Welcome!

What is this about anyway?

- There is more than one country in the world
- Ce n'est pas tout le monde qui parle anglais
- Tjueseks karakterer holder ikke mål
- Нот эврибади из юзин зэ сэйм скрипт ивэн
- 它变得更加复杂的与汉语语言

Definitions

Character Set

- A collection of characters used in a specific environment

Character Encoding Form

- The representation of characters with integer numbers (code points)

Character Encoding Sequence

- The digital representation of code points

Definitions

Character Set

- a b c d e f g h i ... q r s t u v w x y z å æ ø
- α β γ δ ε ζ η θ ι κ ... σ τ υ φ χ ψ ω

Character Encoding Form

- iso-8859-1: a = *97*, ë = *235*
- iso-8859-7: a = *97*, α = *225*, ω = *249*
- Unicode: a = *97*, ë = *235*, ω = *969*

Character Encoding Sequence

- iso-8859-1: a = *0x61*, ë = *0xEB*
- UTF-8: a = *0x61*, ë = *0xC3 0xAB*, ω = *0xCF 0x89*
- UTF-16: a = *0x00 0x61*, ë = *0x00 0xEB*, ω = *0x03 0xC9*

l10n challenges

- A web application for multiple regions
- Support for search, sorting and breaking up text
- Support correct formats for dates, times, currency as used in each region

i18n challenges

- Support for multiple encodings: conversion, detection, processing...
- Support for multiple language in different encodings and scripts

Sorting Strings

How would you sort: *côté* (side), *côte* (coast), *cote* (dimension), *coté* (with dimensions)?

Logical is: cote, cot*é*, c*ô*te, c*ôté*

But the french do it like: cote, c*ô*te, cot*é*, c*ôté*

The french are not the only ones with "weird" sorting!

- In Lithuanian, *y* is sorted between *i* and *k*.
- In traditional Spanish *ch* is treated as a single letter, and sorted between *c* and *d*.
- In Swedish *v* and *w* are considered variant forms of the same letter.
- In German dictionaries, *öf* would come before *of*. In phone books the situation is the exact opposite.

Conversion Between ISO-8859 Character Sets

- Each set has only 256 positions
- Impossible to convert everything
- Conversion will result in broken text
- http://www.eki.ee/letter/

```
ISO 8859-1 ISO-8859-2
Hex Char Hex Char Description
E0 à -- - LATIN SMALL LETTER A WITH GRAVE
E1 á E1 á LATIN SMALL LETTER A WITH ACUTE
E2 â E2 â LATIN SMALL LETTER A WITH CIRCUMFLEX
E3 ã -- - LATIN SMALL LETTER A WITH TILDE
E4 ä E4 ä LATIN SMALL LETTER A WITH DIAERESIS
E5 å -- - LATIN SMALL LETTER A WITH RING ABOVE
E6 æ -- - LATIN SMALL LETTER AE
E7 ç E7 ç LATIN SMALL LETTER C WITH CEDILLA
E8 è -- - LATIN SMALL LETTER E WITH GRAVE
E9 é E9 é LATIN SMALL LETTER E WITH ACUTE
EA ê -- - LATIN SMALL LETTER E WITH CIRCUMFLEX
EB ë EB ë LATIN SMALL LETTER E WITH DIAERESIS
EC ì -- - LATIN SMALL LETTER I WITH GRAVE
ED í ED í LATIN SMALL LETTER I WITH ACUTE
EE î EE î LATIN SMALL LETTER I WITH CIRCUMFLEX
EF ï -- - LATIN SMALL LETTER I WITH DIAERESIS
```

Do We Need Something New?

- PHP only deals with bytes, not characters.
- PHP doesn't know anything about encodings.
- Having a binary image in a string is nice, but not if you need to deal with i18n

Iconv

- Is part of glibc
- BSD requires an external library
- Enabled by default in PHP 5
- Supports 100s of character sets

But it doesn't solve:
localization, sorting, searching, encoding detection *and* you still work with binary data only!

mbstring

- Handles certain encoding problems for you
- Updates string functions by "overloading" them

But it doesn't solve:
localization, sorting, searching *and* you still work with binary data only!

Anything Else That Sucks?

- Some of PHP's functions can make use of POSIX-locales
- But that's only a few of them
- Those locales are system dependent (different names, rules, etc...)
- They are not always available

Unicode and ISO-10646 (UCS)

- UCS uses 31 bits for character storage
- Contains all known characters and symbols
- First 128 bytes are the same as ASCII
- First 256 bytes are the same as ISO-8859-1
- Unicode 3.0 describes the BMP *(Basic Multilingual Plane)* (16 bits)
- Unicode 3.1 describes other planes (21 bits)
- Characters are ordered in language/script blocks: Basic latin, Cyrillic, Hebrew, Arabic, Gujarati, Runic, CJK etc.
- Encoding in numerous encodings: UCS-2, UCS-4, UTF-8, UTF-16 etc.

A Њ ﺙ א 媛

Building New Characters

You can compose new characters from base characters with combining modifiers that use no "space".

Equivalents:

```
å != å
U+0041 != U+00C5 + U+030A
```

Alternative Order:

```
a +^ +   = ậ


a +   +^ = ậ
```

Unicode Is More

- Unicode is a multi-linguage character set
- Standard encodings: UTF-8, UTF-16 and UTF-32
- Defines algorithms for plenty of issues (Collation, Bidi, Normalization)
- It defines properties for characters:

```
Å
00C5;LATIN CAPITAL LETTER A WITH RING ABOVE;Lu;0;L;0041 030A;;;;
    N;LATIN CAPITAL LETTER A RING;;;00E5;

Dž
01C4;LATIN CAPITAL LETTER DZ WITH CARON;Lu;0;L;<compat> 0044 017D;;;;
    N;LATIN CAPITAL LETTER D Z HACEK;;;01C6;01C5

Å
212B;ANGSTROM SIGN;Lu;0;L;00C5;;;;
    N;ANGSTROM UNIT;;;00E5;
```

What Do We Want for PHP?

- Native Unicode strings
- A clear separation between Binary, Native (Encoded) Strings and Unicode Strings
- Unicode string literals
- Updated language semantics
- Where possible, upgrade the existing functions
- Backwards compability
- PHP should do what most people will expect
- Make complex things possible, without making using strings in PHP complex
- Must be as good as Java's support

How is It Going To Work?

- UTF-16 as internal encoding
- All functions and operators work on Normalized Composed Characters (NFC)
- All identifiers can contain Unicode characters
- Internationalization is explicit, not implicit
- You can turn off Unicode semantics if you don't need it

UTF 16 Surrogates

As UTF-16 is supposed to encode the full Unicode character set.

- UTF-16 uses a double two-byte sequence for characters outside the BMP
- Special ranges in the Unicode range are used for this

```
byte 1 = 0xd800 - 0xdbff
byte 2 = 0xdc00 - 0xdfff


U+10418 DESERET CAPITAL LETTER GAY
0xd810 0xdc18
```

- Code *point*: a character
- Code *unit*: a two-byte sequence with UTF-16

How Will It Be Implemented?

ICU: International Components for Unicode

- Unicode is extremely complex, with ICU we don't have to implement it ourselves
- ICU has a lot of features, is fast, stable, portable, extensible, Open Source and well maintained and supported

ICU Features

- Character, String and Text processing
- Text Transformations
- Encoding Conversions
- Collation
- Localization: date, time, number, currency formatting

Roadmap

- Support Unicode in the Engine
- Upgrade existing functions
- Add new functions for explicit i18n/l10n support
- Expose ICU's features

How Do We Turn It On?

- With an INI setting: unicode_semantics
- It can be turned on "per-request"
- (Almost) no behavioral changes when it's not enabled
- The setting does not mean you won't have any Unicode strings

String Types

- *binary*: Used to represent binary data, for example the contents of a JPEG file.

```
. P N G . . . . . I H D R
89 50 4E 47 0D 0A 1A 0A 00 00 00 0D 49 48 44 52
```

- *string*: Native string, encoded with the current script's encoding. For backwards compatibility.

```
B l å b æ r ø l
62 6C C3 A5 62 C3 A6 72 C3 A8 6C
```

- *unicode*: Strings, internally encoded in UTF-16.

```
B l å b æ r ø l
62 00 6C 00 E5 00 62 00 E6 00 72 00 F8 00 6C 00
```

String Literals

Unicode Semantics are *off*:

```
<?php // script is encoded in UTF-8
$str = "hallo daar!";
echo gettype($str), ': ', strlen($str), "\n";

$str = "привет!";
echo gettype($str), ': ', strlen($str), "\n";
?>
```

outputs:

```
string: 11
string: 13
```

Unicode Semantics are *on*:

```
<?php // script is encoded in UTF-8
$str = "hallo daar!";
echo gettype($str), ': ', strlen($str), "\n";

$str = "привет!";
echo gettype($str), ': ', strlen($str), "\n";
?>
```

outputs:

```
unicode: 11
unicode: 7
```

B1nary String Literals

- Binary string literals are explicit
- The actual variable's contents depend on the script encoding

```
<?php // script is encoded in UTF-8
function varc($s) {
    for ($i = 0; $i < strlen($s); ++$i)
        echo sprintf("%02X ", ord($s[$i]));
    echo "<br/>\n";
}



$s1 = b'weed';
$s2 = b"qua\x72k";
$s3 = b<<<EOBS
    gold = 金
EOBS;



    echo varc($s1), varc($s2), varc($s3), "\n";
?>
```

Literal Escapes

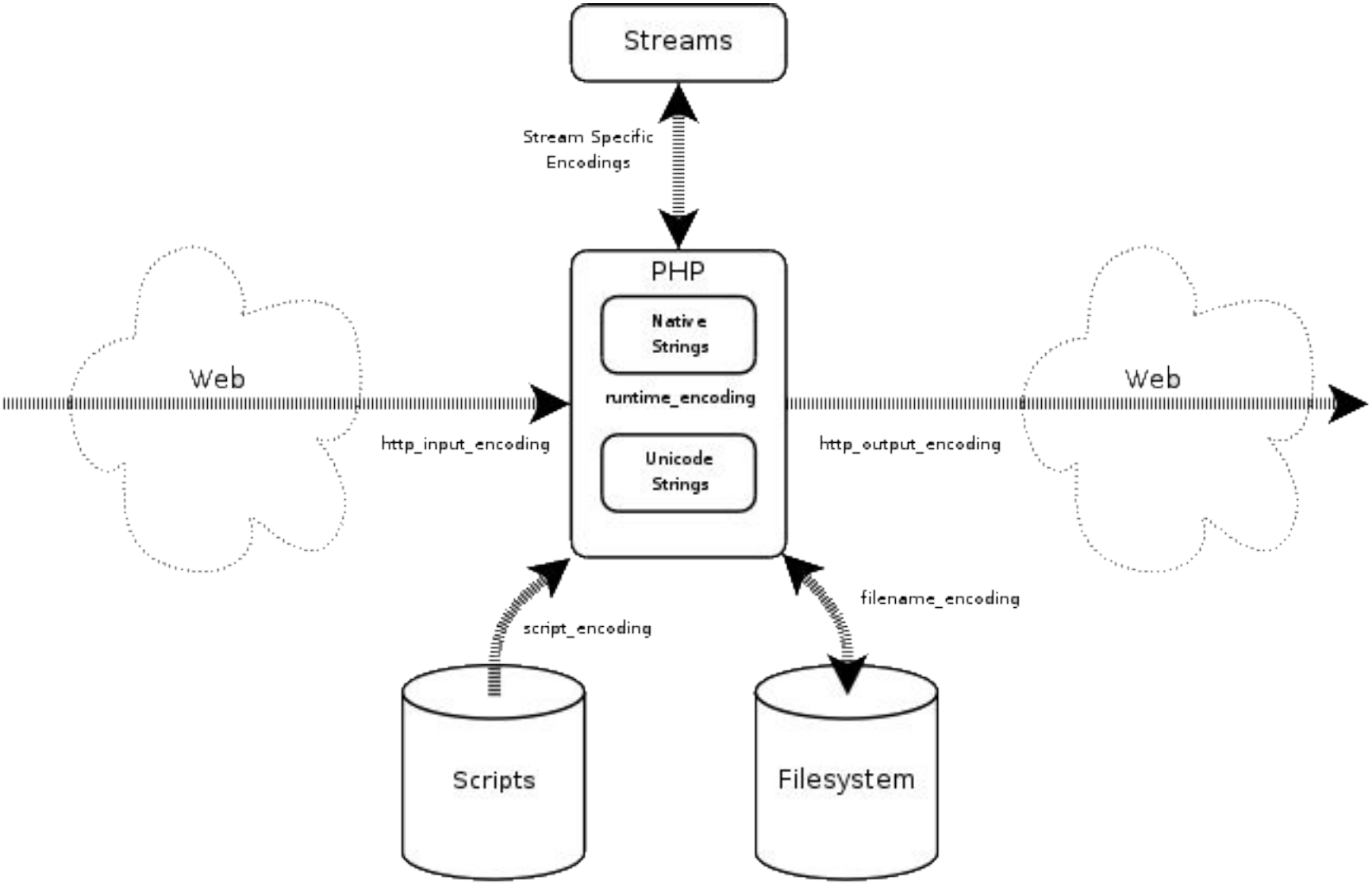
When Unicode semantics are enabled, you can use the \uXXXX and \UXXXXXXX escape sequences to specific Unicode code points

```
<?php // script is encoded in UTF-8

$str = "    is equivalent with \u91d1<br/>\n";
echo $str, "<br/>\n";

echo "   is equivalent with:<br/>\n";
echo "- \U010083<br/>\n";
echo "- \C{LINEAR B IDEOGRAM B105 EQUID}";
?>
```

Encodings Overview



Script Encoding

- Is used by the parser to read in your script
- Determines how string literals and identifiers are handled
- Can be set with an ini setting (script_encoding) or with an inline "pragma"
- No matter what the script's encoding is, the resulting string is always a Unicode string (or identifier)

Script Encoding

Interpreting an iso-8859-1 script as UTF-8:

```
<?php
    declare(encoding="iso-8859-1");
    $str = "blå = 青";
    var_inspect($str);
?>
```

Interpreting an UTF-8 script as UTF-8:

```
<?php
    declare(encoding="utf-8");
    $str = "blå = 青";
    var_inspect($str);
?>
```

Runtime Encoding

- Determines which encoding to attach to Native Strings
- Also used when functions are not upgraded to support Unicode yet

Encoding problems:

```
<?php
    ini_set('unicode.runtime_encoding', 'iso-8859-5');
    ini_set('unicode.from_error_subst_char', '2D');
    $food = 'blåbær != блабар';
    $food2 = (string) $food;
    $food3 = (unicode) $food2;
    echo $food, '<br/>', $food2, '<br/>', $food3, "<br/>\n";
?>
```

HTTP Input Encoding

- In Unicode mode, we need to make sure incoming HTTP variables are correctly converted to Unicode
- GET requests never come with encoding attached
- POST requests sometimes come with encoding attached, but it might be wrong
- If there is no encoding found, PHP can use the http_input_encoding setting
- Frequently the input variables are in the same encoding as the page where they where send from
- But sometimes not, so an application can ask to recode them

HTTP Output Encoding

- Is used as encoding for the output of the script
- Script output is encoding on the fly
- Binary strings will never be automatically converted

On the fly encoding:

```
<?php
    declare(encoding="iso-8859-1");
    ini_set('unicode.output_encoding', 'utf-8');

    $str = "rødbærsyltetøy<br/>";
    $bstr = b"rødbærsyltetøy<br/>";

    echo $str, $bstr;
?>
```

Fallback Encoding

- Used if any of the other encoding settings is not set
- Easy way of configuring all encoding settings
- Defaults to UTF-8 if it's not set

INI Settings Recap:

```
unicode.script_encoding = "UTF-8"
    Source encoding for your script

unicode.runtime_encoding = "iso-8859-15"
    Internal encoding used for "native strings"

unicode.from_error_subst_char = "2f"
    Hex value of substitution character

unicode.http_input_encoding = "UTF-8"
    Default encoding for HTTP input variables

unicode.output_encoding = "UTF-8"
    Encoding used for script output

unicode.fallback_encoding = "UTF-8"
    Fallback encoding
```

String Conversion

- There will never be any implicit conversion from or to Binary Strings.
- The setting unicode.from_error_subst_char can be used to specify a hex value that should be used if a character can not be converted.

Autoconversion of strings:

```
<?php
    $native = (string) "blåbær";
    var_inspect($native);
    echo "<br/>\n";

    $native .= "øl";
    var_inspect($native);
```

Characters, not Bytes!

- All functions and operators work on Code Points (characters) and not Code Units (bytes)
- Backward compatible if you only used single byte encodings before
- This does create overhead though, as we need to scan through a whole string

String Indexes:

```
<?php
    $string = "黄旭"; // bytes are: 0xE9 0xBB 0x83 0xE6 0x97 0xAD

    echo $string[1];
?>
```

Array Keys

- All string types can be used as array keys.
- Behavior depends on unicode_semantics setting.

With Unicode semantics on:

- (string)"key" and (unicode)"key" index the same element

With Unicode semantics off:

- (string)"key" and (unicode)"key" index a *different* element

PHP and HTML

- PHP's strength is its embedding in HTML.
- These HTML blocks should be in the same encoding as the PHP script embedded in it.
- Embedded HTML will be converted to the output encoding.

```
<?php
    $string = "黃蘚"; echo $string[0];
?>旭<?php
    echo $string[1];
?>
```

Upgrading Functions

- PHP has a few thousand functions
- About half of them use a parameter parsing API
- This API can be modified to do automatic conversions
- Upgrade will be a continuing process
- Requires cooperation from extension maintainers
- Guidelines are important

Guidelines

- Behavior of functions should not change
- Search/comparison functions work in binary mode
- Case mapping functions use simple case-mapping
- Combining sequences do not influence matching
- Formatting functions do not use ICU API

ICU Locales

- ICU comes with it's own Locale information
- PHP currently uses POSIX locales for some functions only
- Those functions need to be modified

ICU Locales

Functions that are modified to use ICU locales:

- *str_word_count()*
- *strtoupper()* and *strtolower()*

Functions that do not use locale information:

- *ucfirst()* and *ucwords()*
- *strnatcasecmp()*, *strnatcmp()* and *stristr()*
- *strcmp()* and *strncmp()*

Additional functions:

- *i18n_loc_set_default()*
- *strtotitle()* (name not known yet)
- *i18n_format_number()* and *i18n_parse_number()*

ICU Locales

```
<?php
    i18n_loc_set_default("nl");
    echo i18n_strtotitle("het ijsselmeer ( sselmeer) is ßaf"), "<br/>\n";

    i18n_loc_set_default("tr");
    echo i18n_strtotitle("het ijsselmeer ( sselmeer) is ßaf"), "\n";
?>
```

ICU Locales

```
<pre># orig norm loc trad
-------------------------
<?php
    $d = $c = $b = $a = array('mapa', 'kilo', 'libro', 'llave', 'loca');
    sort($b);
    i18n_loc_set_default('es_VE');
    sort($c, SORT_LOCALE_STRING);
    i18n_loc_set_default('es_VE@collation=traditional');
    sort($d, SORT_LOCALE_STRING);

    for ($i = 0; $i < 5; ++$i) {
        echo sprintf('%d. %-5s %-5s %-5s %-5s<br/>',
            $i + 1, $a[$i], $b[$i], $c[$i], $d[$i]);
    }
?>
```

i18n Extensions

- *i18n_core*: always enabled, functions to set the locale, the locale aware string functions. String searching API.
- *i18n_regexp*: Unicode aware regular expressions
- *i18n_translit*: PECL/translit extension, integrated with ICU's transliteration
- *i18n_...*: Other specialized extensions, such as normalization, break iteration...

Identifiers

```
<?php
    function 誅(&$兽)
    {
        $兽 = "斃";
    }

    $彪 = "tiger";
     誅($彪);

    var_dump($彪);
?>
```

PHP Streams

- PHP has a streams-based IO
- Generalized file, network, data compression, and other operations
- Streams will operate on binary strings by default

```
<?php
    $f = fopen('../presentations/slides/i18nl10n/test-file.txt', 'r');
    $data = fread($f, 32);
    var_dump($data);

    $udata = unicode_decode($data, 'latin1');
    var_dump($udata);
?>
```

PHP Streams

Explicit filter:

```
<?php
    $f = fopen('../presentations/slides/i18nl10n/test-file.txt', 'r');
    stream_filter_append($f, 'unicode.from.latin1');
    $data = fread($f, 32);
    var_dump($data);
?>
```

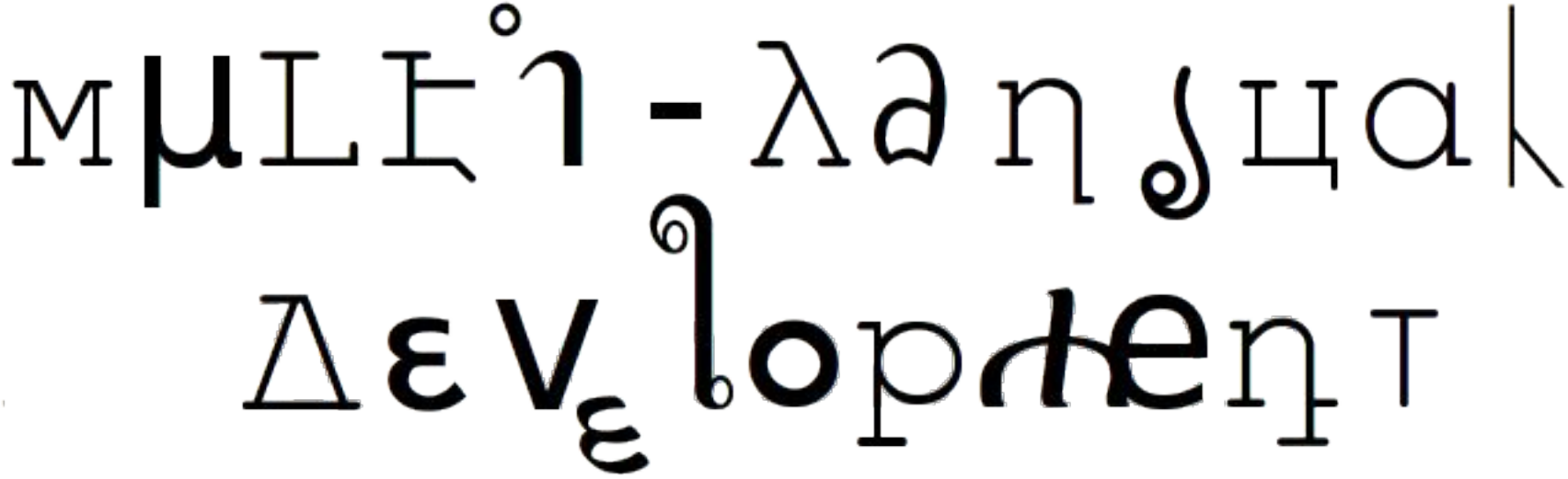
Default filter:

```
<?php
    $ctx = stream_context_get_default();
    stream_context_set_params(
        $ctx, array('input_encoding' => 'latin1'));
    $f = fopen('../presentations/slides/i18nl10n/test-file.txt', 'rt');
    $data = fread($f, 32);
    var_dump($data);
?>
```

When Can We Have This?

- When it is ready.
- Development version is in CVS.
- Release: hopefully this year.

Resources



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Questions?: dr@ez.no