ORACLE

Geodaten und XML:
XML in der Oracle-Datenbank

Geodaten und XML

- XML-Standards und Geodaten
  - WMS: getCapabilities, getFeatureInfo
  - WFS
  - KML, GML, GPX, ...
- XML-Verarbeitung daher häufig gefordert
  - XML verarbeiten (Informationsextraktion)
  - XML konstruieren

Eingebaute Funktionen

- PL/SQL-Paket SDO_UTIL ...
  - TO_GMLGEOMETRY
  - TO_GML311GEOMETRY
  - TO_KMLGEOMETRY

  - FROM_GMLGEOMETRY
  - FROM_GML311GEOMETRY
  - FROM_KMLGEOMETRY

KML Geometrie erzeugen ...

Built-In-Function TO_KMLGEOMETRY


```
select sdo_util.to_kmlgeometry(geometry) KML
from geo_staaten
where feature_name='LUXEMBOURG'

KML
--------------------------------------------------------------------
<Polygon><extrude>0</extrude><tessellate>0</tessellate><altitudeMo
de>relativeToGround</altitudeMode><outerBoundaryIs><LinearRing><co
ordinates>5.74006284,49.862178 5.77917684,49.84760601 5.78176092,4
9.83479298 5.77622484,49.82968197 5.75738316,49.83354297 5.7602019
6,49.81635801 5.75054784,49.81374504 5.759748,49.80879 5.75207496,
:
:
49.980375 5.84045712,49.968207 5.83958988,49.95673596 5.81707116,
49.94938701 5.81195484,49.93768701 5.78109816,49.93548003 5.764208
04,49.88585898 5.74006284,49.862178</coordinates></LinearRing></o
uterBoundaryIs></Polygon>
```

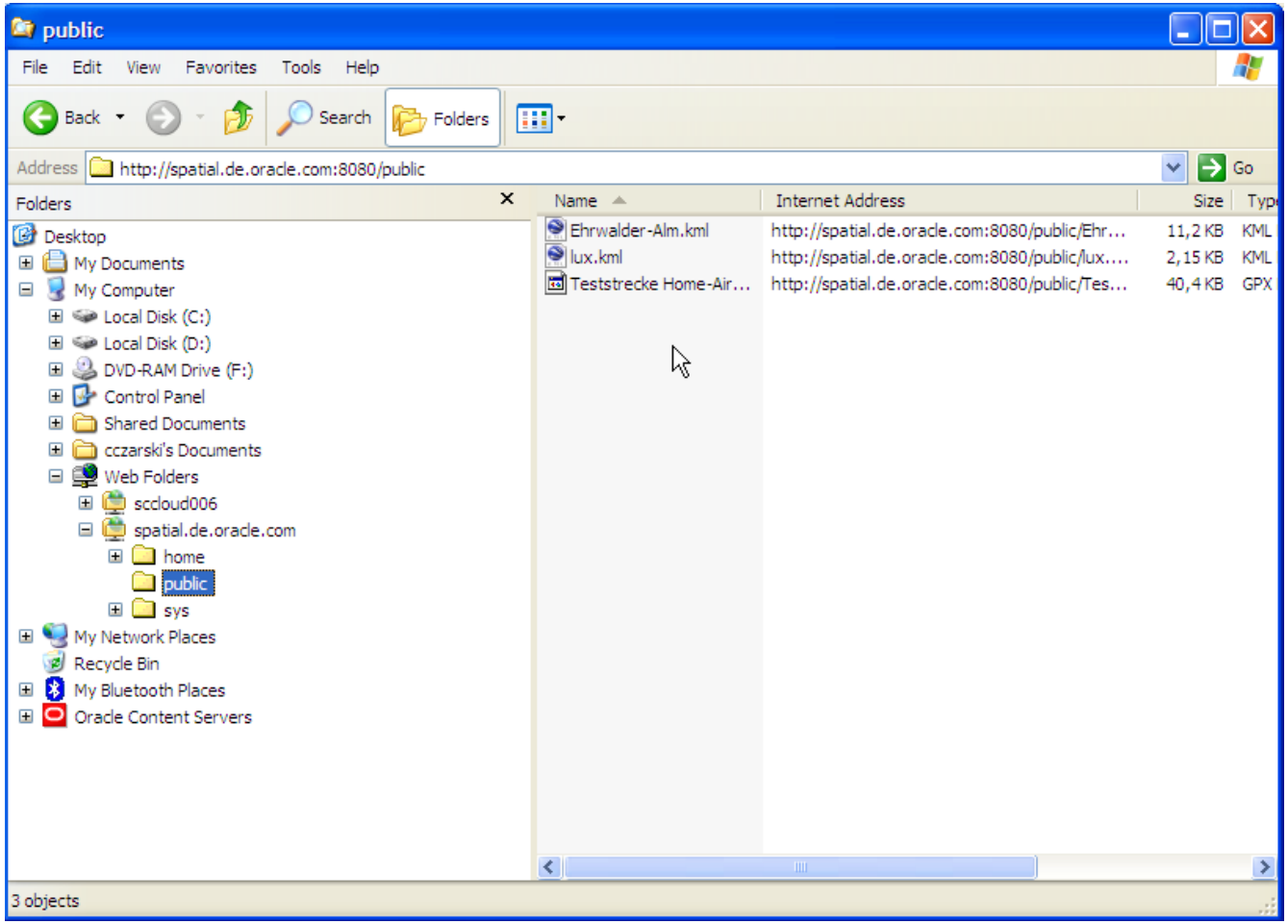
KML-Datei per HTTP verfügbar machen

... mit dem *XML DB Repository*

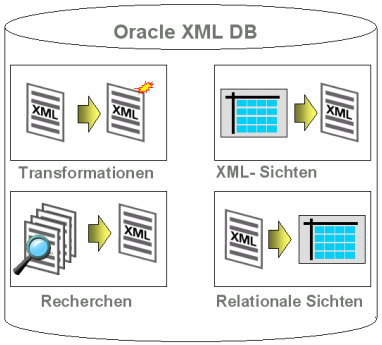
```
declare
  v_create   boolean;
  v_kml      clob;
begin
  select sdo_util.to_kmlgeometry(geometry) into v_kml
  from geo_staaten
  where feature_name='LUXEMBOURG';

  v_create := dbms_xdb.createresource(
   abspath => '/public/lux.kml',
   data  =>   v_kml
  );
end;
/
```

Zugriff mit WebDAV ...

Alternativ FTP oder HTTP möglich.

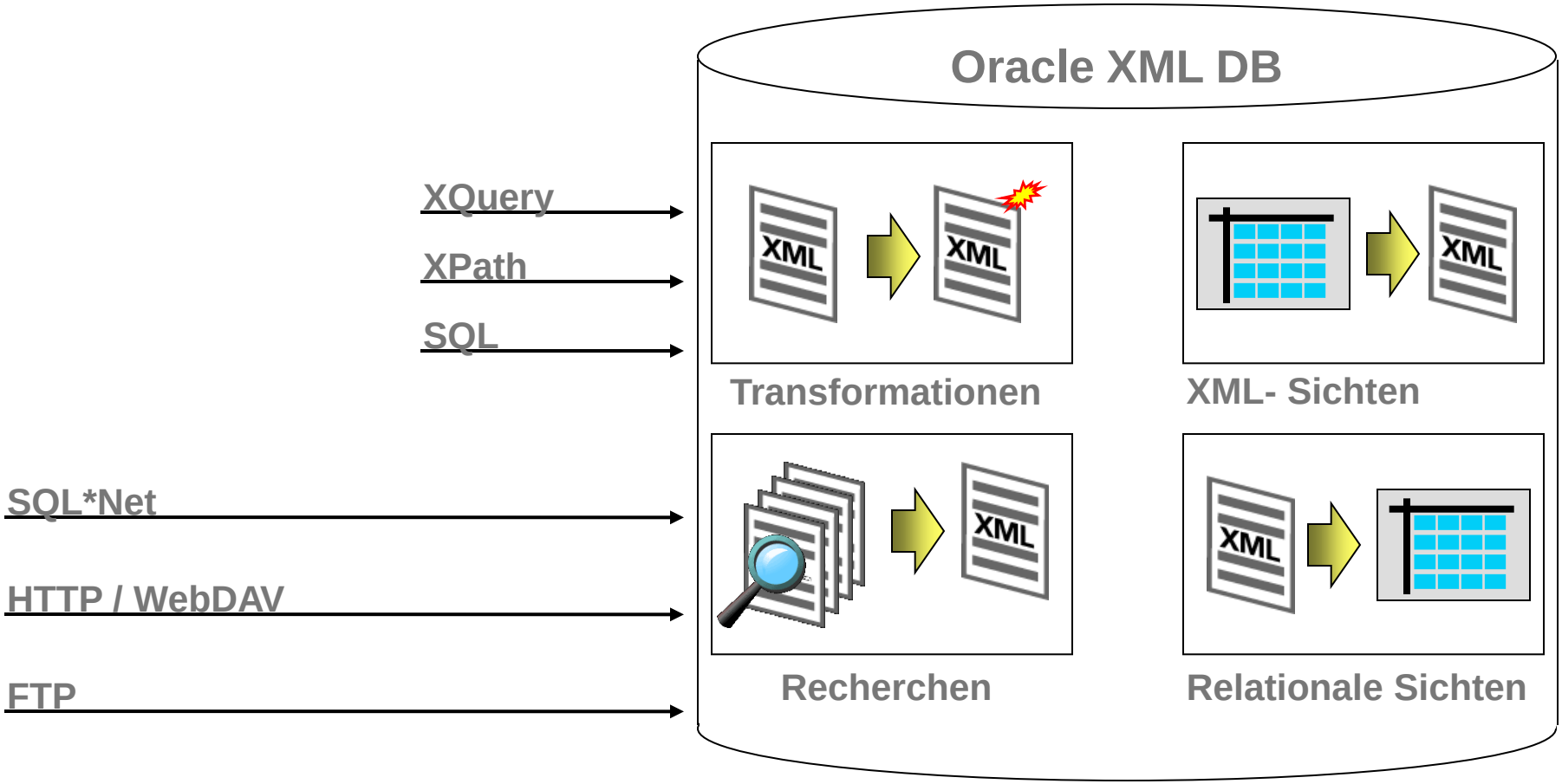


Grundlage: Oracle XML DB
Kurzprofil



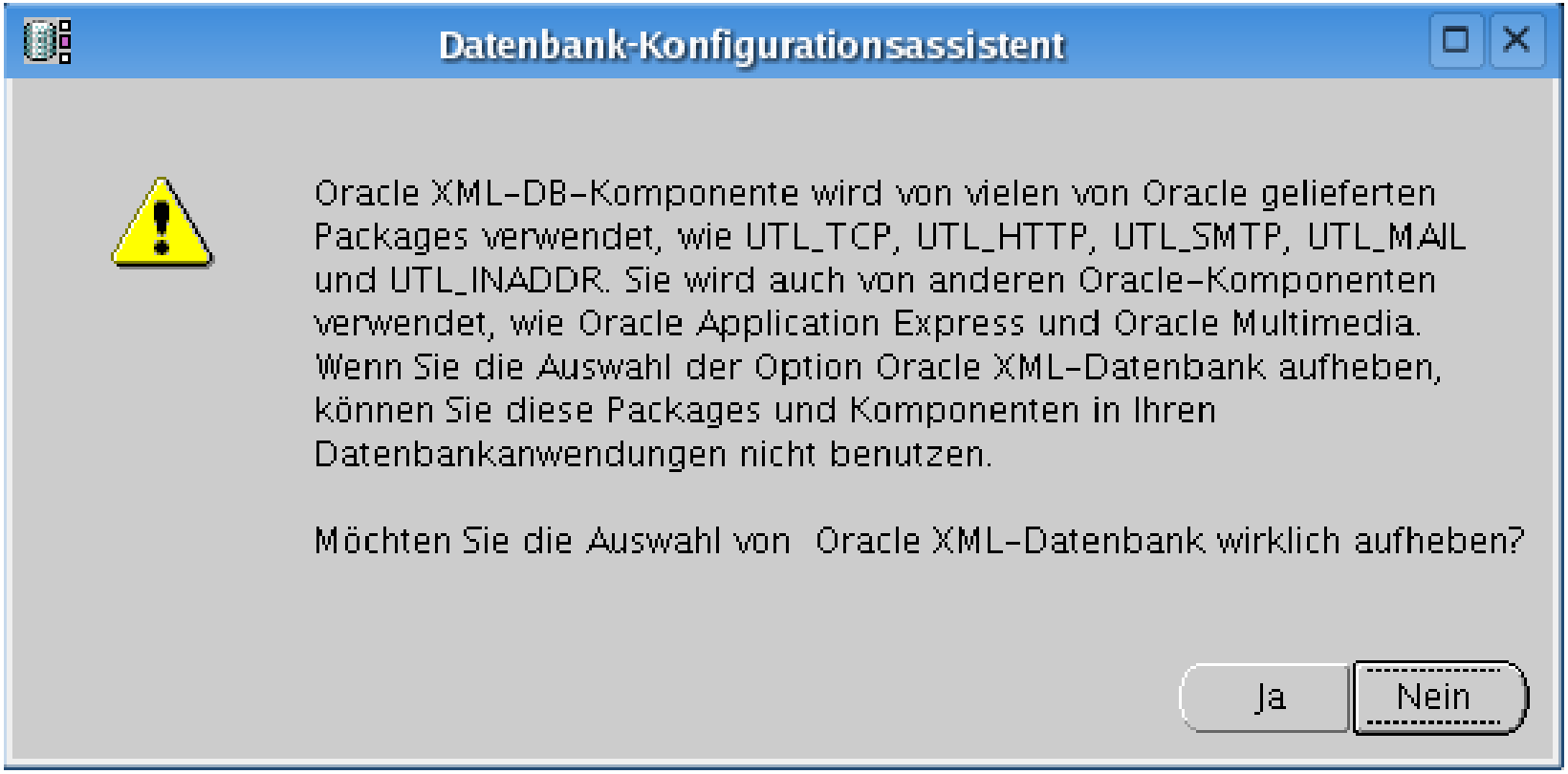
- XML und SQL in einer Datenbank
- Standardkonform (W3C, SQL:2003...)
  - XML/SQL
  - XQuery
  - XML Schema, DOM
- Verfügbar ab Oracle 9*i* Release 2
- Alle Datenbankeditionen
- Keine zusätzliche Installation erforderlich

Oracle XML DB



XML DB in Oracle11*g*

PL/SQL ACLs via XML DB



XML DB Installation

- Überprüfen ob Funktionalität installiert ist mit **`dba_registry`**
- Falls Funktionalität nicht installiert
  1. XML DB Repository installieren mit
     `$ORACLE_HOME/rdbms/admin/catqm.sql`
  2. HTTP- und FTP -Listener aktivieren
     `$ORACLE_HOME/rdbms/admin/catxdbdbca.sql`

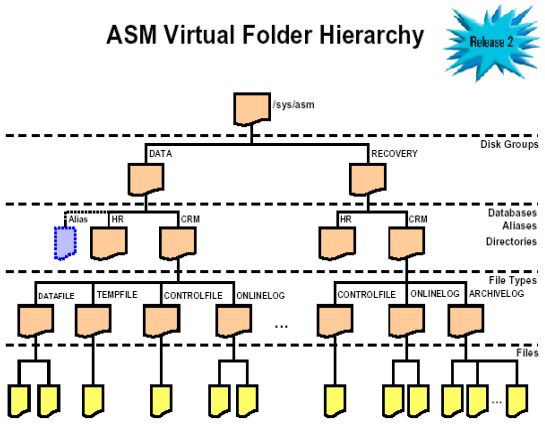
XML DB Protokollserver
Kontrolle

```
$ lsnrctl status

LSNRCTL for Linux: Version 11.1.0.6.0 - Production on 22-FEB-2008 16:14:08

Copyright (c) 1991, 2007, Oracle.  All rights reserved.

Connecting to (DESCRIPTION=(ADDRESS=(PROTOCOL=IPC)(KEY=EXTPROC1522)))
STATUS of the LISTENER
------------------------
Alias                     LISTENER
Version                   TNSLSNR for Linux: Version 11.1.0.6.0 - Production
Start Date                15-FEB-2008 11:56:54
Uptime                    7 days 4 hr. 17 min. 14 sec
Trace Level               off
Security                  ON: Local OS Authentication
SNMP                      OFF
Listener Parameter File   /space/orabase/11gR1/network/admin/listener.ora
Listener Log File         /space/orabase/diag/tnslsnr/stuamdmuc3/listener/alert/log.xml
Listening Endpoints Summary...
  (DESCRIPTION=(ADDRESS=(PROTOCOL=ipc)(KEY=EXTPROC1522)))
  (DESCRIPTION=(ADDRESS=(PROTOCOL=tcp)(HOST=stuamdmuc3)(PORT=1522)))

  (DESCRIPTION=(ADDRESS=(PROTOCOL=tcp)(HOST=stuamdmuc3)(PORT=1111))(Presentation=FTP)(Sessio
  n=RAW))

  (DESCRIPTION=(ADDRESS=(PROTOCOL=tcp)(HOST=stuamdmuc3)(PORT=2222))(Presentation=HTTP)(Sessi
  on=RAW))
Services Summary...
Service "ora11gR1" has 1 instance(s).....
```

XML DB in der Oracle DB

Dateien und Ordner im XML DB Repository

- File/Folder-Sicht auf eine Repository-Tabelle
- PL/SQL-Zugriff via DBMS_XDB
- Basis für FTP und WebDAV
  - Zugriffskontrolle mit ACL
  - Versionierung
  - Links
  - Metadatenverwaltung



Datentyp XMLTYPE

- Verwendbar wie jeder andere Datentyp
  - als Tabellenspalte
  - in PL/SQL Logik
- XML-Know How in der Datenbank
  - EXTRACT, EXTRACTVALUE
  - XSLTRANSFORM
  - UPDATEXML
  - APPENDCHILDXML
  - SCHEMAVALIDATE
  - ...

Zugriff mit SQL: SQL-Funktionen

- EXTRACT, EXTRACTVALUE
- EXISTSNODE

```
select
 extractvalue
  (value(po), '/PurchaseOrder/Reference') reference
,extractvalue
  (value(po), '/PurchaseOrder/User') as username
,extractvalue
  (value(po), '/PurchaseOrder/CostCenter') as cc
from PURCHASEORDER_TAB po
```

Zugriff mit SQL

Umgang mit XML-Hierarchien

- SQL-Funktionen XMLSEQUENCE, XMLTABLE
- Auch mehrere Hierarchieebenen möglich

```
select
  extractvalue
    (value(po), '/PurchaseOrder/Reference') reference
 ,extractvalue
    (value(po), '/PurchaseOrder/User') as username
 ,count(value(li)) as lineitems
from
  PURCHASEORDER_TAB po,
  table(xmlsequence(extract
    (value(po),'/PurchaseOrder/LineItems/LineItem')
  )) li
where existsnode
 (value(po),'/PurchaseOrder/[CostCenter="A10"]')=1
```

Beispiel: WMS getCapabilities-Request

Verarbeitung mit der XML DB

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<!DOCTYPE WMT_MS_Capabilities (View Source for full doctype...)>
<!--  end of DOCTYPE declaration  -->
- <WMT_MS_Capabilities version="1.1.1">
  <!--  MapServer version 5.2.0 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=WBMP OUTPUT=SVG SUPPORTS=PROJ SUPPORTS=AGG SUPPORTS=FREETYPE SUPPORTS=ICONV SUPPORTS=WMS
  SUPPORTS=WFS_SERVER SUPPORTS=WFS_CLIENT SUPPORTS=WCS_SERVER SUPPORTS=GEOS INPUT=TIFF INPUT=EPPL7 INPUT=POSTGIS INPUT=OGR INPUT=GDAL INPUT=SHAPEFILE  -->
  - <Service>
      <Name>OGC:WMS</Name>
      <Title>OSM_Basic</Title>
      <Abstract>Open Street Map</Abstract>
    - <KeywordList>
        <Keyword>osm basic</Keyword>
        <Keyword>WhereGroup</Keyword>
        <Keyword>OpenStreetMap</Keyword>
      </KeywordList>
      <OnlineResource xmlns:xlink="http://www.w3.org/1999/xlink" xlink:href="http://osm.wheregroup.com/cgi-bin/osm_basic.xml?SERVICE=WMS&" xlink:type="simple" />
    - <ContactInformation>
      - <ContactPersonPrimary>
          <ContactPerson>Olaf Knopp</ContactPerson>
          <ContactOrganization>Wheregroup GmbH & Co.KG</ContactOrganization>
        </ContactPersonPrimary>
        <ContactPosition>Development</ContactPosition>
      - <ContactAddress>
          <AddressType>postal</AddressType>
          <Address>Siemensstrasse 8</Address>
          <City>Bonn</City>
          <StateOrProvince>NRW</StateOrProvince>
          <PostCode>53121</PostCode>
          <Country>Germany</Country>
        </ContactAddress>
        <ContactVoiceTelephone />
        <ContactFacsimileTelephone>0049-2289090380</ContactFacsimileTelephone>
        <ContactElectronicMailAddress>info@wheregroup.com</ContactElectronicMailAddress>
```

WMS Capabilities auswerten ...

1. Dokument abrufen

```
select httpuritype(
  'http://osm.wheregroup.com/cgibin/osm_basic.xml?REQUEST=GetCapabilities
   &SERVICE=WMS&VERSION=1.1.1'
).getxml() from dual;

HTTPURITYPE('HTTP://OSM.WHEREGROUP.COM/CGI-BIN/OSM_BASIC
--------------------------------------------------------
<?xml version="1.0" encoding="CP850" standalone='no'?>
<!DOCTYPE WMT_MS_Capabilities[
<!ELEMENT VendorSpecificCapabilities EMPTY>]>
<!-- end of DOCTYPE declaration -->
<WMT_MS_Capabilities version="1.1.1">
  <!-- MapServer version 5.2.0 OUTPUT=GIF OUTPUT=PNG OUT
  :
```

WMS Capabilities auswerten ...

2. Dokument verarbeiten

```
with wms as (
 select httpuritype(
  'http://osm.wheregroup.com/cgi-bin/osm_basic.xml?REQUEST=GetCapabilitie
   s&SERVICE=WMS&VERSION=1.1.1'
 ).getxml() xml
 from dual
)
select
  layer_name, layer_srs
from wms, xmltable(
  'for $i in /WMT_MS_Capabilities/Capability/Layer
    for $j in $i/SRS
   return <layer><name>{$i/Name/text()}</name>
          <srs>{$j/text()}</srs></layer>'
   passing xml
  columns
    layer_name varchar2(40) path '/layer/name/text()',
    layer_srs varchar2(40)  path '/layer/srs/text()'
)
```

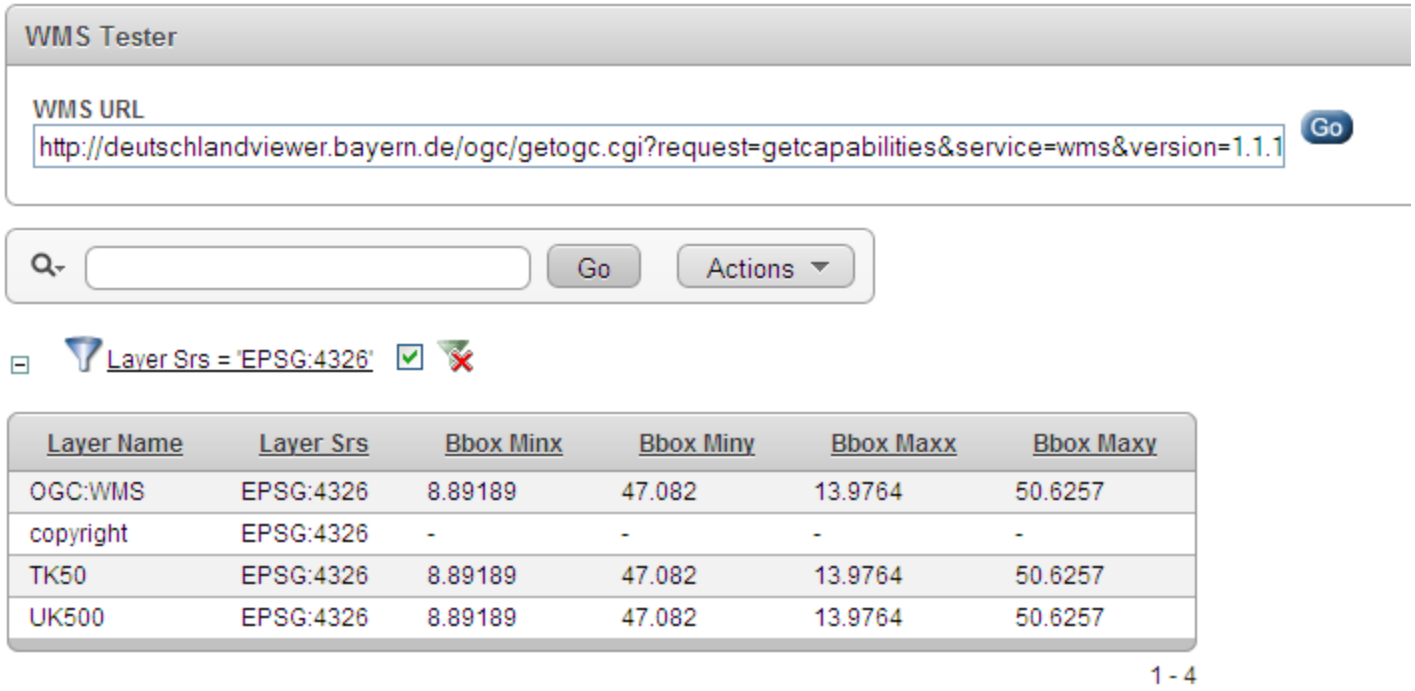
WMS Capabilities auswerten ...

3. Ergebniss ansehen

LAYER_NAME	LAYER_SRS
OSM_Basic	EPSG:31467
OSM_Basic	EPSG:31466
OSM_Basic	EPSG:31468
OSM_Basic	EPSG:31469
OSM_Basic	EPSG:31492
OSM_Basic	EPSG:31493
OSM_Basic	EPSG:31494
OSM_Basic	EPSG:31495
OSM_Basic	EPSG:31462
OSM_Basic	EPSG:31463
OSM_Basic	EPSG:31464
OSM_Basic	EPSG:31465
OSM_Basic	EPSG:4326
OSM_Basic	EPSG:25832
OSM_Basic	EPSG:25833
OSM_Basic	EPSG:31257

... mehr dazu in Kürze auf oracle-spatial.blogspot.com!

Aufbereitet in APEX ...



Beispiel: GPX-Dateien verarbeiten

- GPS-Punkte im XML-Format ...

```
<gpx xmlns="http://www.topografix.com/GPX/1/1" tc2=" ...
   <trk>
       <name>2010-11-16T03:46:55Z</name>
       <trkseg>
           <trkpt lat="51.4799802" lon="7.9678522">
               <ele>270.7484131</ele>
               <time>2010-11-16T03:46:55Z</time>
           </trkpt>
           <trkpt lat="51.4799436" lon="7.9678679">
               <ele>264.0192871</ele>
               <time>2010-11-16T03:47:06Z</time>
           </trkpt>
           <trkpt lat="51.4797696" lon="7.9681059">
               <ele>264.4998779</ele>
               <time>2010-11-16T03:47:12Z</time>
           </trkpt>
           <trkpt lat="51.4797497" lon="7.9681919">
               <ele>264.9805908</ele>
               <time>2010-11-16T03:47:14Z</time>
           </trkpt>
```

Beispiel II: GPX-Dateien verarbeiten

- Zugriff auf Einzelpunkte mit SQL
  - Danach einfaches Umwandeln in SDO_GEOMETRY

```
select
  extractvalue(value(tp), '/trkpt/@lon', c_gpxns) x,
  extractvalue(value(tp), '/trkpt/@lat', c_gpxns) y,
  extractvalue(value(tp), '/trkpt/time', c_gpxns) m
from
  table(xmlsequence(extract(
    gpx_as_xml,
    '//trkpt',
    'xmlns="http://www.topografix.com/GPX/1/1"'
  ))) tp
```

http://oracle-spatial.blogspot.com/2010/11/jungst-habe-ich-fur-einen-kollegen.html

XML generieren

SQL/XML Standard (SQL:2003)

- XMLElement()
- XMLForest()
- XMLAgg()
- XMLComme
- XMLCDATA(
- XMLPI()
- XMLRo
- XML Serialize()

XML sollte *immer* so generiert werden ...

Alte PL/SQL-Pakete wie DBMS_XMLGEN oder DBMS_XMLQUERY, Funktionen wie SYS_XMLGEN oder gar "Stringverkettung" in PL/SQL sind *keine* empfehlenswerten Methoden.

Eingangsbeispiel: KML ...

- *Problem:*
  KML wird in Google Earth nicht angezeigt ...

```
select sdo_util.to_kmlgeometry(geometry) KML
from geo_staaten
where feature_name='LUXEMBOURG'

KML
--------------------------------------------------------------------
<Polygon><extrude>0</extrude><tessellate>0</tessellate><altitudeMo
de>relativeToGround</altitudeMode><outerBoundaryIs><LinearRing><co
ordinates>5.74006284,49.862178 5.77917684,49.84760601 5.78176092,4
9.83479298 5.77622484,49.82968197 5.75738316,49.83354297 5.7602019
:
:
49.94938701 5.81195484,49.93768701 5.78109816,49.93548003 5.764208
04,49.88585898 5.74006284,49.862178</coordinates></LinearRing></o
uterBoundaryIs></Polygon>
```

KML, KML und KML ...

- Da fehlt doch was ...

```
<kml xmlns="http://www.opengis.net/kml/2.2">
 <Document>
  <Placemark>
   <name>CDATA example</name>
   <description> ...</description>
<Polygon><extrude>0</extrude><tessellate>0</tessellate><altitudeMo
de>relativeToGround</altitudeMode><outerBoundaryIs><LinearRing><co
ordinates>5.74006284,49.862178 5.77917684,49.84760601 5.78176092,4
9.83479298 5.77622484,49.82968197 5.75738316,49.83354297 5.7602019
:
:
49.94938701 5.81195484,49.93768701 5.78109816,49.93548003 5.764208
04,49.88585898 5.74006284,49.862178</coordinates></LinearRing></o
uterBoundaryIs></Polygon>
  </Placemark>
 </Document>
</kml>
```

Ein "richtiges" KML erzeugen ...

- Anwendung der SQL/XML Funktionen ...

```
select
  xmlelement("kml",
   xmlattributes('http://www.opengis.net/kml/2.2' as "xmlns"),
   xmlelement("Document",
    xmlelement("Placemark",
     xmlelement("name", 'Luxembourg'),
     xmlelement("Description", 'Landesgrenze'),
     XMLTYPE(SDO_UTIL.TO_KMLGEOMETRY(GEOMETRY))
    )
   )
  )
from geo_staaten
where feature_name = 'LUXEMBOURG';
```

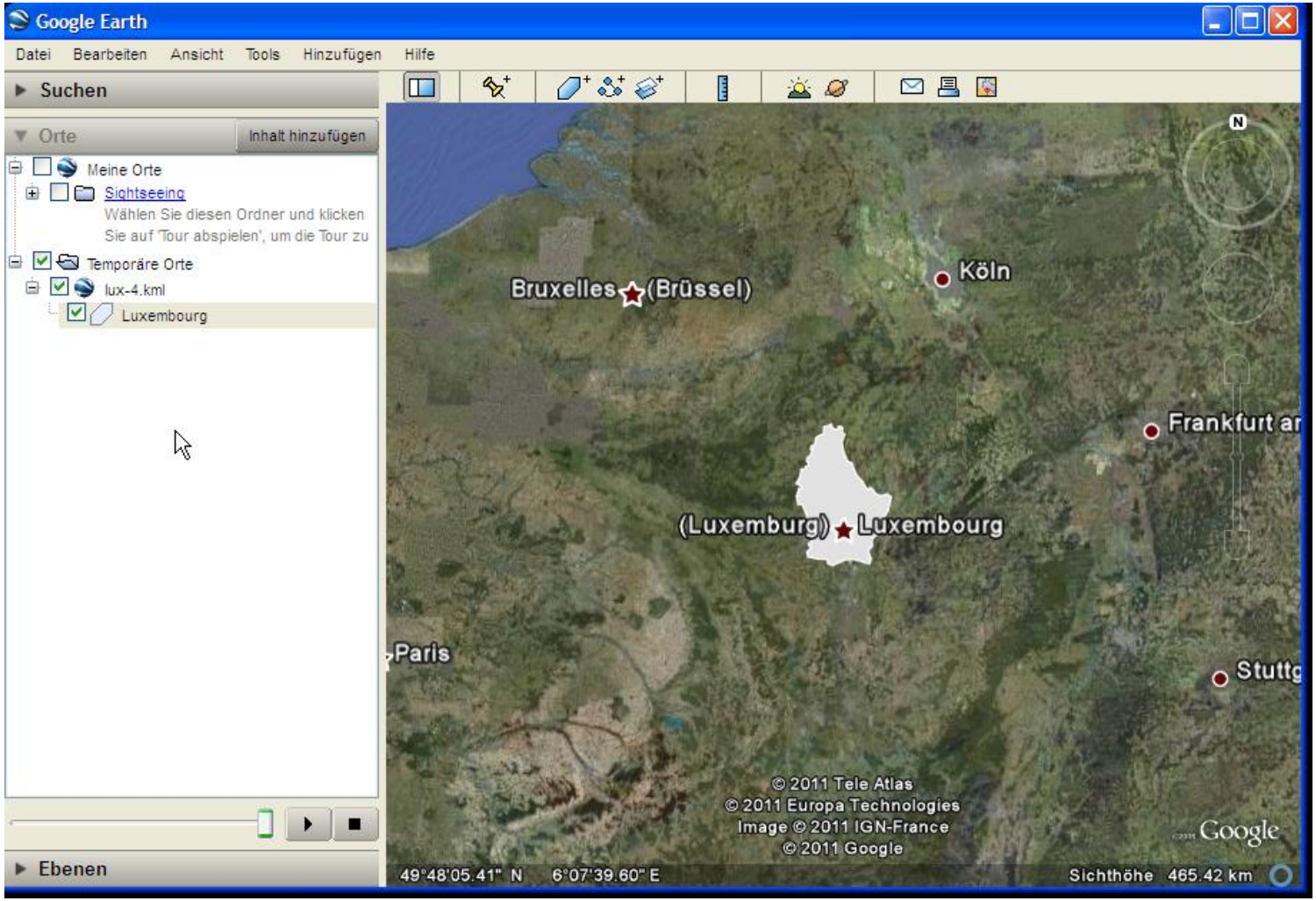
Ein "richtiges" KML erzeugen

Das Ergebnis ... als XML

```
- <kml xmlns="http://www.opengis.net/kml/2.2  ">
  - <Document >
    - <Placemark >
        <name >Luxembourg </name >
        <Description >Landesgrenze </Description >
      - <Polygon >
          <extrude >0</extrude >
          <tessellate >0</tessellate >
          <altitudeMode >relativeToGround </altitudeMode >
        - <outerBoundaryIs >
          - <LinearRing>
              <coordinates >5.74006284,49.862178 5.77917684,49.84760601 5.78176092,49.
                5.759748,49.80879 5.75207496,49.80544902 5.75261712,49.79914101 5.74
                5.82932304,49.69949499 5.82407604,49.67679303 5.84414316,49.673025 5
                5.90255712,49.61116503 5.89926996,49.58347599 5.88950388,49.5796460
                5.84163684,49.53292902 5.86332792,49.53125403 5.85803592,49.5250710
                5.99592384,49.45874103 5.99964804,49.43804004 6.03934812,49.4280500
                6.32881188,49.50547497 6.36260184,49.53255003 6.36318216,49.571865 6
                6.48472212,49.80464496 6.432273,49.79607804 6.39222516,49.80625803 6
                6.19679088,49.97065698 6.16223916,49.97577798 6.12810504,50.028588 6
                6.10613496,50.16332097 6.08328504,50.16390102 6.08712516,50.1521210
                5.96692584,50.16407004 5.959755,50.12143902 5.91802884,50.11284798 5
                5.87133612,50.03679501 5.86036404,50.02004502 5.86127808,50.012145 5
                5.81707116,49.94938701 5.81195484,49.93768701 5.78109816,49.9354800
            </LinearRing>
```

Ein "richtiges" KML erzeugen

Das Ergebnis ... in Google Earth



Ein weiteres Beispiel

GPX-Dateien erzeugen

- Das Zielformat ...

```
<?xml version="1.0" encoding="utf -8" ?>
- <gpx xmlns="http://www.topografix.com/GPX/1/1 " xmlns:tc2 ="http://www.garmin.com/xmls
  xmlns:xsi="http://www.w3.org/2001/XMLSchema -instance "
  xmlns:tp1 ="http://www.garmin.com/xmlschemas/TrackPointExtension/v1 " version ="1.1" c
  xsi:schemaLocation ="http://www.topografix.com/GPX/1/1 http://www.topografix.com/GPX/1
  http://www.garmin.com/xmlschemas/TrackPointExtension/v1 http://www.garmin.com/xmls
  - <trk>
    <name>2010-11-16T03:46:55Z </name>
    - <trkseg >
      - <trkpt lat="51.4799802 " lon="7.9678522 ">
          <ele>270.7484131 </ele>
          <time>2010-11-16T03:46:55Z </time>
        </trkpt >
      + <trkpt lat="51.4799436 " lon="7.9678679 ">
      + <trkpt lat="51.4797696 " lon="7.9681059 ">
      + <trkpt lat="51.4797497 " lon="7.968191 ">
      + <trkpt lat="51.4798410 " lon="7.9683517 ">
      + <trkpt lat="51.4803376 " lon="7.9686642 ">
      + <trkpt lat="51.4804108 " lon="7.9686944 ">
      + <trkpt lat="51.4806803 " lon="7.9686530 ">
      + <trkpt lat="51.4808056 " lon="7.9686819 ">
      + <trkpt lat="51.4808884 " lon="7.9688763 ">
      + <trkpt lat="51.4809137 " lon="7.9690126 ">
      - <trkpt lat="51.4809888 " lon="7.9695931 ">
```

SDO_GEOMETRY nach GPX ...

- SQL-Abfrage ...

```
select
 xmlelement("gpx",
  xmlattributes('http://www.topografix.com/GPX/1/1' as "xmlns"),
  xmlelement("trk",
   xmlelement("name", 'GPX Name'),
   xmlelement("trkseg",
    (
     select
      xmlagg(
       xmlelement("trkpt", xmlattributes(v.y as "lat", v.x as "lon"))
      )
      from table(sdo_util.getvertices(v_geom)) v
    )
   )
  )
 ) into v_gpx
from dual;
```

SDO_GEOMETRY nach GPX

Als PL/SQL-Funktion ...

```
FUNCTION make_gpx RETURNS XMLTYPE
 Argument Name                  Typ                     In/Out
 ------------------------------ ----------------------- ------
 P_NAME                         VARCHAR2                IN
 P_GEOM                         SDO_GEOMETRY            IN
```

- Anwendungsgebiete
  - Linestrings konvertieren und auf GPS-Gerät laden
  - Bereitstellung von Routen
  - Zeitinformationen per LRS ermitteln
  - Auch Höheninformationen denkbar

http://oracle-spatial.blogspot.com/2011/03/sdo-nach-gpx-konvertieren-ein-beispiel.html

Weitere Informationen

- Blogs zum Thema Oracle Spatial und Oracle MAPS
  - http://oracle-spatial.blogspot.com
  - http://oracle-maps.blogspot.com
- Blog zum Thema SQL und PL/SQL
  - http://sql-plsql-de.blogspot.com
- Dokumentation: Oracle XML DB
  - http://www.oracle.com/technetwork/database/features/xmldb/index.html

Fragen & Antworten