SPC251
Making Programs Unicode Enabled
Contributing Speakers

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Though the word 'ABAP' has been lost, when the title had been shortened for the TechEd program overview, we will talk only about ABAP today.

JAVA programs always use Unicode. So they don't require special enablement.

C and C++ programs at SAP (kernel and basis tools) had been Unicode enabled many years ago. Programmers outside of SAP normally don't have the need to write programs in C or C++, which can be used with and also without Unicode and which are portable to several different operating systems and hardware platforms.
SAP's approach to Unicode

Unicode Enabled ABAP

Tools for Unicode Enabling

Exercises
Part I – SAP’s approach to Unicode

- Demo – Unicode vs. Non-Unicode R3
- Unicode Essentials
- Transparent Unicode Enabling for R/3

Part II – Unicode Enabled ABAP

- Unicode Restrictions
- New ABAP Features

Part III – Tools for Unicode Enabling

- Migration to Unicode
- Unicode Scan UCCHECK
- Coverage Analyzer SCOV

Exercises
Unicode Essentials

What is Unicode?

- Character encoding schema for (nearly) all characters used world wide
  - ما هي السفرة الموحدة ‘لونكود‘ in Arabic
  - 什麼是Unicode(統一碼/標準萬國碼)? in Chinese (Traditional)
  - What is Unicode? in English
  - რაა Unicode? in Georgian
  - Τι είναι το Unicode? in Greek
  - यूनिकोड क्या है? in Hindi
  - Cos'è Unicode? in Italian
  - ユニコードとは何か？in Japanese
  - 유니코드에 대해? in Korean
  - Что такое Unicode? in Russian

- Each character has a unique number („Unicode code point“)
  - Notation U+nhhh (where nhhh are hexadecimal digits)

- See [http://www.unicode.org](http://www.unicode.org) for complete code charts
### Old Solution For Multiple Languages: MDMP*

* Check your system type with report RSCPINST → current configuration

<table>
<thead>
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<th>COLOR</th>
<th>SPRAS</th>
<th>NAME</th>
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<tbody>
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<td>Y</td>
<td>KO</td>
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</table>

West European View  | Japanese View  | Korean View  |

![West European View](image1)
![Japanese View](image2)
![Korean View](image3)
Old Solution For Multiple Languages: MDMP

West European View

Japanese View

Korean View

End of support with NetWeaver 04

(As of release NetWeaver 04s and moving forward, MDMP will no longer be supported)
Only Supported Solution For Multilingual Systems: Unicode
SAP NetWeaver™ – The Integration Platform?

### Evolution of mySAP Technology

Unifies and aligns people, information and business processes

- Integrates across technologies and organizational boundaries
- A safe choice with full .NET and J2EE interoperability

The business foundation for SAP and partners

- Powers business-ready solutions that reduce custom integration
- Its Enterprise Services Architecture increases business process flexibility

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<thead>
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<td>Multi channel access</td>
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<td>Portal Collaboration</td>
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<td>Master Data Mgmt</td>
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<td>Business Process Mgmt</td>
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<td>J2EE ABAP</td>
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<td>DB and OS Abstraction</td>
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## SAP NetWeaver™ With Non-Unicode ABAP Stack

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<table>
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<tr>
<th>Composite Application Framework</th>
<th>Life-Cycle Mgmt</th>
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<tr>
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SAP NetWeaver™

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- Portal
- Collaboration

INFORMATION INTEGRATION
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- Knowledge Mgmt
- Master Data Mgmt

PROCESS INTEGRATION
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SAP NetWeaver™ With Non-Unicode ABAP Stack

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Only Solution For Full Integration: Unicode

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## Representation of Unicode Characters

### UTF-16 – Unicode Transformation Format, 16 bit encoding
- Fixed length, 1 character = 2 bytes (surrogate pairs = 2 + 2 bytes)
- Platform dependent byte order
- 2 byte alignment restriction

### UTF-8 – Unicode Transformation Format, 8 bit encoding
- Variable length, 1 character = 1...4 bytes
- Platform independent
- No alignment restriction
- 7 bit US ASCII compatible

<table>
<thead>
<tr>
<th>Character</th>
<th>Unicode code point</th>
<th>UTF-16 big endian</th>
<th>UTF-16 little endian</th>
<th>UTF-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>U+0061</td>
<td>00 61</td>
<td>61 00</td>
<td>61</td>
</tr>
<tr>
<td>ä</td>
<td>U+00E4</td>
<td>00 E4</td>
<td>E4 00</td>
<td>C3 A4</td>
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<tr>
<td>α</td>
<td>U+03B1</td>
<td>03 B1</td>
<td>B1 03</td>
<td>CE B1</td>
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<tr>
<td>會</td>
<td>U+3479</td>
<td>34 79</td>
<td>79 34</td>
<td>E3 91 B9</td>
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<tr>
<td>中石 中砳</td>
<td>U+2007B</td>
<td>DA00 DC7B</td>
<td>00DA7BDC</td>
<td>F0A081BB</td>
</tr>
</tbody>
</table>
Transparent Unicode Enabling of R/3

Character Expansion Model

- Separate Unicode and non-Unicode versions of R/3

- No explicit Unicode data type in ABAP
- Single ABAP source for Unicode and non-Unicode systems
Implications:

- Major part of ABAP coding is ready for Unicode without any changes

- Minor part of ABAP coding written before release SAP_BASIS 6.10 has to be adapted to comply with Unicode restrictions
  - Syntactical restrictions
  - Additional runtime checks
  - Runtime tests for semantic changes
Unicode-Enabled ABAP Programs

Program attribute „Unicode checks active“

- Required to run on a Unicode system

<table>
<thead>
<tr>
<th>Attribute (Unicode enabled)</th>
<th>Non-Unicode system</th>
<th>Unicode system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute set</td>
<td>ok</td>
<td>ok</td>
</tr>
<tr>
<td>Attribute not set</td>
<td>ok</td>
<td>not allowed</td>
</tr>
</tbody>
</table>

- If attribute is set, additional restrictions:
  - apply at compile and at run time
  - apply in Unicode systems and in non-Unicode systems
  - ensure that program will run on non-Unicode and Unicode systems with (almost) identical behavior
Program Attribute „Unicode Checks Active“

- **Title:** Example: Unicode enabled program
- **Original language:** EN, English
- **Created:** 13.08.2001, SCHIED
- **Last changed by:** 13.08.2001, SCHIED
- **Status:** Inactive

**Attributes**

- **Type:** Executable program
- **Application:**
- **Authorization Group:**
- **Development class:** $TMP, Private Test Programs and Utilities
- **Logical database:**
- **Selection screen:**
- **Editor lock:**
- **Unicode checks active:**
- **Fixed point arithmetic:**
- **Start using variant:**
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- New ABAP Features

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Exercises
Unicode Enabled ABAP – Overview

Design Goals
- Platform independence
  - Identical behavior on Unicode and non-Unicode systems
- Highest level of compatibility to the pre-Unicode world
  - Minimize costs for Unicode enabling of ABAP Programs
- Improved security, maintainability, and readability of ABAP programs

Main Features
- Clear distinction between character and byte processing
  1 Character ≠ 1 Byte
- Enhanced checks prevent programming based on memory layout assumptions
- Improved conversion facilities
- Improved dataset interface
- Improved support for dynamic programming
Character Processing

CONCATENATE cf1 cf2 TO cf3.
IF cf1 CS cf2. ...

- String operations are only allowed for character-like operands
  - ABAP types C, N, D, and T, STRING
  - Structures consisting only of characters (C, N, D, T)
  - X and XSTRING are no longer considered character-like types

Byte Processing

CONCATENATE xf1 xf2 TO xf3 IN BYTE MODE.
IF xf1 BYTE-CS xf2. ...

- Variants of string operations for byte processing
  - Addition „IN BYTE MODE“ for statements
  - Prefix „BYTE-“ for comparison operations

- Only operands of type X or XSTRING allowed
Determining the Length and Distance

■ Counted in bytes or in characters? Specify!

DESCRIBE FIELD...LENGTH... IN (BYTE | CHARACTER) MODE

DESCRIBE DISTANCE BETWEEN ... AND ... INTO ...
IN (BYTE | CHARACTER) MODE.

Example

FORM write3 USING fld TYPE c.
   DATA: fldlen TYPE i.
   DESCRIBE FIELD fld LENGTH fldlen IN CHARACTER MODE.
   IF fldlen >= 3.
      WRITE: / fld(3).
   ENDIF.
ENDFORM.
## Unicode Restrictions – MOVE

### MOVE Between Incompatible Structures
- Matching data layout („fragment views“) required

<table>
<thead>
<tr>
<th>struc1</th>
<th>struc2</th>
</tr>
</thead>
<tbody>
<tr>
<td>C(6)</td>
<td>C(4)</td>
</tr>
<tr>
<td>N(4)</td>
<td>C(3)</td>
</tr>
<tr>
<td>X(3)</td>
<td>C(3)</td>
</tr>
<tr>
<td>N(4)</td>
<td>X(3)</td>
</tr>
<tr>
<td>I</td>
<td>C(4)</td>
</tr>
<tr>
<td>P(8)</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>C(10)</td>
<td>X(3)</td>
</tr>
<tr>
<td></td>
<td>C(4)</td>
</tr>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>P(8)</td>
</tr>
</tbody>
</table>

#### Example

**DATA:**
```
DATA:
BEGIN OF cstru,
  first(10)  TYPE c,
  tab(1)     TYPE c,
  last(10)   TYPE c,
END OF cstru.
```

```
DATA:
BEGIN OF xstru,
  first(10)  TYPE c,
  tab(1)     TYPE x VALUE '09',
  last(10)   TYPE c,
END OF xstru.
```

```
cstru = xstru.
```

"Unicode error!"
Unicode Restrictions – Access With Offset or Length

Access To Structures With Offset/Length

- Structure must begin with characters
- Offset/length counted in characters
- Access only allowed within the character type prefix of a structure

ASSIGN fld+off(len) TO ...

- Access must not exceed field boundaries
- If ASSIGN fails, field-symbol is set to „unassigned“
- New ... RANGE addition allows the permissible boundaries to be expanded
Class CL_ABAP_CHAR_UTILITIES

Constant attributes with system specific values

charsize     length of 1 character in bytes
newline
cr_lf
form_feed
horizontal_tab
vertical_tab
backspace
minchar      X‘00‘ in non-Unicode systems, U+0000 in Unicode systems
maxchar      X‘FF‘ in non-Unicode systems, U+FFFFD in Unicode systems

Example

CLASS cl_abap_char_utilities DEFINITION LOAD.
DATA: text TYPE string.
REPLACE cl_abap_char_utilites=>horizontal_tab
   WITH space INTO text.
New ABAP Features – Extended File Interface

Reading / Writing Different Text Formats

- Only character-like fields allowed for reading / writing text files
- Explicit open required in Unicode enabled programs

```abap
OPEN DATASET dsn IN TEXT MODE
   ENCODING (DEFAULT | UTF-8 | NON-UNICODE).
TRANSFER text TO dsn.
READ DATASET dsn INTO text.
```

Reading / Writing Legacy Formats

- Reading or writing data in a format compatible to non-Unicode systems
- Not character-like structures allowed

```abap
OPEN DATASET dsn IN LEGACY (TEXT | BINARY) MODE
   ... (LITTLE | BIG) ENDIAN
   ... CODEPAGE cp.
```
Conversion classes

- Code page conversion
  - Unicode / non-Unicode code pages

- Endian conversion
  - Little endian / big endian byte order

- Character conversion
  - Unicode code point / ABAP character

<table>
<thead>
<tr>
<th>ABAP Class</th>
<th>Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>CL_ABAP_CONV_IN_CE</td>
<td>any code page → system code page</td>
</tr>
<tr>
<td>CL_ABAP_CONV_OUT_CE</td>
<td>system code page → any code page</td>
</tr>
<tr>
<td>CL_ABAP_CONV_X2X_CE</td>
<td>any code page → any code page</td>
</tr>
</tbody>
</table>
New ABAP Features – Includes With Group Names

Symbolic Access to Includes of Structures

```
TYPES: BEGIN OF t_key,
  k1(2) TYPE x,
  k2(2) TYPE c,
END OF t_key.

TYPES: BEGIN OF t_rest,
  r1(10) TYPE c,
  r2(10) TYPE c,
END OF t_rest.

DATA: BEGIN OF stru.
  INCLUDE TYPE t_key as key.
  INCLUDE TYPE t_rest as rest.
DATA: END OF stru.

DATA: skey TYPE t_key,
  srest TYPE t_rest.
```

Pre-Unicode

```
skey = stru(4).
srest = stru+4(20).
WRITE: stru-r2.
```

Unicode enabled with group names

```
skey = stru-key.
srest = stru-rest.
WRITE: stru-r2.
```
New ABAP Features – Import/Export Data Buffer

Using fields of type xstring as data containers

- Writing data to an xstring.

```
DATA: my_buffer TYPE xstring.
    data1     TYPE some_type.

...)

EXPORT id = data1 TO DATA BUFFER my_buffer.
```

- Data is stored in a platform-independent format
- Contents of xstring can be exchanged with any other 6.10-system (Unicode and non-Unicode)

- Reading data from an xstring

```
FORM read_buffer USING buffer TYPE xstring.
    DATA: fld2 TYPE some_type.

    IMPORT id = fld2 FROM DATA BUFFER buffer.

    ...

    ENDFORM.
```

- Automatic conversion of data during import
Creating Data Objects Dynamically

Creating and accessing data objects on the heap

DATA: dref TYPE REF TO data.
CREATE DATA dref TYPE sometype.
CREATE DATA dref TYPE (typename).
CREATE DATA dref TYPE c LENGTH len.
CREATE DATA dref TYPE STANDARD TABLE OF (typename)
ASSIGN dref-* TO <f>. "access data object"

Casting to User Defined Types

Look at the contents of a field as a value of another type

FIELD-SYMBOLS: <f> TYPE any.
ASSIGN fld TO <f> CASTING TYPE sometype.
ASSIGN fld TO <f> CASTING TYPE (typename).

fld must provide sufficient alignment and length for the given type
New generic types for parameters and field-symbols

- Eliminate untyped parameters or field-symbols for improved security and performance
New ABAP Features – Enhancement Categorization

If you are writing software for others you may have the following...

Problem

Enhancements on structures or tables may affect your coding:

- Syntax-/runtime errors
- Changed behavior (e.g. damaged or changed data)

Solution

Maintaining the enhancement category in the DDIC: SE11 ( Extras -> Enhancement Category)

- Can not be enhanced
- Can be enhanced - character like
- Can be enhanced – character and numerical type
- Can be arbitrarily enhanced

Additional checks are done on your ABAP programs (SLIN) and show possible problems in allowed enhancement situations
### ABAP lists: Difference between memory and display length

<table>
<thead>
<tr>
<th>한글</th>
<th>Character units in the memory</th>
<th>Display columns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Unicode</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Unicode</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**1 Character ≠ 1 Display Column**
Handling for character fields:

Truncation may be done during display to synchronize memory length and display length at the field boundaries.
Padding is done in the list table (here for the first field S1) to synchronize memory length and display length at the field boundaries.
New ABAP Features – Different List Types

Half width (Default)

Dynamic

Full width
New ABAP statements

- SET/GET CURSOR MEMORY OFFSET
- Dynamic output length: WRITE (*) field.
  Maximum output length: WRITE (**) field.

Utility Class CL_ABAP_LIST_UTILITIES

- Calculating display lengths
- Conversions display length ↔ memory length inside fields
- Handling of implicit field boundaries

See note 541299 for details
New ABAP Features – ABAP List Programming

Field with implicit structure

a) memory-layout

b) display-layout

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New ABAP Features – ABAP List Programming

Golden rules for ABAP list programming

a) Don’t mix up display length and memory length
b) Don’t smudge field boundaries
c) Don’t overwrite parts of fields
d) Don’t do self programmed right-justified or centered
e) Don’t do self programmed scrolling (memory based)
f) Don’t forget to specify sufficient output length, if all data needs always to be visible
Agenda

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Exercises
Migrating to Unicode Enabled ABAP

Step 1

- In non-Unicode system
- Adapt all ABAP programs to Unicode syntax and runtime restrictions
- Set attribute "Unicode enabled" for all programs

Step 2

- Set up a Unicode system
  - Unicode kernel + Unicode database
  - Only ABAP programs with the Unicode attribute are executable
- Do runtime tests in Unicode system
  - Check for runtime errors
  - Look for semantic errors
  - Check ABAP list layout with former double byte characters
Step 1 – Unicode Enabling With UCHECK

Use UCHECK to analyze your applications:

- Remove errors
- Inspect statically not analyzable places (optional)
  - Untyped field symbols
  - Offset with variable length
  - Generic access to database tables
- Set Unicode program attribute using UCHECK or SE38 / SE24 / ...
- Do additional checks with SLIN (e.g. matching of actual and formal parameters in function modules)
Transaction UCCHECK

Check a Program Set for Syntax Errors in Unicode Environment

Object Selection
- Object name: ZTECHED_UNICODE_E...
- Object Type: ...
- Author (TADIR): ...
- Package: ...
- Original system: ...

- Check only programs where the Unicode flag is unchecked
- Include only Objects with Object Repository Entry (TADIR)
- Exclude $ Packages

Restriction of Program Set to Prevent Timeout
- Maximum Number of Programs: 50

Statements that cannot be analysed statically
- Display lines that cannot be analyzed statically
- Show also Locations Hidden with "#C"
- Includes to Be Displayed: $LSYM

Application-specific Checks
- View Maintenance
- Obsolete Function Modules: UPLOAD/DOWNLOAD
What to do with the places that can only be checked at runtime?

- Reduce their number
  - In many cases you can specify the type of parameters and field-symbols
  - Use generic ABAP types where necessary
  - Mark those places that really need untyped parameters due to some kind of generic programming with "#EC * as OK after you did revise them.

- Do ➔ Runtime tests
Step 2 – Testing Your Application

Final tests in the Unicode system

Runtime tests, Runtime tests, Runtime tests, ...

– Because the amount of warnings due to statically not analyzable places may be very large, you cannot type everything. In this case you have to rely on run-time tests.
– Some semantic problems may be seen only in the Unicode system (e.g. byte or character length)
– ABAP list layout can be checked only manually

Monitoring of runtime tests:

Having test plans is good, knowing the coverage of the test is better:

Use the ABAP Coverage Analyzer to monitor runtime tests
Coverage Analyzer (Transaction SCOV)

- persistently traces the execution of all program objects within one system
- traces all processing blocks
  - i.e. FORMS, Methods, Modules... and ABAP events
- collects Information
  - Number of calls
  - Number of runtime errors
  - Number of program changes

Two Different Target Groups

- Developers
  - Help to see in detail which parts of your programs are used and which are not
- Quality Managers
  - Determine the overall system coverage during a test phase
## Coverage Analyzer – Details View For Developers

### Coverage Analyzer: Processing Blocks

#### Processing Blocks Table

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Coverage Analyzer – Global View For QM
Further Information

Public Web:
www.sap.com
http://www.service.sap.com/Unicode@sap : Technology
http://www.service.sap.com/Unicode : Customer contact

Related SAP Education Training Opportunities
http://www.sap.com/education/
http://www.service.sap.com/rkt-unicode

Related Workshops/Lectures at SAP TechEd 2006
SPC200 Conversion of SAP Systems to Unicode, lecture (not in Bangalore)
SPC203 Integration Between Heterogeneous SAP Unicode and Third Party Systems (not in Las Vegas)
SPC251 Making Programs Unicode Enabled; hands on (not in Bangalore)
Contacts

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Email to solution management team:

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THANK YOU FOR YOUR ATTENTION!
Part I – SAP's approach to Unicode
- Demo – Unicode vs. Non-Unicode R3
- Unicode Essentials
- Transparent Unicode Enabling for R/3

Part II – Unicode Enabled ABAP
- Unicode Restrictions
- New ABAP Features

Part III – Tools for Unicode Enabling
- Migration to Unicode
- Unicode Scan UCCHECK
- Coverage Analyzer SCOV

Exercises
Please make sure, that you are only working on programs like ZTECHED_UNICODE_EXERCISE_n XX where XX indicates the two digit number of your working group or your desk.
Please complete your session evaluation.

Be courteous — deposit your trash, and do not take the handouts for the following session.

Thank You!