ORACLE

May 21, 2014
Walter E. Washington Convention Center
Washington, DC USA

Innovation in Spatial Data Processing

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Product Manager EMEA

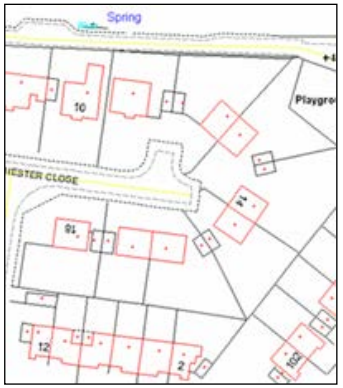
The following is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, and timing of any features or functionality described for Oracle's products remains at the sole discretion of Oracle.

Program Agenda

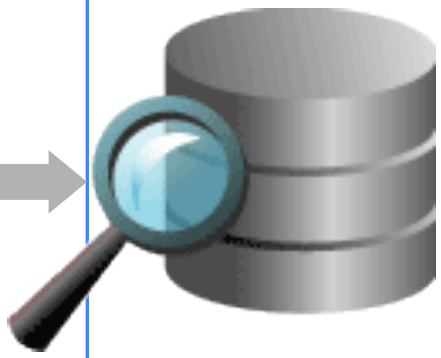
- Introduction
- Spatial Business Processes
- Topology Data Model
- LiDAR Data Management
- 3D Modeling

Introduction

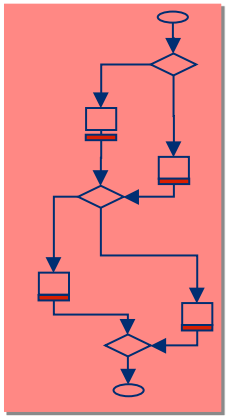
Paper maps



Digital data files



Spatial Information Databases



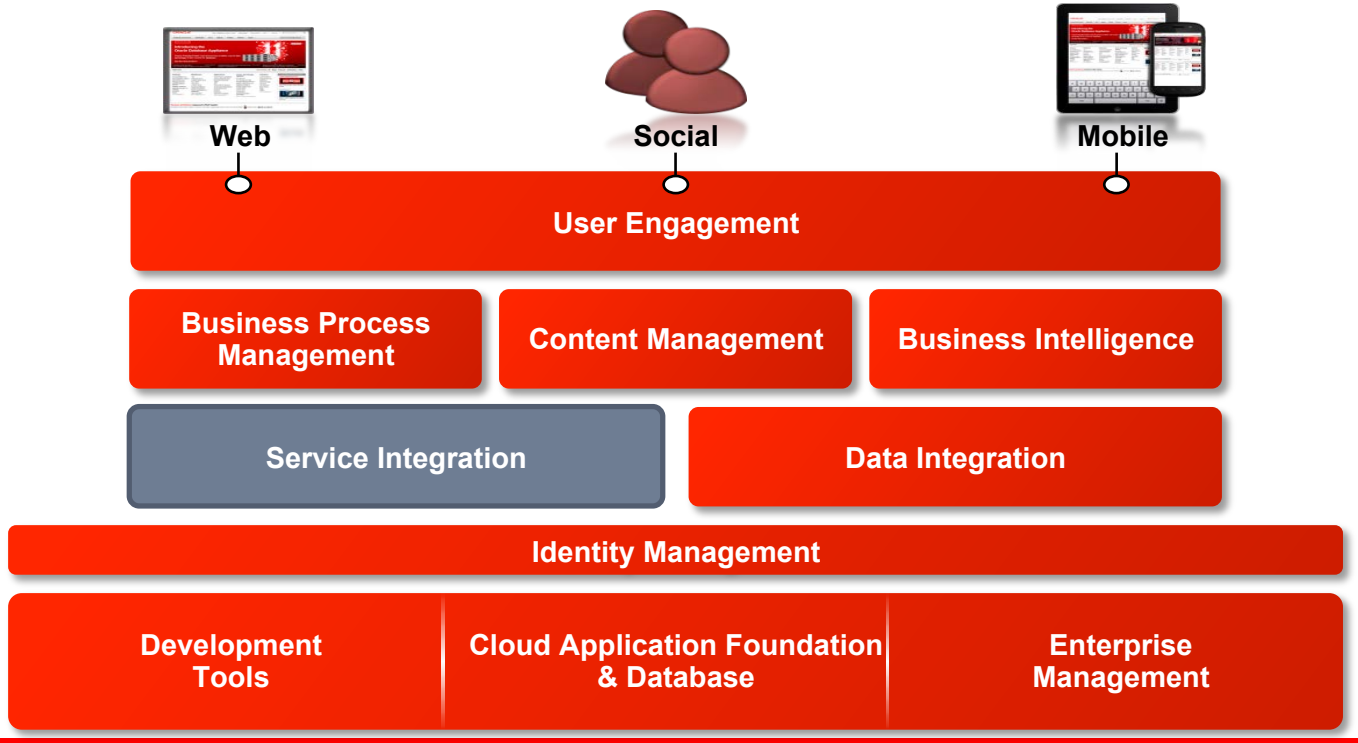
Spatial Business Processes

Spatial Data Integration

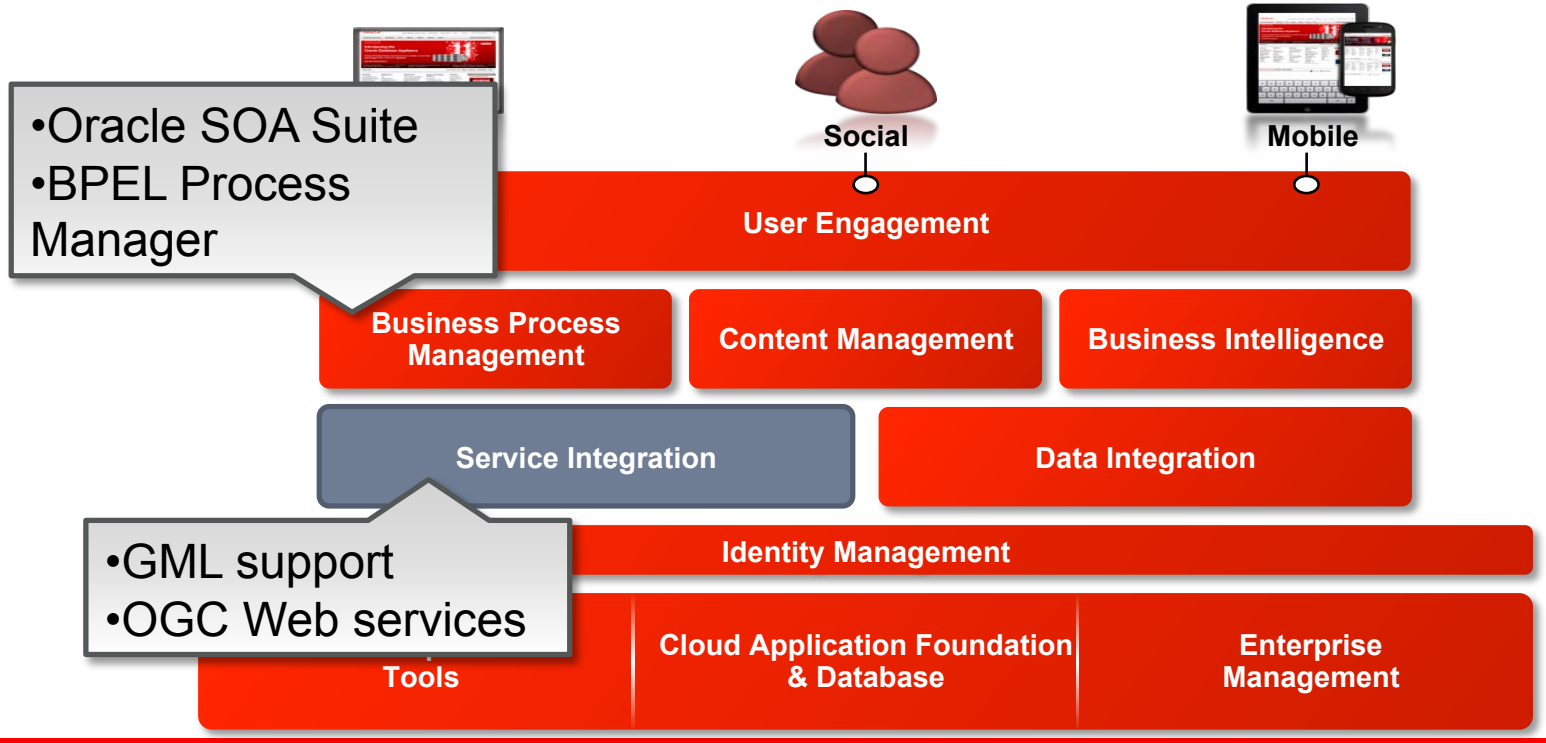
Requirements

- Sharing of spatial data across the enterprise
- Increased automation
- Leveraging investment in SOA technologies
  - Reuse of existing components
  - Compliance with IT standards
- Using open standards to protect investment

Integration Architecture



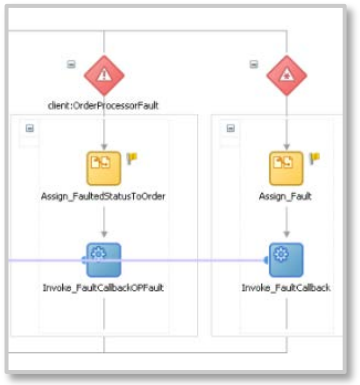
Integration Architecture



Using SOA for geospatial data

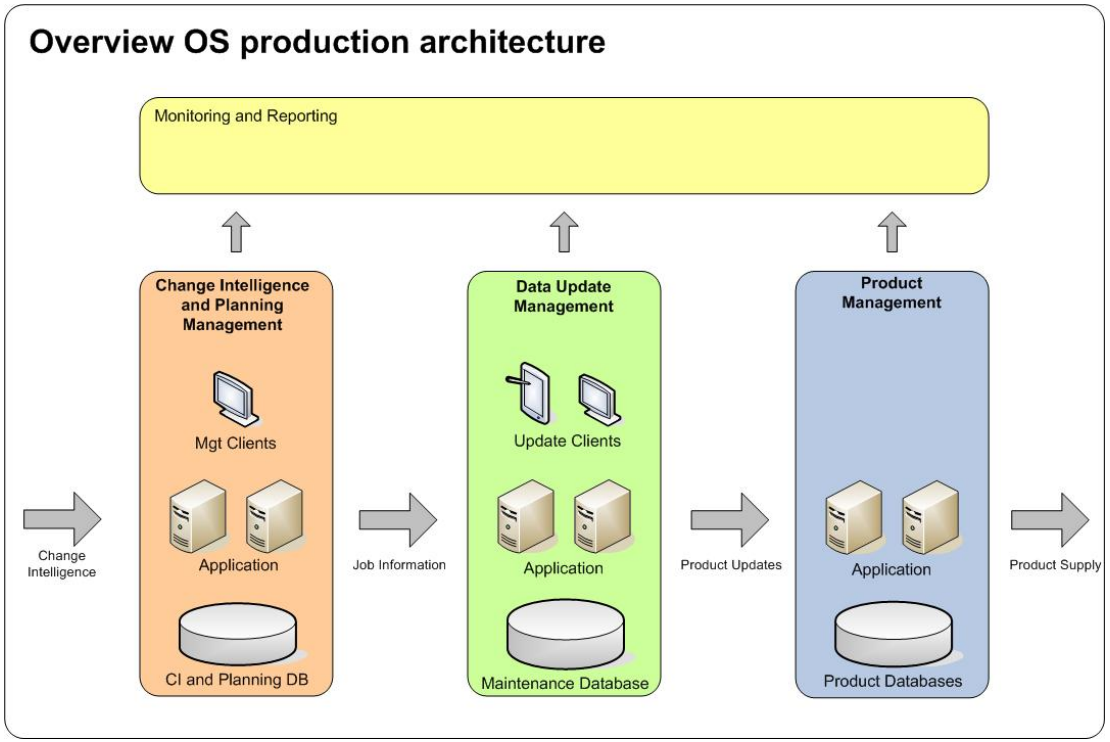
Benefits

- Enabling loose coupling
  - Simplified maintenance, easier upgrade, ...
- Availability of geospatial data in canonical objects
  - Shared across many systems
- Higher level of productivity
  - Reuse of objects, services and (sub-)processes
  - Graphical modeling on open interfaces
- End-to-end visibility into transactions and workflows
- Simplified operations
  - Integrated architecture, including policy-based security



Ordnance Survey (GB) – GDMS

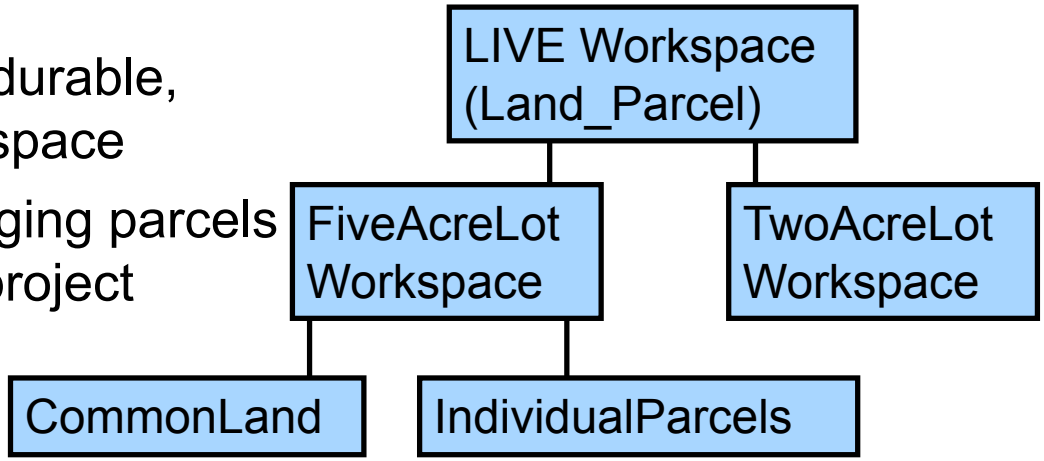
Logical Architecture



Workspace Manager

Support for long transactions

- Enables Web and application-based collaboration on database-backed projects
- Provides shareable workspaces within the database to version data
- Individual transactions are durable, but only visible inside workspace
- Example application: managing parcels in a housing development project



Ordnance Survey (GB) - GDMS

OVERVIEW

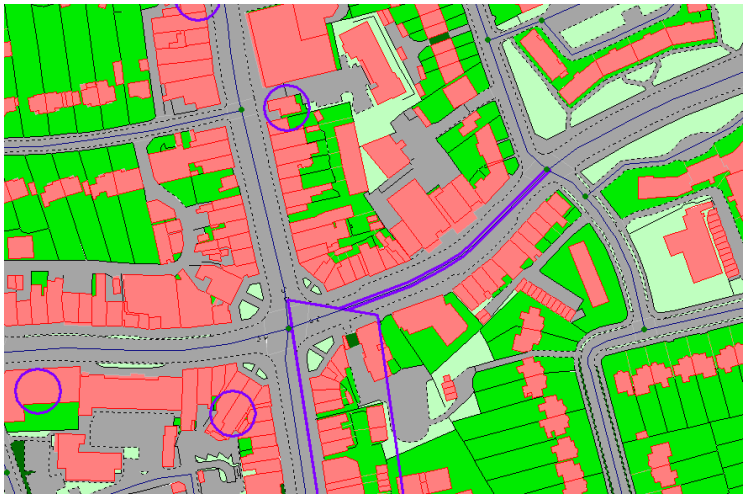
- Centrally managed, authoritative database
- Incorporates 5 corporate national datasets
- Supports national data capture and maintenance
- Contains in excess of 500 million features

CHALLENGES / OPPORTUNITIES

- Need to integrate disparate data sets
- Need to extract 32 million features and submit 313,000 changed features per day
- Need to support multiple users in the same geographic area
- Automated data validation to achieve product ready database

ORACLE SOLUTIONS

- Oracle Spatial Database, Partitioning, RAC, Dataguard
- Oracle Workspace Manager
- Oracle Application Server & Weblogic
- Oracle BPEL & Worklist Application
- Oracle Enterprise Service Bus
- Oracle Identity Management



RESULTS

- Consolidation of raster, vector, network data in 5.3TB sized central repository
- Single source database for product derivation
- Seamless working – removal of tile based restrictions
- Resilient production environment achieving 99.5% availability

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Topology Data Model

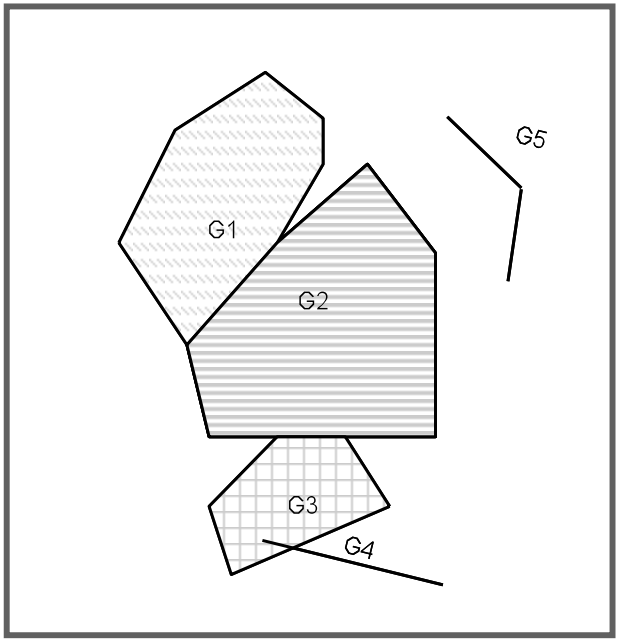
Why use explicit topology?

- Spatial analysis determines relationships between objects
  - Containment, intersection, contact, ...
- This process is expensive:
  - Requires complex geometry calculations
  - Issues with precision, tolerance, ...
- Another approach is to persistently store those relationships
  - Searches can then use those relationships using classical relational queries
- Relationships are based on common reference set
  - Topology primitives: nodes, edges, faces

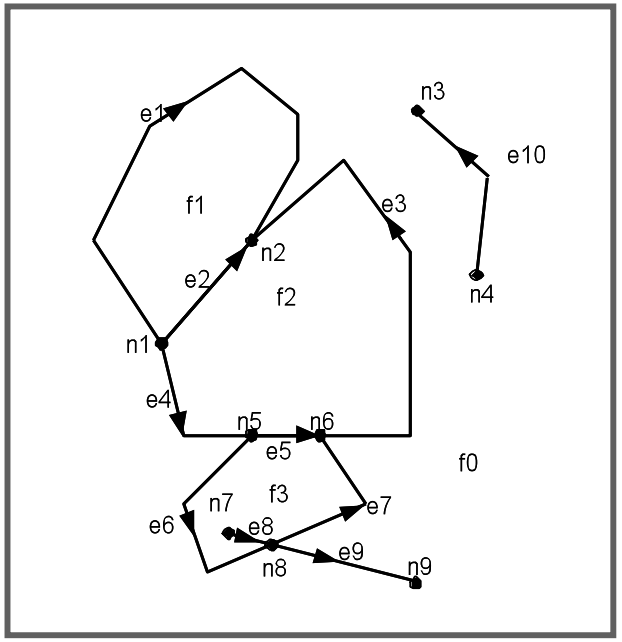
Topology Data Model

Explicit storage of topological relationship

Geometry Storage



Topology Storage



Topology Data Model

Benefits of explicit topology

- No redundant storage of data
  - Shared edges between objects stored only once
  - Features from different tables can share edges, such as roads and land parcels, so hierarchies of features are also supported
- Data consistency
  - No “registration” issues between geometries
  - Moving a boundary between objects is done once
- Topological relationships are quickly and easily determined

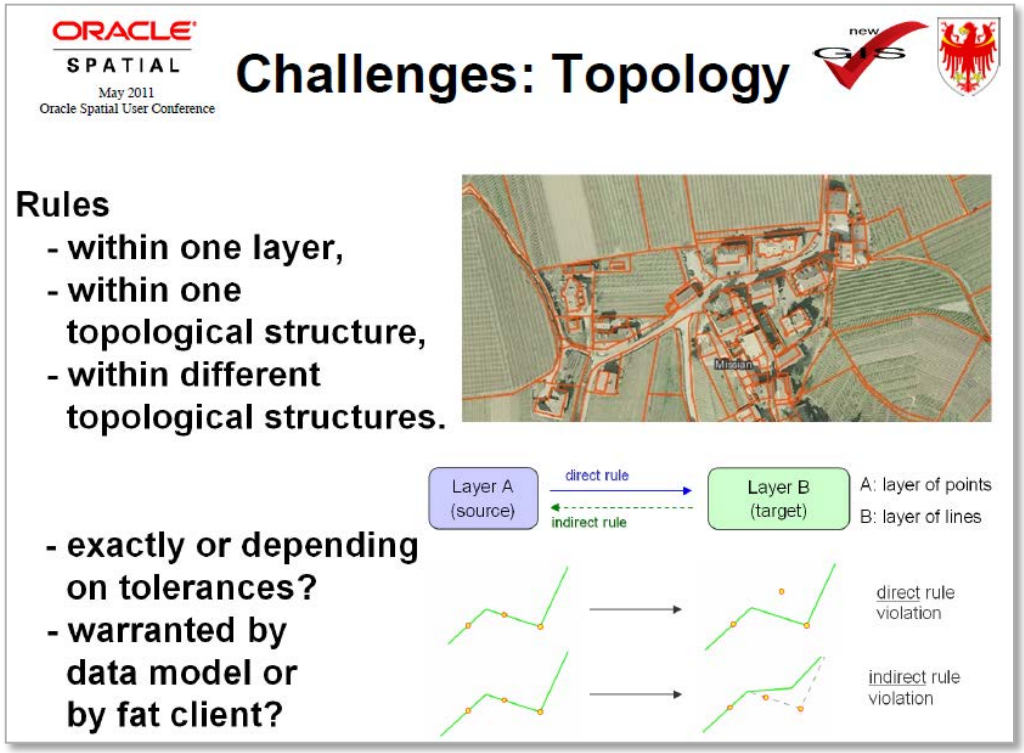
Province of Bolzano, Italy

newGIS

- Objectives
  - Create an open, integrated infrastructure for various applications
    - Based on GML and OGC Web Services
  - Combine spatial data with various attribute data sets
  - Separate application from data management
  - Hosted as a service
  - Support various GIS and CAD clients (commercial and open source)
  - Maintain high-quality data, consistent at any time
  - Enforce data quality on the server side using rules and topology

Province of Bolzano, Italy

newGIS



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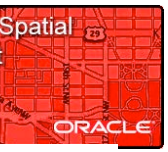
LiDAR Data Management

Why use LiDAR

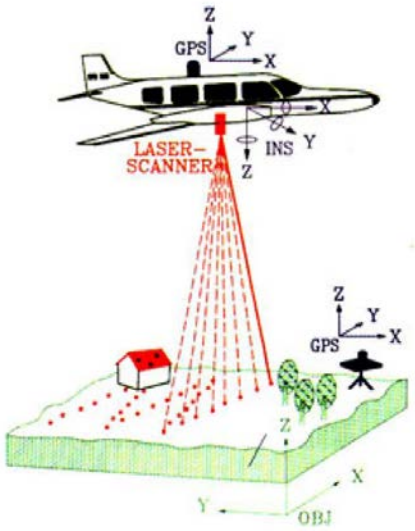
- Fast and efficient way to accurately determine 3D structures using Laser scanning techniques
  - Static terrestrial
  - Mobile terrestrial
  - Aerial
- Sampling rate up to 1,000,000 laser pulses/sec
  - Measuring either multi-returns or full waveform
- Frequently combined with other sensors
  - eg. red, green, blue for colouring

3D data modeling based on LiDAR

Data Processing Workflow



- Raw data collection
  - Massive amounts of data
  - (x,y,z) plus various attributes, up to sampling of full waveform
- Data storage, pre-processing
- Analysis
  - Data extraction, filtering, projection
  - Object recognition
  - Derivation of secondary products (DEM, ...)
- Data dissemination



Why use a database here?

Requires a spatially enabled database

- Data integration with other sources
  - Online availability
  - Geo-referenced imagery, existing 3D structures, attributes,...
- Fast access to arbitrary part of data set
  - For processing or visualization
- General benefits of mature DBMS
  - Information lifecycle management – data administration, tuning
  - Scaleability – multi-processor support, clustering, ...
  - Executing data-intense logic where the data resides

Storing point cloud in SDO_PC datatype

Logical structures

Contains point cloud metadata and footprint

Also contains a pointers to one or more block tables

Physical structures

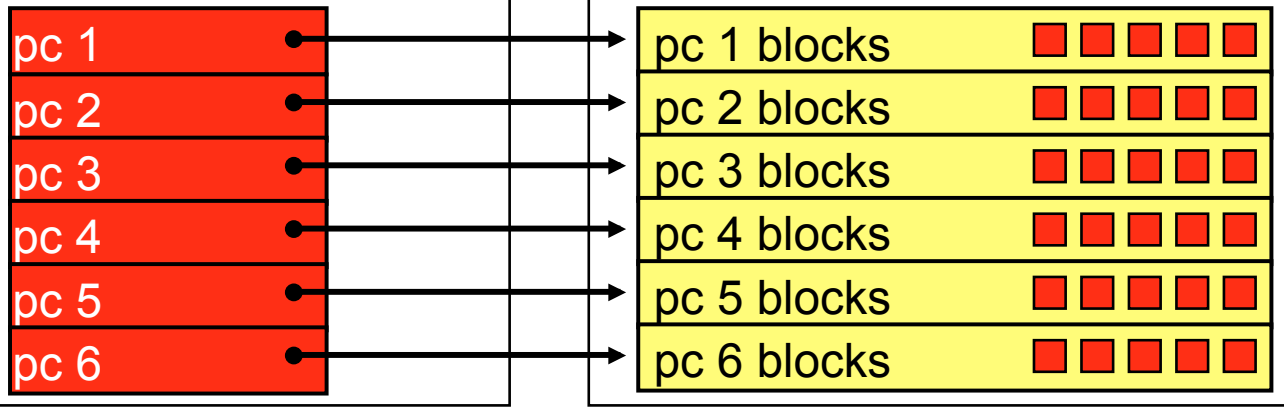
Point cloud block tables

Contain the points

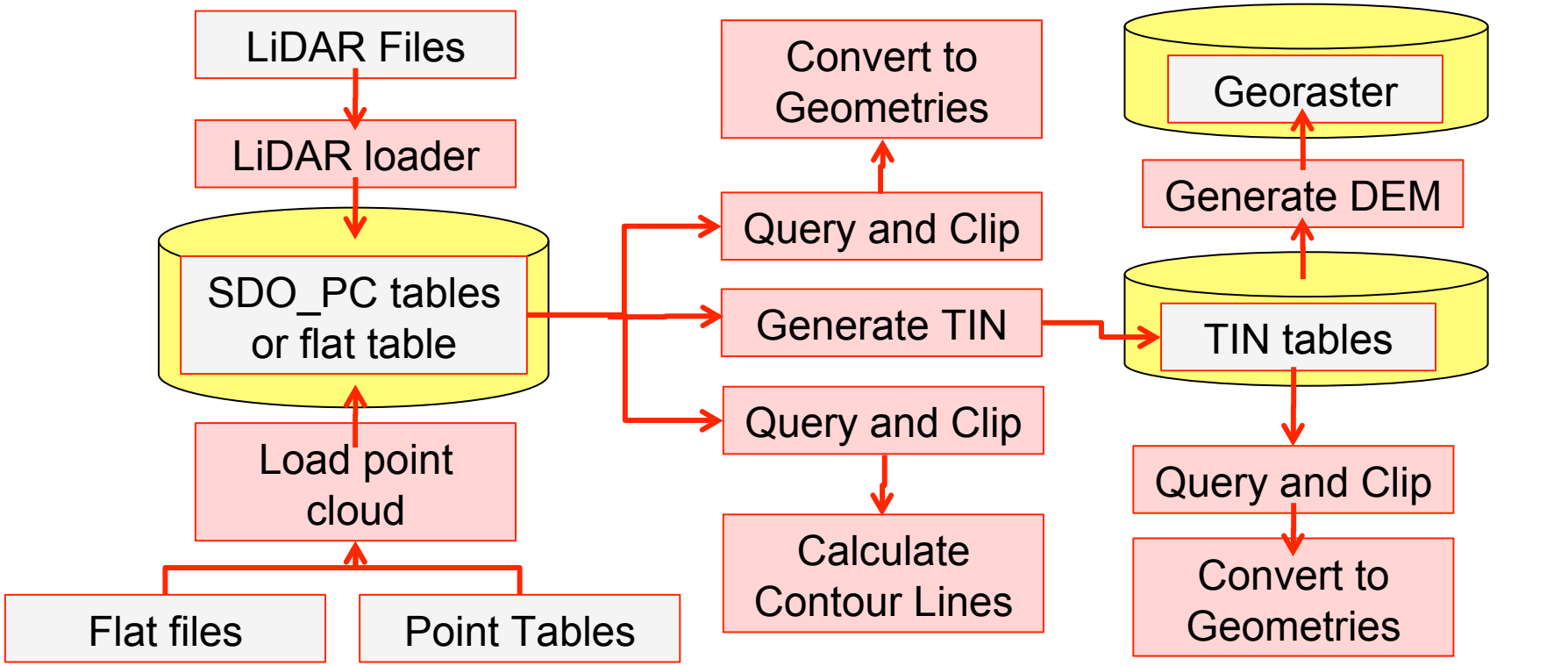
Can be very large

Could be partitioned

Add new tables as necessary



Possible LiDAR data processing flows

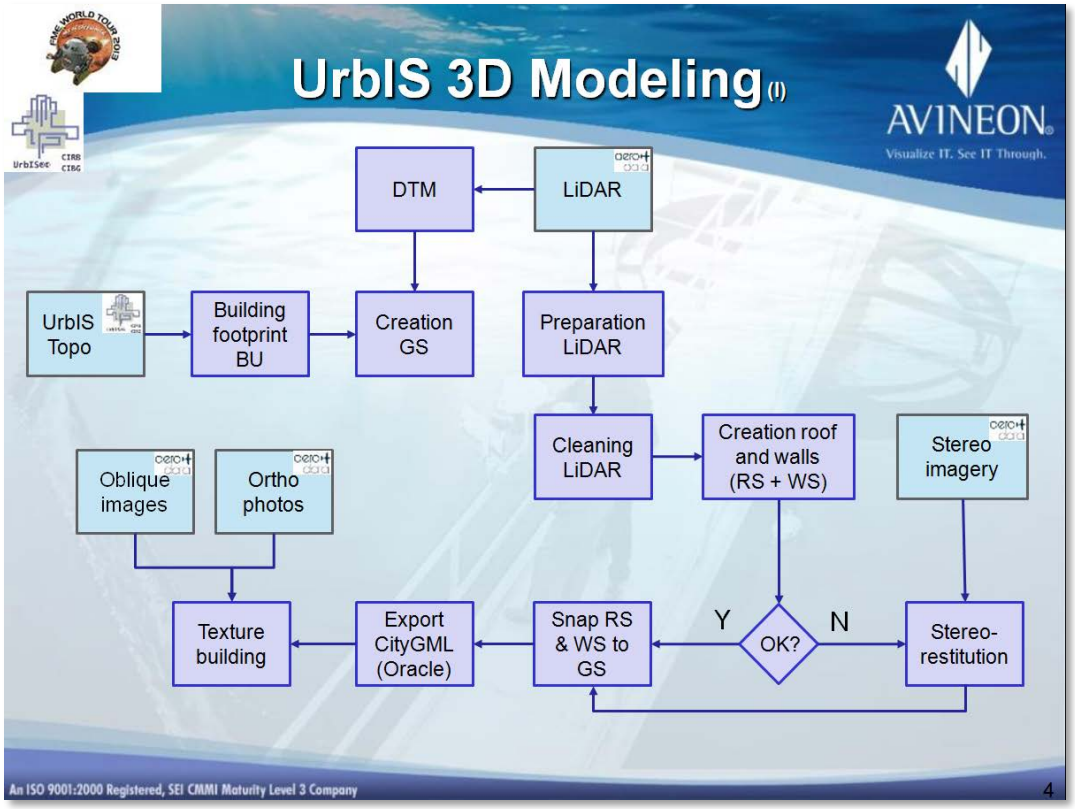


LiDAR Data Processing in Oracle 12c

Benefits

- Ability to rapidly ingest and manage vast amounts of data
- Fast data extraction, based on location or attributes
  - For visualization
  - For further processing
- Executing data logic where the data resides
  - Derivation of secondary products (TINs, DEMs, geometries)
  - Pyramiding
  - Contour generation
  - Object recognition

Capital Region of Brussels – UrbIS 3D



Oracle Spatial Summit 2014

CIRB CIBG

GEOSPATIAL WORLD FORUM

Presentation at Geospatial World Forum 2014, May 5-9

Screenshot courtesy of: Avineon

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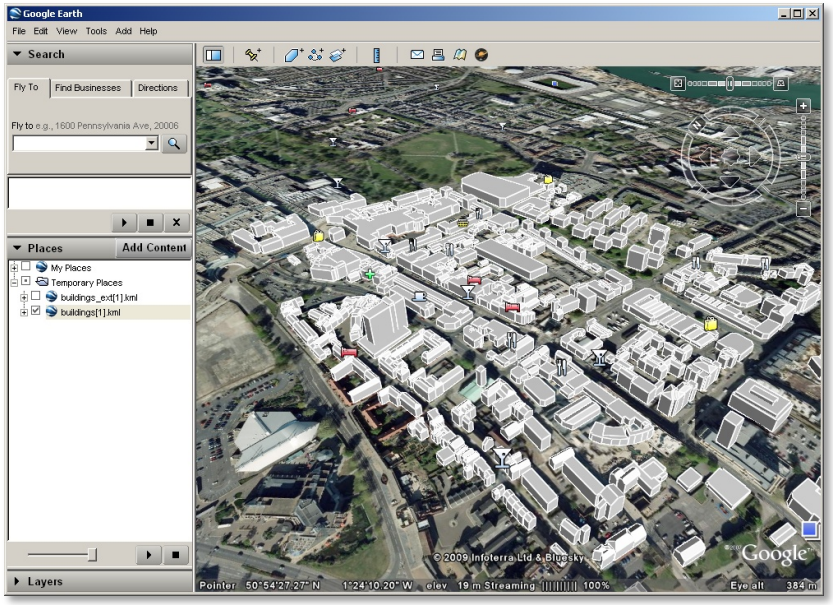
3D Modeling

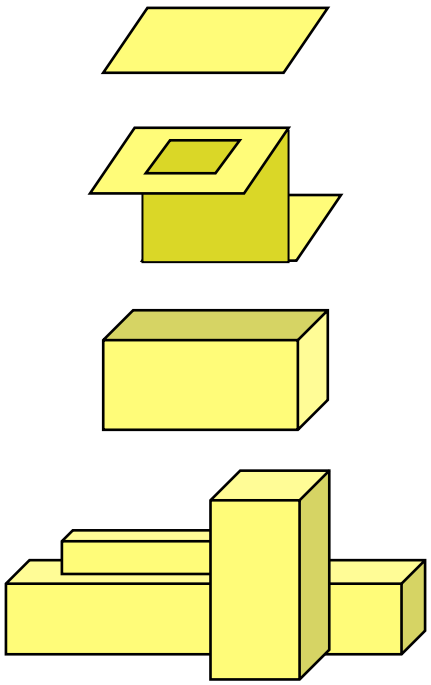
City Modeling – a few use cases ...

- Urban Planning
  - Solar potential
  - Wind Energy
  - Noise Emission
- Public Safety
  - Disaster Management
- Engineering & Construction
  - BIM
  - Asset Management

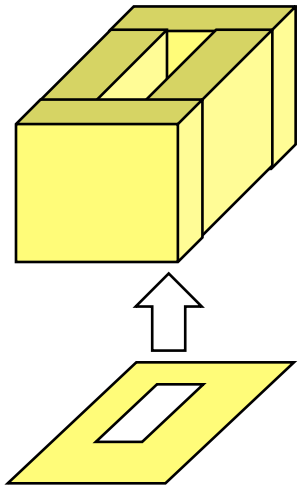


Support for 3D objects

- Simple Surfaces
  - Face = 3D Polygon
- Composite Surface
  - Multiple connected faces
- Simple Solid
  - Closed composite surface
- Composite Solid
  - Multiple connected simple solids

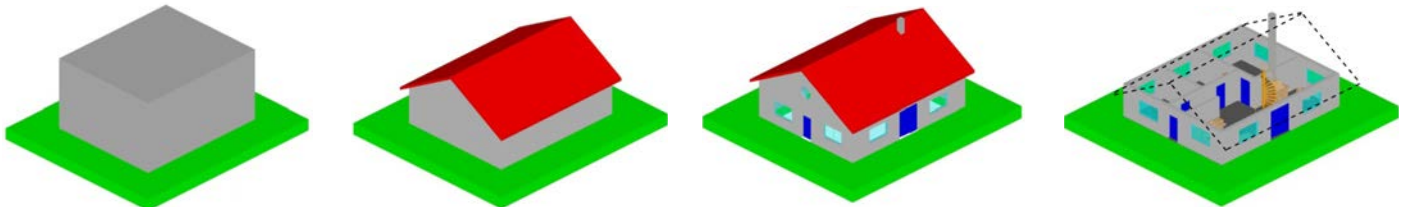


- Extrusion
  - Generating solids from 2D polygons



Data models for City Modeling

3DCityDB (open source) is widely used



LOD1 Building LOD2 Building LOD3 Building LOD4 Building

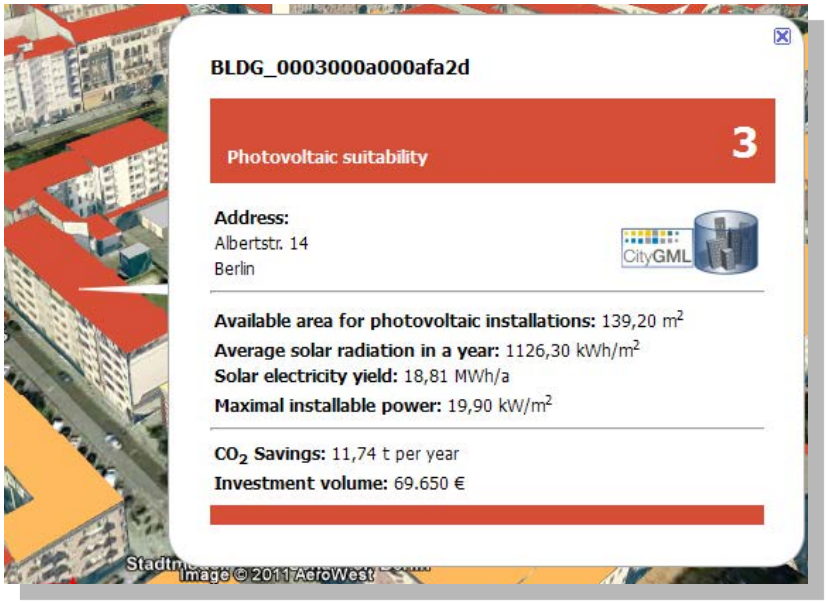
- Semantically structured model
- Structures at multiple levels of detail
- Textures and facades
- Orthophotos
- Versioning

Source: Research Center Karlsruhe

City of Berlin – 3D City Model

Implemented by TU Berlin

- 550000 buildings, reconstructed from 2D cadastre and LIDAR data
- Textures extracted from oblique aerial photography
- Stored in 3DCityDB
- 2012 Oracle Spatial Excellence Award



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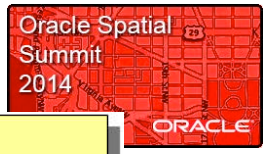
Images courtesy of: TU Berlin, Institute for Geodesy and Geoinformation

Publish KML in the XDB Repository




```
declare
  result boolean;
  kmldoc xmltype;
begin
  SELECT  xmlelement ( "kml",
            xmlattributes ('http://www.opengis.net/kml/2.2' as "xmlns"),
            xmlelement ("Document",
              xmlelement ("Style",
                xmlattributes('BuildingStyle' as "id"),
                xmlelement ("LineStyle", xmlelement ("width",'1'),xmlelement ("color",'ff0000ff')),
                xmlelement ("PolyStyle", xmlelement ("color", '7d0000ff'))
              ),
              xmlagg (
                xmlelement ("Placemark",
                  xmlelement ("name", 'Building '|| gmlid),
                  xmlelement ("styleUrl", '#BuildingStyle'),
                  xmltype (
                    sdo_util.to_kmlgeometry (snap_to_ground (sdo_cs.transform(geom,4327),0))
                  )
                )
              )
            )
          )
  INTO kmldoc
  FROM buildings_ext;
  result := dbms_xdb.createResource ('/public/Buildings/buildings_ext.kml', kmldoc);
end;
/
```

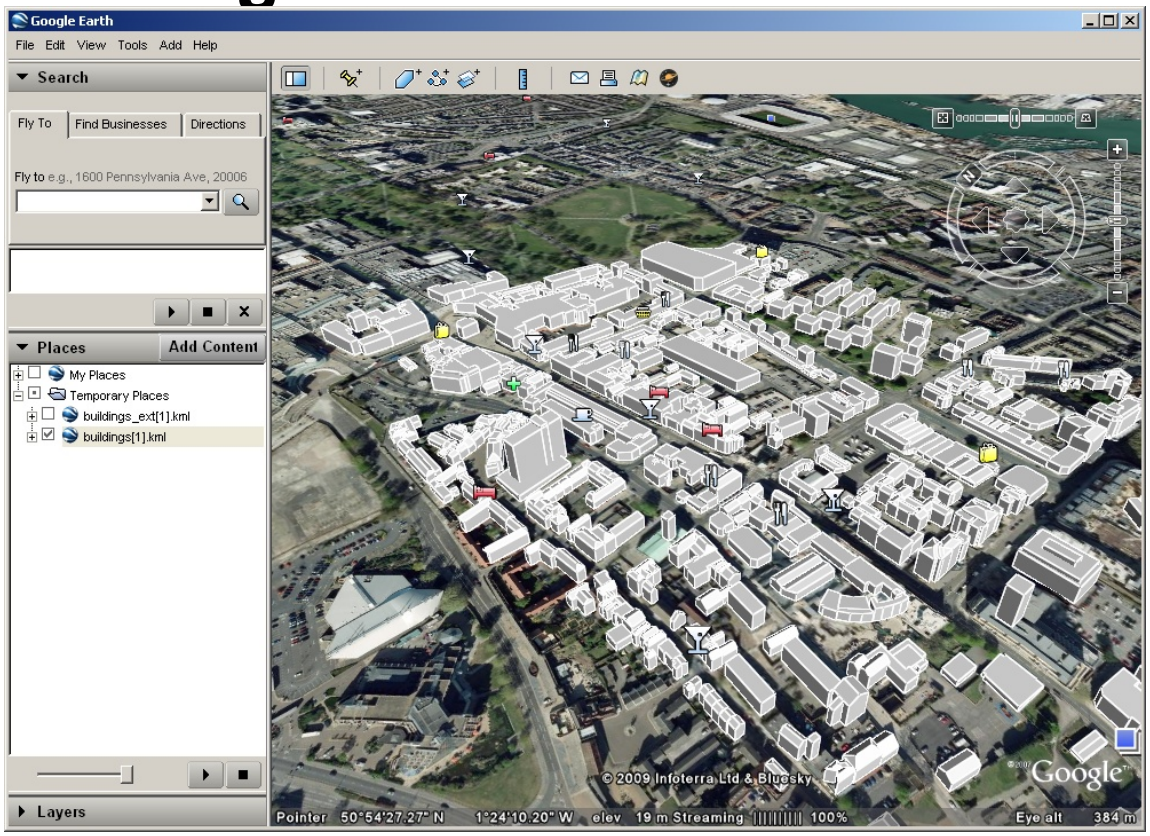
Style definition

Use the style

Fix Z values

Transform to WGS84

View in Google Earth



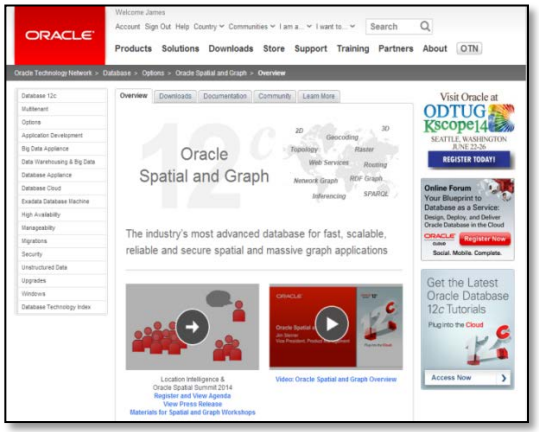
Innovation in Spatial Data Processing

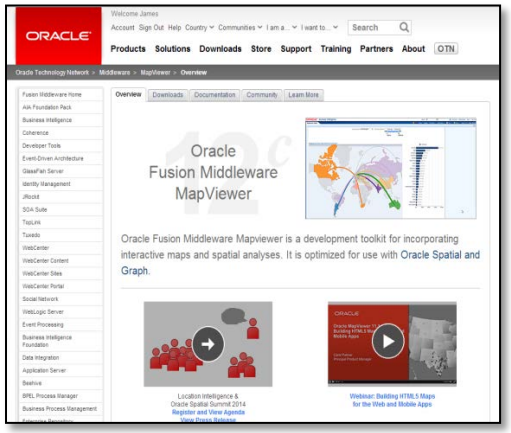
More reference projects today ...

- Spatial Business Processes
  - Ordnance Survey Ireland
  - Track B, 3.30pm, presented by Chris Tagg, 1Spatial
- Explicit Topology Management
  - US Census Bureau
  - Track B, 3.30pm, presented by Jay Spurlin
- LiDAR Data Management
  - Austrian Federal Railways
  - Track A, 3.30pm, presented by Dr. Rinaldo Wurglitsch, IQsoft

Resources

Oracle Technology Network

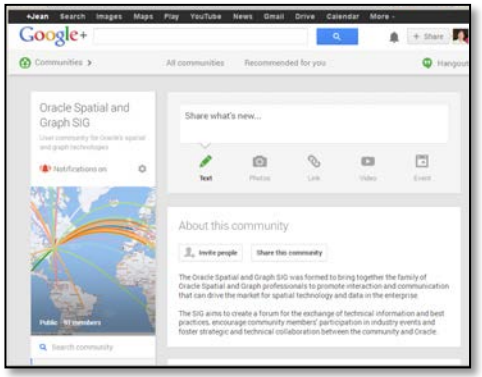




- www.oracle.com/technetwork/database/options/spatialandgraph
- www.oracle.com/technetwork/middleware/mapviewer
- blogs.oracle.com ➔ oraclespatial ➔ oracle_maps_blog

Oracle Spatial & Graph Special Interest Group

Connect and exchange knowledge with the community of Spatial & Graph users



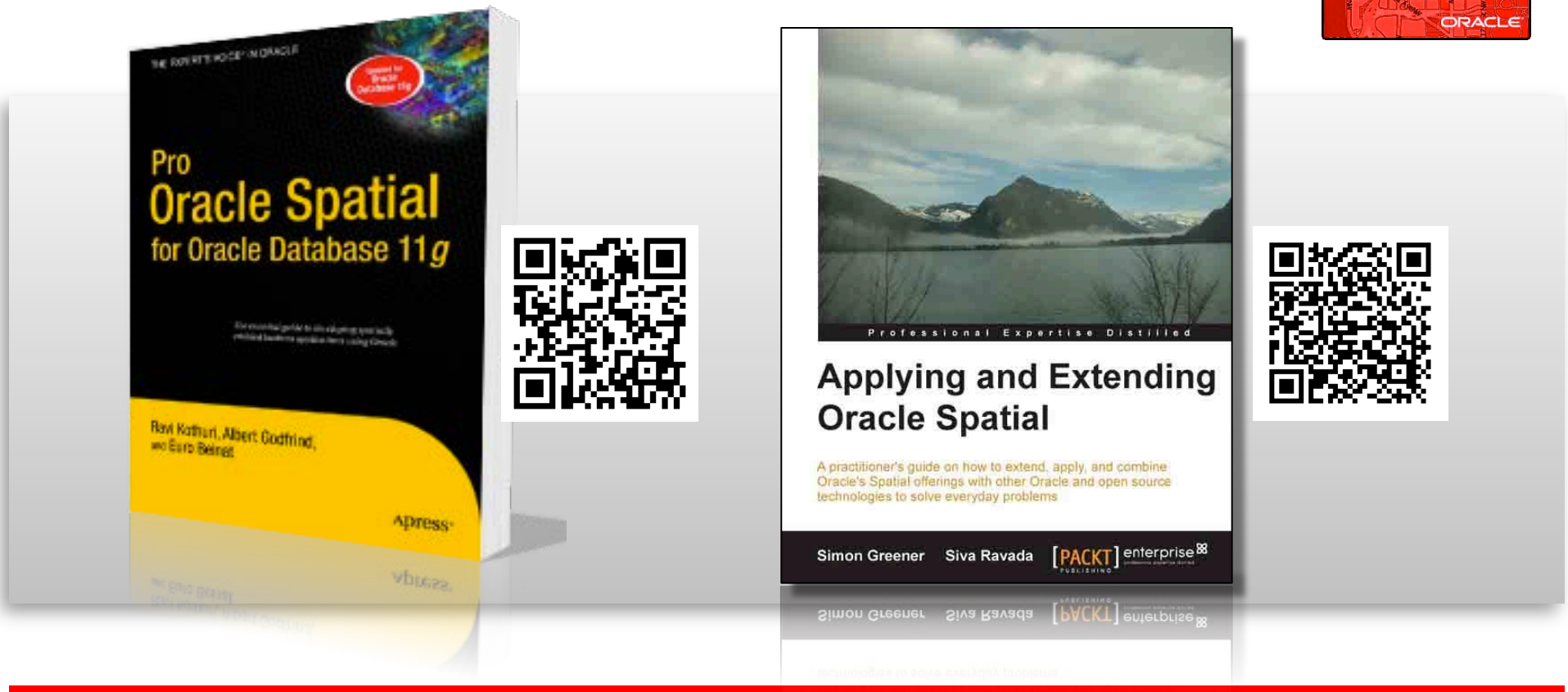
- **Talk with the Board this week**
  - Wednesday lunch – SIG Board presentation (150AB)
  - Stop by the SIG User Group roundtable at Meet the Experts, 4:30pm Wednesday in150AB
  - Visit Oracle's exhibitor table at breaks & sign up
- **Join us**
  - Online communities: LinkedIn , Google+ , IOUG SIG (free membership)
  - Visit OTN Spatial Community page www.oracle.com/technetwork/database/options/spatialandgraph/community (or search online for "Oracle Spatial and Graph Community")
  - Email oraclespatialsig@gmail.com

Spatial Certification & Partner Specialization

Get valuable credentials – differentiate your skills

- **Learn more at the Summit**
  - Wed, Track C 3:30 – Exam preparation session
  - Talk to us at Oracle's exhibitor table & "Meet the Experts" Certification table (Wed 4:30-5:00)
- **Take the next steps**
  - Schedule an exam, access topic lists / online training, learn about Partner Specialization requirements www.oracle.com/technetwork/database/options/spatialandgraph/learnmore/spatial-specialization-1835642.html
  - Online training materials for Certified Implementation Specialist exam https://competencycenter.oracle.com/oncc/full_glp.cc?group_id=22003

More Resources



- **Next:**
  Lunch – Awards & SIG Presentation in Room 150AB
  (11:45am-1:15pm)

- **4:30-5:00pm: Meet the Experts – roundtable Q&A on topics in Room 150AB**
  - **Spatial Performance**
  - **Upgrading/Testing Apps for Spatial 12c**
  - **Raster & 3D**
  - **MapViewer/BI**
  - **Certification**
  - **SIG User Group**
- **Closing Reception (5:00) – Exhibit Hall**

ORACLE

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Washington, DC USA