was used to switch to the graphical desktop. In Fedora 17 Ctrl-Alt-F1 switches to the graphical desktop and Ctrl-Alt-F2 to Ctrl-Alt-F5 select these four text consoles. You can log in as a *root* and restore the files. *Do not just read these instructions.* Try to do it now !

In a much worse case the system will boot into a bad shape where even switching to the text console will not work. Although most likely it will not happen, it is better to know in advance what to do. You should press Ctrl-Alt-Del and boot `linux single`. In this mode you have *root* access without entering the password. The system starts in the text mode without any network. It is therefore an ideal method for rescue from many types of catastrophs. The method for booting `linux single` depends on your boot loader. In grub you wait until the boot menu is desplayed and press any key to stop automatic boot. Then select your kernel and press e to edit it. Find the command loading the kernel and append `single` to its end. Finally press b to boot.

Remember that the exact method may differ if you have a different version of grub or even a different boot loader. Consult your manual. **Try to do it!** Although the keyboard layouts are not dangerous, knowledge of this way may be useful. It can, for instance, be used to recover forgotten *root* password.

When you end in the single mode, you will have to reboot. Older versions use just the `reboot` command, Fedora 17 requires `systemctl reboot`.

7.2   Locating the **xkb** directory

As written in section 6, the `xkb` directory was changed during time. Before installation you should locate it in your system. If you do not manage to guess it, issue the following command:

```
find / -name xkb -type d -ls
```

This command may find several directories. We have to locate the directory containing a few subdirectories the most important of which are `rules` and `symbols`. In the next sections we will refer to this directory as `$xkb`.

7.3   Saving important files

Important files reside in the `$xkb/rules` directory. Files `xorg.lst` and `xorg.xml` should be symlinks. They will not be modified. If they are normal files, your system is very old. The keyboard layout files from this package will still work but your fonts are old too and currency symbols € and ₮ as well as some other characters will be unavailable. Remember that new OpenType fonts may not work with an old version od fontconfig. There is no way out of it, upgrade is needed.

Unless your `xkb` is too old as written above, you have to make a backup copy of `base*` and `evdev*` files. You can do it simply by:

```
cd $xkb/rules
for a in base* evdev*; do cp -pv $a saved-$a; done
```

If anything happens and you will have to restore them as described in section 7.1, you do the reverse operation simply by

```
cd $xkb/rules
for a in saved-*; do cp -pv $a ${a#saved-}; done
```

Of course, you can edit the files in any text editor and revert the changes but copying the saved files is easier.

7.4   Installing the **xkb** files

This package contains three directories: `manual` with this manual, `symbols` with the layout definition files, and `rules` with fragments of configuration files.

You should first decide whether you wish to install both layouts or only one of them. After decision you copy the corresponding file(s) from the package's `symbol` directory to `$xkb/symbols`. Afterwards you have to modify `base.xml` and/or `evdev.xml`. The fragments are present in the `define-cz_tex.xml` and `define-dvng` files, respectively. The best place for these fragments is at the end of the `<layoutList>` element. It should better be done by means of an XML editor as shown in Figure 1.

Afterwards open the `base.lst` and `evdev.lst` files, locate the end of the `! layout` section and add the definitions of the selected layouts (one of the following lines or both):

```
cz_tex            Czech (TeX)
dvng              Devanagari (Phonetic, Velthuis like)
```

The `$xkb` directory may contain `symbols.dir` file. It should contain the list of layout files. Inspection of the file distributed with Fedora 17 reveals that only a few files are listed in it. It is not sure whether editing the file is needed. Anyway, the fragments are prepared in the `cze_tex.dir` and `dvng.dir` files. Put the contents to the end of the `symbols.dir` file.

In the rescue instructions we did not mention to make a copy of the `symbols.dir` file. It is quite easy to restore it by any text editor because the lines are placed at its end.

After installation the permissions of the new files has to be checked. It seems that the files need not be owned by *root* but they must be readable by everybody.

After installation of the files you have to restart Xorg which is usually done by Ctrl-Alt-Backspace. Remember that it kills all programs running on your desktop.

7.5   Enabling the keyboard layouts in the desktop environments

After restarting Xorg the new layouts are available for configuration but cannot yet be used. It is first necessary to configure them.

As shown in figures 2 and 3, the keyboard layouts contained several variants differing in the selection of the level 3 modifier. These variants have been removed because the level 3 modifier should be configured in the keyboard preferences dialogue. The system works without explicit support in the layout definition files. The author prefers to use any Win key as the level 3 modifier.
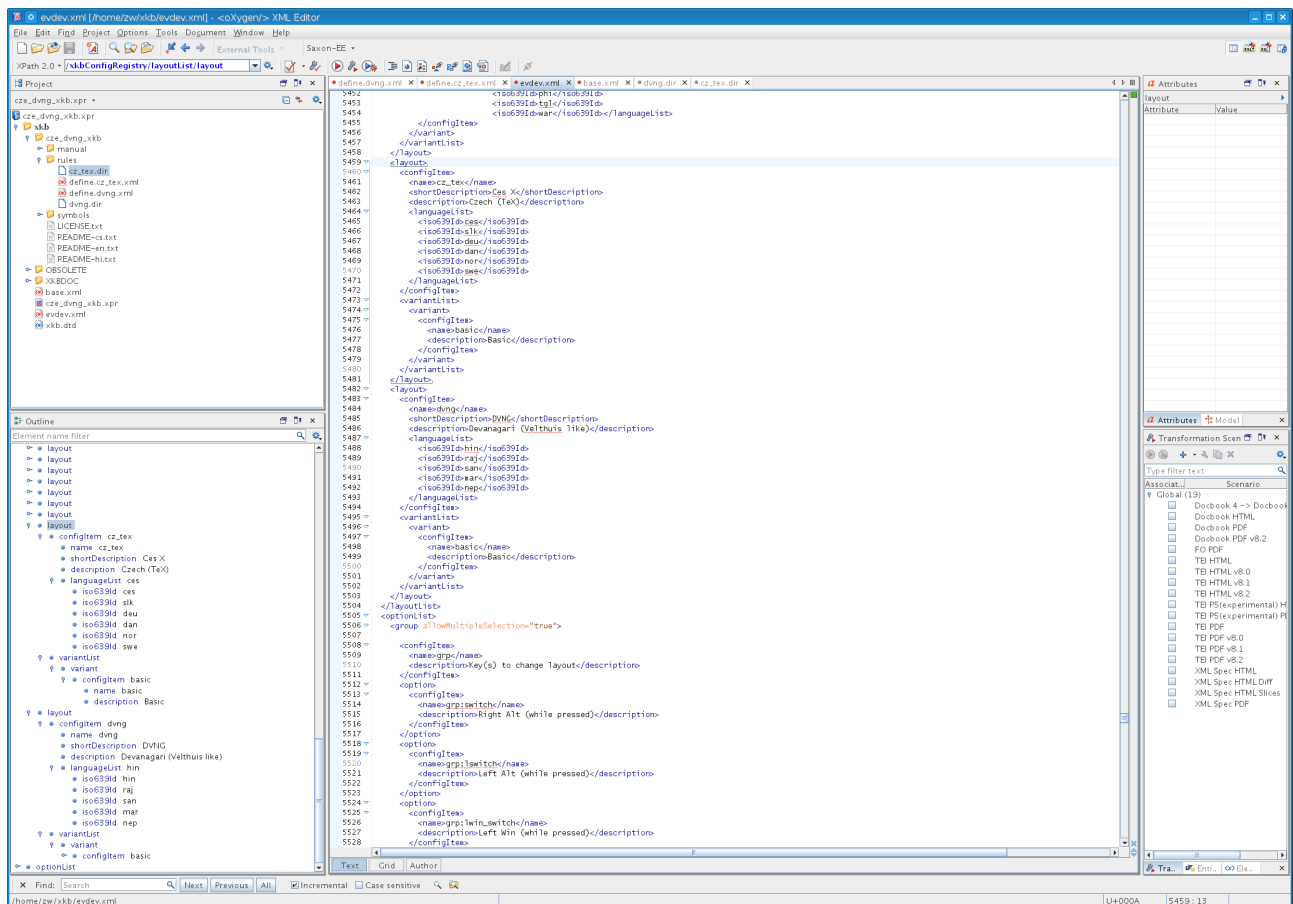

Figure 1: Editing the XML configuration files

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The first example shows how to configure the keyboard in Gnome version 2. Open the keyboard preferences and select the layout and switching options similarly as shown on Figure 2. Gnome version 3 is quite user hostile, at least according to author's point of view. The author hopes that the keyboard preference dialogue is not very different.
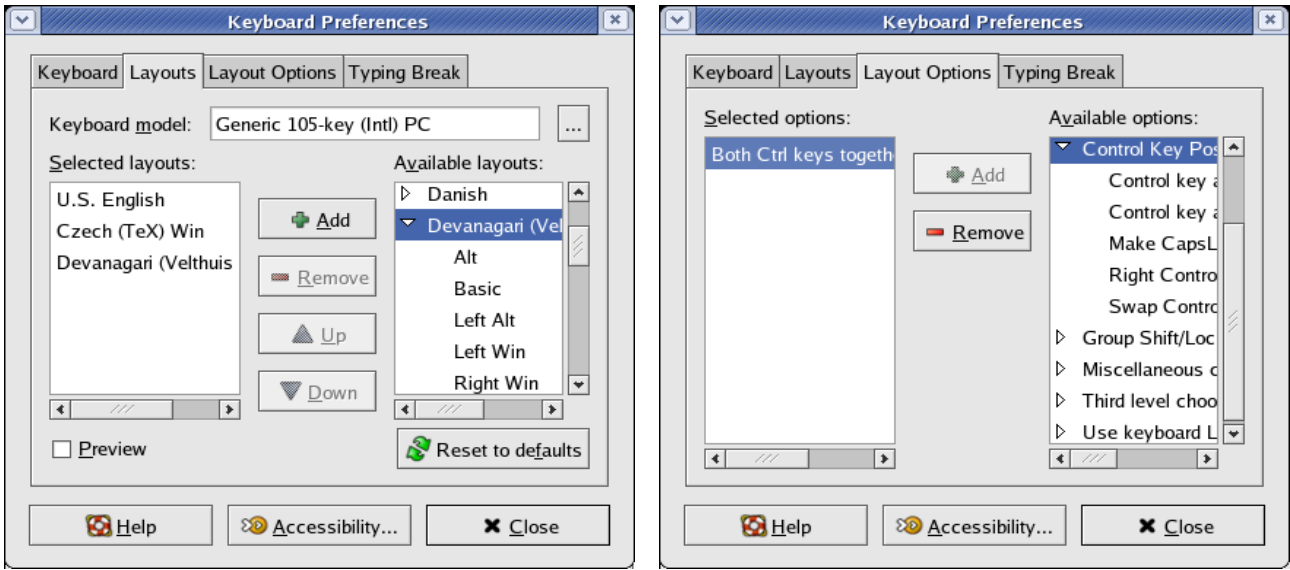

Figure 2: Enabling the keyboard in Gnome v. 2.x

Xfce alone does not contain any tool for keyboard switching. It is offered by the panel plugin `xfce4-xkb-plugin` that has to be installed separately. It most probably exists as a package for your Linux distribution. The keyboard preference dialogue is similar.

Figure 3 shows the dialogues in the KDE plasma workspace. Notice that even the key sequence for killing the X server can be configured.
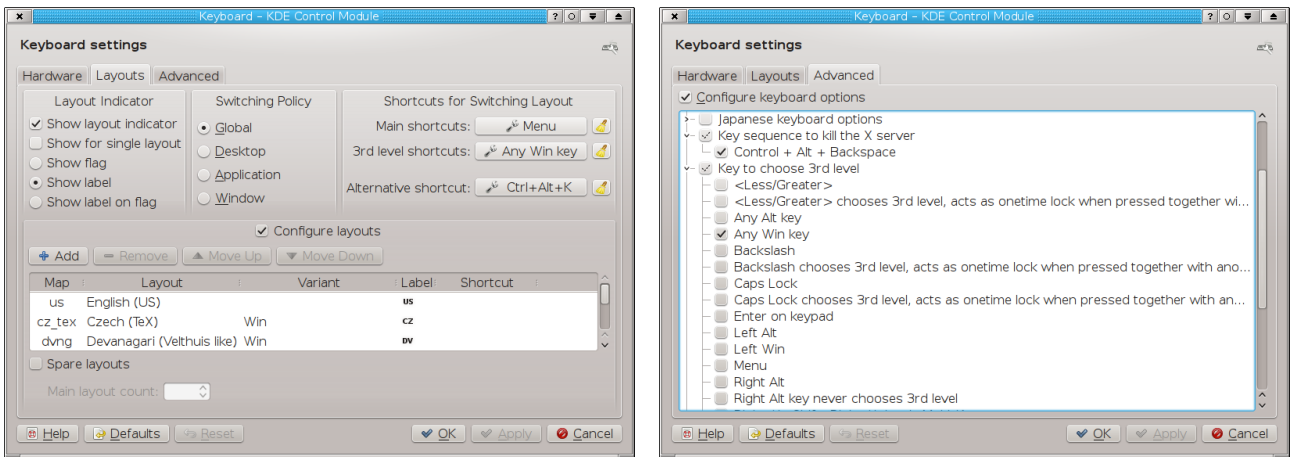

Figure 3: Enabling the keyboard in the KDE plasma session

7.6   Layout switching shortcut

The layout switching shortcut is configured in the keyboard preferences dialogue. The shortcut should be simple so that the user can switch layouts quickly. However, it should be selected in such a way that the layouts could not be switched accidentally. The shortcut must not hide important keys. The following shortcuts are bad from the author's point of view:

left shift + right shift – Imagine you wish to type and abbreviation such as PS. You will type it as left shift + P and right shift + S. It may happen that you hold both shifts for a while and the layouts will be switched.

shift + control – Some applications make use of shortcuts in the form of Shift-Ctrl-key, for instance Shift-Ctrl-S is often used for *Save As*. If you select shift + control for layout switching, these application shortcuts will be unavailable.

alt + control – This is a similar case, Ctrl-Alt-key shortcuts are used in some applications and they will be hidden.

Originally the author used both control keys as a layout switching shortcut. Currently, the KDE plasma workspace offers even better possibility, the Menu key. If you wish to use two different layouts only, it may be advantageous to use the Scroll Lock key and let the keyboard status displayed by the Scroll Lock LED.

7.7   Uninstallation

As a matter of fact, uninstallation should not be needed. Once you know that the existence of the files does not break your graphical subsystem you need not care. You may wish to disable the layouts in the keyboard preference dialogue. If you really wish to uninstall them, follow these steps:

1. Remove the layouts from the keyboard preference dialogue.
2. Remove the information on the added layouts from configuration files `base.lst`, `base.xml`, `evdev.lst`, `evdev.xml`, `symbols.dir`.
3. Delete files `cze_tex` and `dvng` from the `$xkb/symbols` directory.
4. Restart Xorg.

It seems the the configuration files are examined at Xorg startup only. It should not therefore be necessary to restart Xorg immediatelly after editing the configuration files.

8   Known problems

The layouts are routinely used by the author and were tested on several distributions, mainly CentOS and Fedora. However, some problems are known.

8.1   Disabled control keys

Both the Czech and Devanāgarī keyboards for some reason disable control keys Ctrl-1, Ctrl-2 etc. in Fedora 17. Control keys work properly if the keyboard is switched to US or any other standard layout. This problem did not appear in previous Linux distributions.

8.2   Problems with Xorg updates

Whenever Xorg is updated, the modified configuration files may be overwritten with the distribution files. However, the keyboard preferences are stored somewhere in the configuration of the desktop environment. The keyboard layouts continue to work even if the X server is restarted and the infor-mation is no longer present in `base.xml` and `evdev.xml` files. The problem arises if you wish to modify your keyboard preferences. At that time these keyboard layouts may be deleted. Be prepared

to add the required information as you did during installation as described in section 7.4 on page 8. Fortunately Xorg update does not remove files from the `$xkb/symbols` directory.

The author plans to contact the `xkb` developers. There is thus chance that these layouts will become a part of standard distribution.

8.3 Missing characters

It may happen that a key does not type a character as defined in the layout table. This is not a problem of `xkb` but a problem of a font. The author added many characters that might be useful but some of them do not exist in all fonts. All characters were tested with GNU FreeFont release 2012-05-03 [7]. It is the font with which this manual was typeset.

8.4 Czech right quote missing

UNICODE contains separate pair of Czech (double) quotes and English quotes. The standard says that the Czech right quote is a variant of the English left quote. Some fonts contain both complete pairs, some fonts do not contain the Czech right qoute and the English left quote must be used. Especially when writing a web page without supplying the font is it better to use the English left quote for compatibility.

8.5 Installation problems

A few problems occur during installation:

- Xfce `xkb` plugin loses the setting of the layout switch shortcut. It seems to be a problem of the plugin, not the layouts.
- If the Xorg configuration files are edited and new layouts added, Gnome may lose all its settings and recover them after rebooting the computer. It happend to me only once in CentOS 5.0, so maybe it was a Gnome bug that has already been fixed. Anyway, it may be better to remove the keyboard indicator from the panel, restart the X server, install the files and after restarting the X server add the keyboard indicator back to the panel.

Finally it should be noted that it might be better to put user's changes to files `base.extras.xml` and `evdev.extras.xml` but it was not tried.

9 References

1. Transliteration Pages,
   `http://homepage.ntlworld.com/stone-catend/translit.htm`
2. Velthuis Devanāgarī for TEX, `http://devnag.sarovar.org/`
3. Avinash Chopde: ITRANS, `http://www.aczoom.com/itrans/`
4. Czech/Slovak keyboard for eComStation (OS/2),
   `http://icebearsoft.euweb.cz/ecomstation-sw/icekeybd.php`
5. Chapter 9 of the Unicode Standard v. 4, South and Southeast Asian Scripts,
   `http://www.unicode.org/versions/Unicode4.0.0/ch09.pdf`
6. Frequently Asked Questions: Indic Scripts and Languages,
   `http://www.unicode.org/faq/indic.html`
7. Free UCS Outline Fonts - Summary,
   `https://savannah.gnu.org/projects/freefont/`