

# Koordinatentransformation als Web Service

Standardkonforme Implementierung mit **deegree**

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deegree day 2008, 17. Juni 2008



**vodafone**

# Web Coordinate Transformation Service (WCTS)

deegree based implementation using standards

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deegree day 2008, June 17th



# Agenda

- Introduction
- Status quo
- Why a web service and why deegree?
- Considered standards
- The user application "Kotrans"
- The web services
- Live demonstration
- Outlook
- Discussion

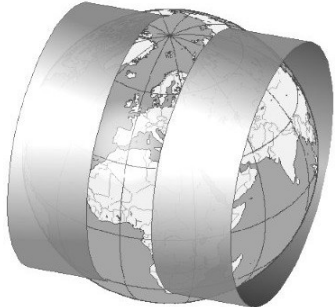
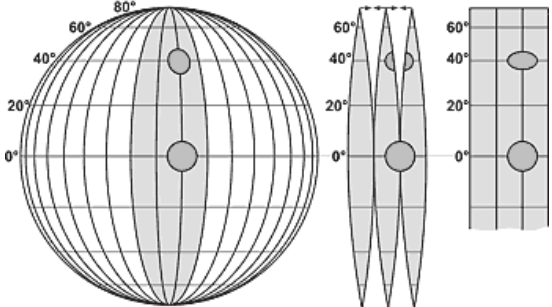
# Coordinate transformation



„A coordinate transformation is a conversion from one system to another, to describe the same space.“

- **Federal Office for Cartography and Geodesy (BKG\*)**: „Transformation and Conversion: The change of coordinate from one Coordinate Reference System to another is a so called coordinate operation. There exist two kinds of operations - coordinate transformation and coordinate conversion.“
- **„Transformation**: The change of coordinates from one CRS to another CRS based on **different datum** is only possible via a coordinate transformation.“
- **„Conversion**: The change from one Coordinate System to another based on the **same datum** is possible via a coordinate conversion.“
- In this presentation the terms „transformation“ and „conversion“ are used as synonyms to simplify matters
- \*) Reference: <http://crs.bkg.bund.de/crs-eu/>

# Coordinate transformation



**Map on the sphere**

geographic coordinates

**Map on the plane**

projected coordinates

Gauß-Krüger

**Map on the plane**

projected coordinates

UTM

X:6,741130 Y:51,242998



X:3342344,28 Y:5681103,42





X:342334,13 Y:5679271,96

# Status quo

- The network planning department uses (since 1992) at least four different coordinate systems:
  1. geographische Koordinaten (Ellipsoid: Bessel, Datum: DHDN)
  2. geographische Koordinaten (Ellipsoid: WGS84, Datum: WGS84)
  3. Gauß-Krüger Koordinaten (Ellipsoid: Bessel, Datum: DHDN)
  4. Gauß-Krüger Koordinaten (Ellipsoid: Krassowski, Datum: Pulkowo)
  5. *Arcor: UTM, Zone 32N (Ellipsoid: GRS80, Datum: ETRS89)*
- Examples: Position of antennas, position of sites (equipment), point-to-point radio systems, ...
- All these coordinates are stored in relational database management systems (most commonly used: Sybase database servers)
- Nearly 90% of all coordinates at Vodafone D2 are stored (in 21 systems) **outside a GIS and/or outside a spatially enabled database!**
- Beyond the network planning department, coordinates are used in many other applications and domains (business support systems, operating support systems, ...)

# Status quo

- Example for coordinates used outside network support systems: Shop finder
- 1. customer calls the hotline (a computer) and wants to know the next Vodafone Shop to his current position
- 2. hotline asks for a permission to localise the customer
- 3. location server determines customer's position
- 4. an application computes the „nearest“ (linear distance) Vodafone Shop

-  EPSG:4326
-  EPSG:31467 (geocoded addresses)
- for calculating a distance, both pairs of coordinates have to be in the same coordinate system



# Status quo: coordinate transformation at Vodafone D2

- C-library designed in the early days of Mannesmann Mobilfunk (antecessor of Vodafone D2)
- Implementing a private geodetic datum „Potsdam IST (Information Systems Technique)“ --> in 1992 the datum definition by BKG was a „*state secret*“
- C-library is used by >20 different systems
- 2005: embedding of [PROJ.4](#) in Vodafone C-library (using BKG 1995 parameters)
- Disadvantages:
  - C-library, no thread safeness
  - Hard coded parametrisation of coordinate systems in library (in case of a change of parameters, you have to change the source code, to recompile the library and to integrate the new one in over 20 applications)
  - Nobody knows which application uses the library with which parametrisation
  - 1995 parameters, but 2001 ones are up to date!
  - Usability of C-library in Java environments is very poor (JNI wrapper for PROJ.4, but no native Java implementation)
  - Missing web service interface



# Why a web service and why deegree?

- To overcome the obstacles of the C-library
  - Adjustable coordinate definitions
  - Adjustable coordinate conversions/transformations
  - No hard coding --> changes only on one (!) centralised server
  - Java not C
- „To participate in the SOA hype“
  - Provide web service interfaces for Vodafone D2 SDI
  - Provide web service interfaces for Non-SDI's (90%)
  - Simplify programming (WSDL)
- 3 reasons for deegree & lat/lon
  - Markus Müller (married Markus Lupp) is coauthor of the OGC specification (he should know how it works)
  - lat/lon head quarter is in Bonn (Germany)
  - deegree is (one of) the most complete and active implementation(s) of OGC standards

## 1. Open Geospatial Consortium Inc.

Date: 2007-10-08

Reference number of this document: OGC 07-055r1

Version: 0.4.0

Category: OpenGIS® Discussion Paper

Editors: Arliss Whiteside, **3.** Markus Müller, Stephane Fellah, Frank Warmerdam

## 2. Web Coordinate Transformation Service (WCTS) Interface Engineering Report

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# Considered standards

## ■ Standards

- **Open Geospatial Consortium, Inc.(OGC):**  
[Web Coordinate Transformation Service \(WCTS\)](#) draft Implementation Specification  
[Web Coordinate Transformation Service \(WCTS\) Interface Engineering Report](#)
- **European Petroleum Survey Group (EPSG) :**  
[EPSG Geodetic Parameter Dataset](#)
- **Federal Office for Cartography and Geodesy (BKG):**  
[Transformation parameters](#) (already included in EPSG)
- **Web Services Interoperability Organization (WS-I):**  
[Basic Profile 1.1 Profile](#) for SOAP and WSDL  
incl. Testing Tools (for sopaUI, Eclipse, ...)
- **Vodafone D2 internal standards:**  
Software releases (Tomcat 5.5.x, Java 1.5, ...)  
Logfile guidelines for monitoring purposes

# D2-WCTS / Kotrans

## ■ “Standards”

Implementations by Specification | OGC® - Microsoft Internet Explorer / Vodafone D2 GmbH

Adresse <http://www.opengeospatial.org/resource/products/byspec>

**OGC®** "Making location count" OGC® Home | OG

Open Geospatial Consortium, Inc.

[About](#) [Standards](#) [Programs](#) [Press](#) [Events](#) [Implementing](#) [Compliance](#)

**Implementing**

- Registered Products
  - All Registered Products
  - Implementation Statistics
  - View By Specification**
  - Compliant Products
  - Implementing Products
  - Register Your Products
- OGC Cookbooks
- Demonstrations

**Compliant vs. Implementing**

Interested in the difference between products listed as compliant and those listed as implementing?

HOME » RESOURCE » PRODUCTS

## Implementations by Specification

1) Select a specification

Web Coordinate Transformation Service v.0.4.0

### Web Coordinate Transformation Service 0.4.0

2) Jump to Organization -

lat/lon	Product Name	OGC Spec
	deegree Web Coordinate Transformation Service 2.1.0	WCTS 0.4.0

## D2-WCTS / Kotrans

- <http://localhost:8080/kotrans>
- **D2-WCTS:** the web services (1. OGC, 2. SOAP)
- **Kotrans:** the user application (GUI)
- Both, D2-WCTS and Kotrans are using the same code
- but they are deployed as separate web applications (Tomcat \*.wars) for performance reasons (batch)

## ▪ Live demo

# D2-WCTS / Kotrans - Backup



Einzelmodus

Batchmodus

Hilfe & Kontakt

Entwicklerinformationen

## Koordinatentransformation

 Einzelmodus

 Batchmodus

## Einzelmodus

Hier haben Sie die Möglichkeit, Einzelkoordinaten zu transformieren.


Bitte wählen Sie das Koordinatensystem Ihrer Quell-Koordinaten (oben) sowie das Koordinatensystem der Ziel-Koordinaten (unten) aus.

Geben Sie dann die zu transformierenden Koordinatenwerte ein und betätigen die Schaltfläche "Prüfen und Koordinaten bestimmen"!

X-Koordinate (Länge/Rechtswert)

Y-Koordinate (Breite/Hochwert)

Quell-Koordinatensystem

DHDN, Dezimalgrad (EPSG:4314) 

Ellipsoid  
Bessel 1841 (EPSG:7004)


Datum  
Deutsches Hauptdreiecksnetz (EPSG:6314)

**Prüfen und Koordinaten bestimmen** 

X-Koordinate (Länge/Rechtswert)

Y-Koordinate (Breite/Hochwert)

Ziel-Koordinatensystem

DHDN, Dezimalgrad (EPSG:4314) 

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# D2-WCTS / Kotrans - Backup



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## Koordinatentransformation

Einzelmodus

Batchmodus

## Batchmodus

Koordinaten

X-Koordinate (Länge/Rechtswert)

GK3\_X

Y-Koordinate (Breite/Hochwert)

GK3\_Y

Feldnamen stehen in der ersten Zeile

Quell-Koordinatensystem

DHDN / Gauss-Kruger zone 3 (EPSG:31467)

Ellipsoid

Bessel 1841 (EPSG:7004)

Datum

Deutsches Hauptdreiecksnetz (EPSG:6314)

Ziel-Koordinatensystem

WGS 84, Dezimalgrad (EPSG:4326)

Ellipsoid

WGS 1984 (EPSG:7030)

Datum

World GeodeticSystem 1984 (EPSG:6326)

Ziel-Format

Text

Text

ESRI Shape

Google Earth KML

gesendet werden soll, die den Link zur bearbeiteten Downloaddatei enthält.

E-Mail

oliver.heimann@vodafone.com

Daten weiter verarbeiten

# D2-WCTS / Kotrans Backup

The screenshot shows the Google Earth interface with a map of Düsseldorf, Germany. A data table is displayed in a pop-up window, and a settings dialog box is open in the bottom right corner. The interface includes a left sidebar with 'Orte' (Places) and 'Ebenen' (Layers) panels, and a top menu bar.

**Düsseldorf Data Table:**

Strasse	Hausnr	PLZ	Ort	GK3_X
Am Seester...	1	40547	Düsseldorf	3342118.15

**Settings Dialog Box:**

- Quelle-Koordinatensystem: DHDN / Gauss-Kruger zone 3 (EPSG:31467)
- Ellipsoid: Bessel 1841 (EPSG:7004)
- Datum: Deutsches Hauptdreiecksnetz (EPSG:6314)
- Ziel-Koordinatensystem: WGS 84, Dezimalgrad (EPSG:4326)
- Ellipsoid: WGS 1984 (EPSG:7030)
- Datum: World Geodetic System 1984 (EPSG:6326)
- Ziel-Format: Google Earth KML
- Titel des Dokumentes: Willkommen zu den deegree days 2008
- Name des Punktes in Karte und Inhaltsverzeichnis: Ort
- Kurzbeschreibung des Punktes im Inhaltsverzeichnis: Strasse

# D2-WCTS / Kotrans - Backup



Einzelmodus

Batchmodus

Hilfe & Kontakt

Entwicklerinformationen


## Entwicklerinformationen

### SOAP-Schnittstellen

 [KOTRANS \(WSDL\)](#)

### OGC-Schnittstellen

 [WCTS GetCapabilities](#)

 [OGC Coordinate Transformation Service](#)

Dies ist der Inhalt der Datei modules/developer/developer.html

Der eigentliche Text kommt von Herrn Heimann.



# D2-WCTS / Kotrans - Backup

The screenshot displays the soapUI 2.0.2 interface. On the left, the Navigator shows a project named 'D2-WCTS' with several test cases, including 'Request with Elements' which is currently selected. The main workspace is split into two panes showing XML. The left pane shows the request XML, and the right pane shows the response XML. Below the XML panes, there are tabs for 'Aut Headers (0)', 'Attachments (0)', 'Headers (6)', 'Attachments (0)', 'SSL Info', and 'WSS (0)'. A status bar indicates 'response time: 332ms (2448 bytes)'. At the bottom, a log window shows various system messages.

**Request XML:**

```
<?xml version='1.0' encoding='UTF-8'>
<soapenv:Envelope xmlns:soapenv='http://schemas.xmlsoap.org/soap/envelope/'>
  <soapenv:Header/>
  <soapenv:Body>
    <deegree:wcts:Transform xmlns:deegree:wcts='http://www.deegree.org/wcts' xmlns:ows='http://www.opengeospatial.org/ows' xmlns:xsi='http://www.w3.org/2001/XMLSchema-instance' xsi:schemaLocation='http://www.deegree.org/wcts http://www.deegree.org/wcts/wcts.xsd'>
      <!-- Shows the usage of the Transform operation -->
      <wcts:SourceCRS>urn:ogc:def:crs:EPSG::31466</wcts:SourceCRS>
      <wcts:TargetCRS>urn:ogc:def:crs:EPSG::31466</wcts:TargetCRS>
      <deegree:wcts:InputData>
        <ows:ReferenceGroup>
          <ows:Title>A German nonsense geometry</ows:Title>
          <ows:Reference xlink:href='http://www.deegree.org/wcts/wcts.xsd#ows1_1_0'>ows1_1_0</ows:Reference>
        </ows:ReferenceGroup>
        <deegree:wcts:InlineData>
          <!-- GeometryData can be used to describe the geometry -->
          <deegree:wcts:GeometryData>
            <gml:Point srsName='urn:ogc:def:crs:EPSG::31466'>
              <gml:pos>6.7408916 3.141592653589793</gml:pos>
            </gml:Point>
            <!-- FMS: 3.141592653589793 -->
            <!-- ArcGIS 9.1: 3.141592653589793 -->
            <!-- SKG CTS: 3.141592653589793 -->
          </deegree:wcts:GeometryData>
          <gml:Polygon srsName='urn:ogc:def:crs:EPSG::31466'>
            <gml:exterior>
              <gml:LinearRing>
                <gml:posList srsDimension='3'>
                  6.7408916 3.141592653589793 6.7408916 3.141592653589793
                </gml:posList>
              </gml:LinearRing>
            </gml:exterior>
            <gml:interior>
              <gml:LinearRing>
                <gml:posList srsDimension='3'>
                  6.7408916 3.141592653589793 6.7408916 3.141592653589793
                </gml:posList>
              </gml:LinearRing>
            </gml:interior>
          </gml:Polygon>
        </deegree:wcts:InputData>
      </deegree:wcts:Transform>
    </soapenv:Body>
  </soapenv:Envelope>
</pre>

Response XML:



```
<?xml version='1.0' encoding='UTF-8'>
<SOAP-ENV:Envelope xmlns:SOAP-ENV='http://schemas.xmlsoap.org/soap/envelope/'>
  <SOAP-ENV:Header/>
  <SOAP-ENV:Body>
    <wcts:OperationResponse xmlns:wcts='http://www.deegree.org/wcts' xmlns:ows='http://www.opengeospatial.org/ows'>
      <ows_1_1_0:ReferenceGroup xmlns:ows_1_1_0='http://www.deegree.org/ows'>
        <ows_1_1_0:Title>A German nonsense geometry</ows_1_1_0:Title>
        <ows_1_1_0:Reference xlink:href='none' xmlns:xsi='http://www.w3.org/2001/XMLSchema-instance'>ows_1_1_0</ows_1_1_0:Reference>
      </ows_1_1_0:ReferenceGroup>
      <d_wcts:InlineData xmlns:d_wcts='http://www.deegree.org/d_wcts'>
        <d_wcts:GeometryData>
          <gml:Point srsName='urn:ogc:def:crs:EPSG::31466'>
            <gml:pos srsDimension='2'>3342327.731125 3.141592653589793</gml:pos>
          </gml:Point>
          <gml:Surface srsName='urn:ogc:def:crs:EPSG::31466'>
            <gml:patches>
              <gml:PolygonPatch>
                <gml:exterior>
                  <gml:LinearRing>
                    <gml:posList srsDimension='3'>
                      3342327.731125 3.141592653589793 3342327.731125 3.141592653589793
                    </gml:posList>
                  </gml:LinearRing>
                </gml:exterior>
                <gml:interior>
                  <gml:LinearRing>
                    <gml:posList srsDimension='3'>
                      3342327.731125 3.141592653589793 3342327.731125 3.141592653589793
                    </gml:posList>
                  </gml:LinearRing>
                </gml:interior>
              </gml:PolygonPatch>
            </gml:patches>
          </gml:Surface>
        </d_wcts:GeometryData>
      </ows_1_1_0:ReferenceGroup>
    </wcts:OperationResponse>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
</pre>

Request Properties:



| Property     | Value               |
|--------------|---------------------|
| Name         | Request with Ele... |
| Description  |                     |
| Message Size | 3011                |
| Encoding     | UTF-8               |



Log:



```
Mon Jun 16 10:57:24 MEST 2008:INFO:initialized soapui-settings from [localdisk/geo5/heimann/soap/soapui-2.0.2/bin/soapui-s
Mon Jun 16 10:57:28 MEST 2008:INFO:Loading workspace from [file:/home/tesg/heimann/default-soapui-workspace.xml]
Mon Jun 16 10:57:28 MEST 2008:INFO:Loaded project from [file:/localdisk/geo5/heimann/wcts/abnahme/soap/D2-WCTS-soapu
Mon Jun 16 10:57:29 MEST 2008:INFO:Loaded project from [file:/localdisk/geo5/heimann/soap/soapui-2.0.2/Geocoder-soapui-p
Mon Jun 16 10:57:29 MEST 2008:INFO:Loaded project from [file:/home/tesg/heimann/Microsoft-soapui-project.xml]
Mon Jun 16 10:58:06 MEST 2008:INFO:Saved project [D2-WCTS] to [localdisk/geo5/heimann/wcts/abnahme/soap/D2-WCTS-so
Mon Jun 16 10:58:20 MEST 2008:INFO:Initializing SSL
Mon Jun 16 10:58:21 MEST 2008:INFO:Got response for [WCTS_SoapBinding.Transform:Request with Elements] in 332ms (244
```


```


```

# Outlook

## ■ Version 2.0

- Additional coordinate systems (EPSG:3068, EPSG:2397-2399, ...)
- Additional In-/Output formats for batch processing (Tab-text, MS Excel using [Apache POI HSSF](#))
- Some GUI optimisations (Ajax Tooltips, ...)
- Preparations to support different transformations (now: only Helmert, 7 params)

now: `<wcts:Transformation>urn:ogc:def:coordinateOperation:EPSG::WWWWW</wcts:Transformation>`

soon: `<wcts:Transformation>urn:ogc:def:coordinateOperation:EPSG::1777</wcts:Transformation>`

Geben Sie dann die zu transformierenden Koordinatenwerte ein und betätigen die Schaltfläche "Prüfen und Koordinaten bestimmen"!

|                                 |                                 |
|---------------------------------|---------------------------------|
| X-Koordinate (Länge/Rechtswert) | Y-Koordinate (Breite/Hochwert)  |
| <input type="text"/>            | <input type="text"/>            |
| Beispiel-Koordinate: 6.7379417  | Beispiel-Koordinate: 51.2418626 |

kleinere Schrift für Beispiel-Koordinaten

Quell-Koordinatensystem

DHDN, Dezimalgrad (EPSG:4314)

GUI optimisations: sample coordinates

## ■ For the future

- Transformation: DE\_DHDN ([BeTA, 2007](#)) to ETRS89 (EPSG:15948) using [jGridShift](#)

# Discussion

- Your questions and remarks!?

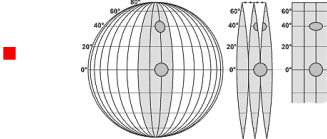
# Contact

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# Picture references



[http://www.aquarius.geomar.de/omc/images/ortho\\_proj.gif](http://www.aquarius.geomar.de/omc/images/ortho_proj.gif)



<http://www.kowoma.de/gps/geo/mercatorkonstruktion.gif>



<http://upload.wikimedia.org/wikipedia/commons/a/a0/Utmzylinderrp.jpg>