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“IT Infrastructure for BIM and GIS – 3D Data, Semantics, and Workflows”

Hans Viehmann
Product Manager EMEA
ORACLE Corporation
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@SpatialHannes

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Major challenges of infrastructure projects

IT perspective

- Creating a Single-Source-of-Truth for BIM and GIS
  - Managing all kinds of spatial and non-spatial data
  - Providing metadata for search
- Integrating spatial data into business processes
  - Supporting entire asset management lifecycle
  - Automated workflows between servers, rather than spatial data in silos
- Interoperability on data-, process- and application-level
  - Making use of valuable geospatial data wherever needed
  - Delivering consistent information across domains (semantic interoperability)

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Managing data in BIM projects

Typical issues today

- Different kinds of data are held in files or speciality data stores
  - Need different skill sets for each specialized system
  - Making integrated analysis difficult
- Support for new datatypes is required
  - LiDAR data collection growing particularly rapidly
- Finding the appropriate dataset is challenging
  - Metadata are either incomplete or not accessible/searchable
- Datasets are semantically inconsistent
  - Identical terms do not necessarily mean the same thing

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Solution approach: Data integration

Combining all kinds of geospatial data, metadata and attribute data

- Integrated storage allows joint analysis
  - Without moving potentially large datasets between systems
  - Including metadata for efficient search
- Database offers semantic technologies for further analysis
- Using a single system simplifies application development significantly
  - Same development paradigm and toolset
- Operational benefits, especially when used in the cloud
  - Consistent platform for administration
  - Comprehensive security mechanisms

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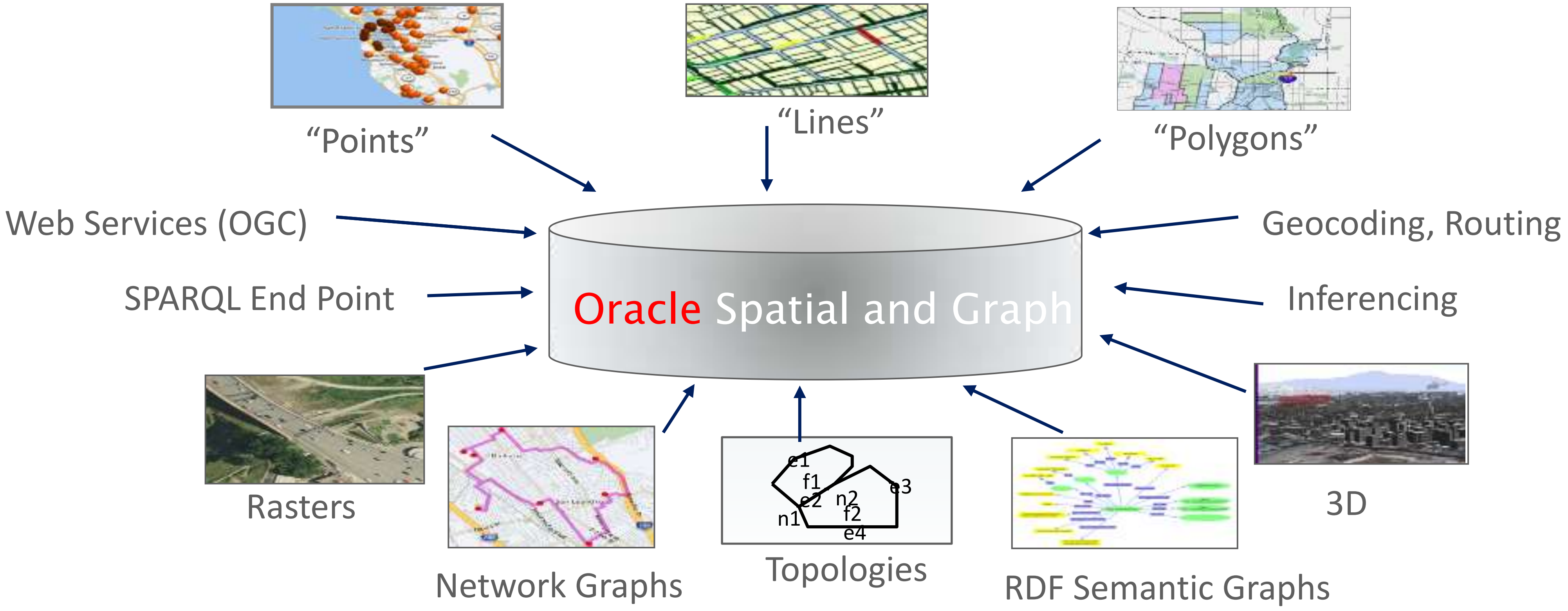
Data integration requires spatially-enabled database

Ideally supporting semantic integration through RDF



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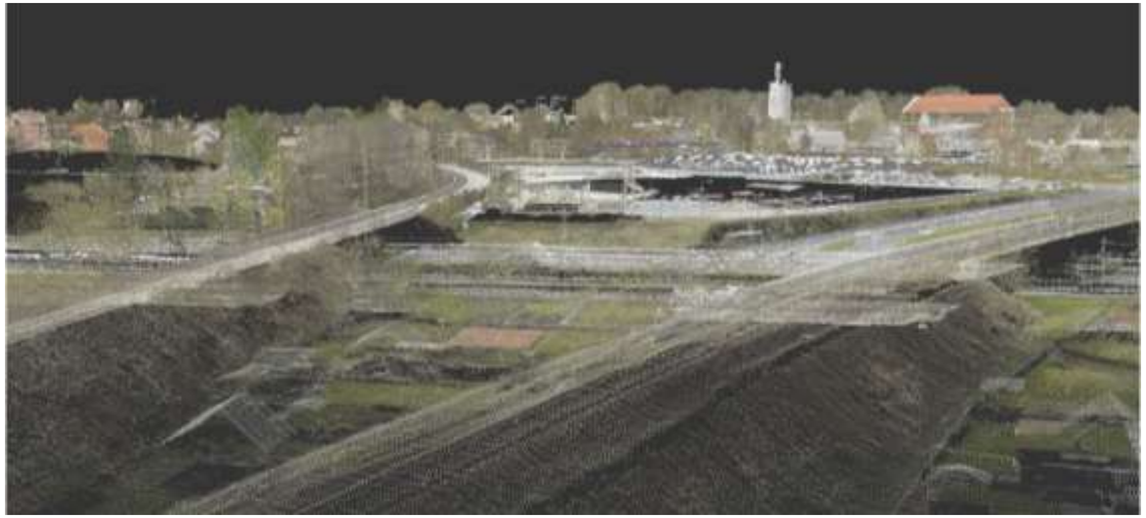
Case Study: ÖBB-Infrastruktur AG, R&D

Implemented by IQsoft, Austria

- Optimized railway planning, construction and maintenance
- Integrated LiDAR, raster and vector data management
- Storing and processing >8 billion points of objects along railway tracks
- Enables LiDAR data to be viewed with existing infrastructure vector data
- Comprehensive metadata management through CSW standard
- Data delivery through OGC WebServices



Screenshot courtesy of: IQsoft, Austria

"[This technology…] is indispensable to process geospatial data with high efficiency at low cost"

Dr. Michaela Haberler-Weber
ÖBB-Infrastruktur AG, R&D

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Spatial Data Types are not enough

Using the data requires object model

- Modeling required for any kind of analysis beyond visualization
  - Associating objects with geometry, topology, semantics, appearance, ...
- CityGML is established standard for urban infrastructure
  - Information model to represent relevant 3D urban objects
  - Defining classes and relations for these objects
  - XML-based format to exchange and store data (GML3-based application schema)
  - Standardized by OGC, currently in version 2.0.0
  - Can be used to derive logical data model in databases

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3DCityDB implements CityGML

Open source data model - www.3dcitydb.org

- Semantically rich, hierarchically structured model
- Five different Levels of Detail (LODs), including textures and facades
- Representation of generic and prototypical 3D objects
- Free, also recursive aggregation of geo objects
- Complex digital terrain models (DTMs)
- Management of large aerial photographs using SDO_GEORASTER objects
- Version and history management
- Matching/merging of building features
- Works with Oracle Spatial and Graph 10gR2, 11g and 12c

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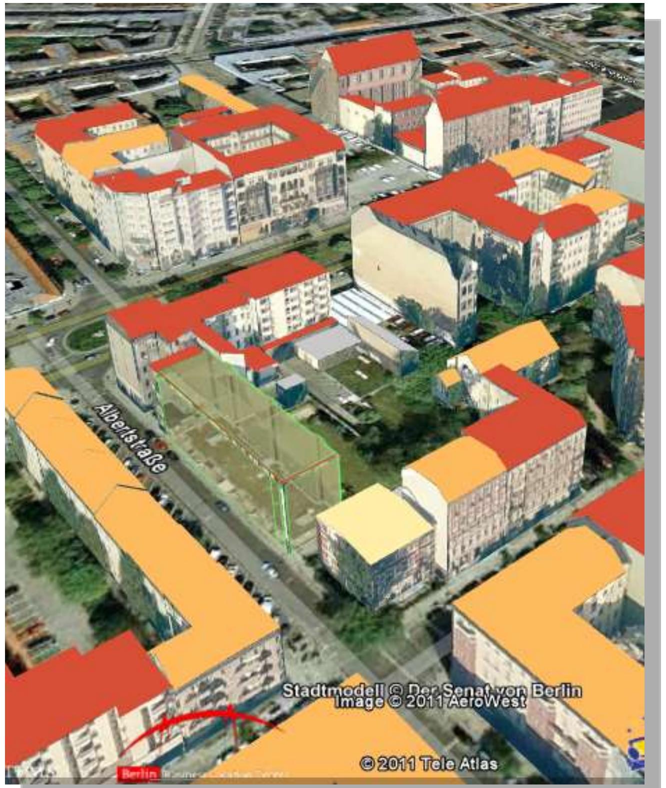
Case study: City of Berlin – 3D City Model

Implemented by TU Berlin

- 3D vector and raster data in 3DCityDB
- Data model based on CityGML
- 560000 buildings, reconstructed from 2D cadastre and LiDAR data
- Textures extracted from oblique aerial photography



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

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Integrating spatial data into business processes

Typical issues today

- GIS systems disconnected from business systems
  - Dedicated, specialized systems
  - High training cost
  - Costly operations and maintenance
- Manual effort in delivering location-related information
  - Labour intensive, time consuming, error prone
  - Not scalable for large infrastructure projects
- Not making use of the full value of geospatial information

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Solution approach: Service-oriented Architectures

With spatial data seamlessly integrated

- Implementing automated workflows across systems
  - Including the GIS System(s)
  - Loose coupling allowing simple transition to cloud computing
- Making use of standard IT development paradigm
  - Structured SOA approach, resulting in reduced cost through reuse
  - Using graphical design tools for rapid application development
- Operational benefits
  - Integrated administration and Business Activity Monitoring
  - Comprehensive security mechanisms

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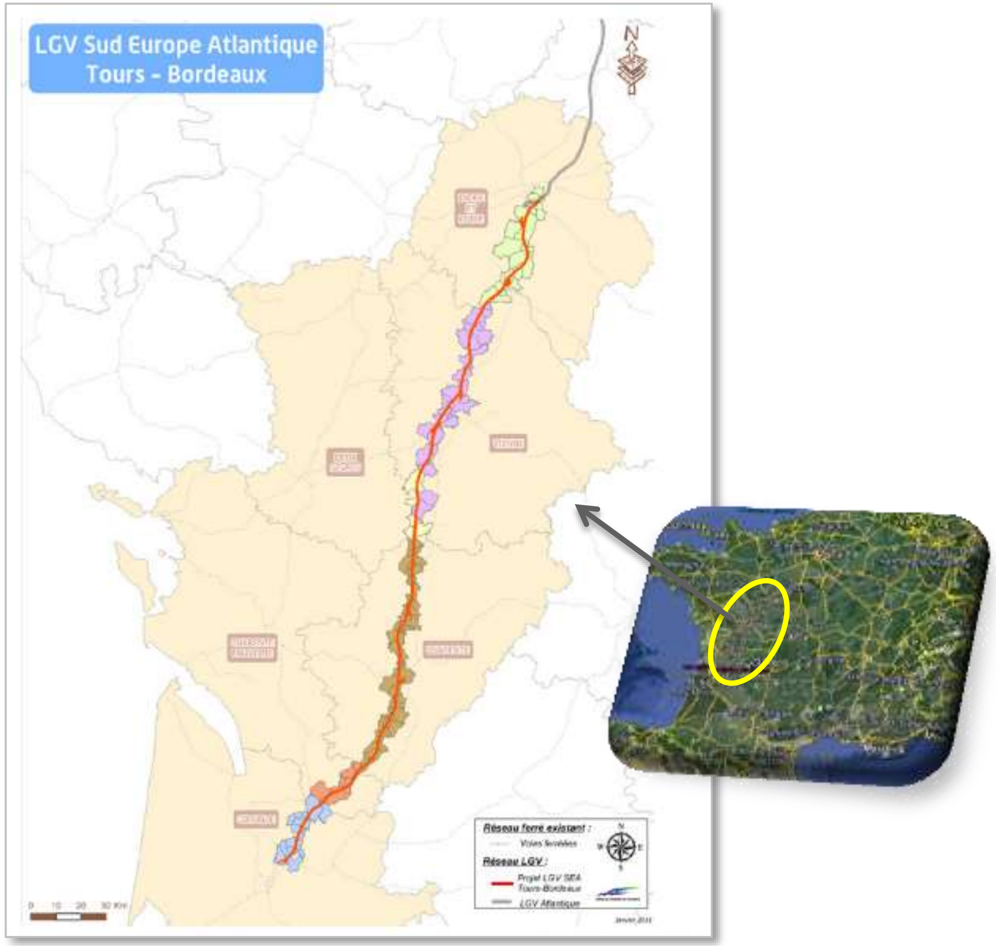
Case study: DPR COSEA

- Consortium building high-speed railway line from Tours to Bordeaux
- centralized spatial data repository for collaborative construction planning, synchronization and analysis
  - Project Management, Document Management, GIS, Business Intelligence
  - high-availability platform, serving 2500 users
  - Autodesk as GIS client, using LRS
- Primavera P6 for project portfolio mana-gement consolidating all project plans
- Partners: IBM, Qualora



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Interoperability

Typical issues today

- More than one GIS or mapping component in the organization
  – Need to share data online
- Adding more components to the infrastructure
  – Specific tools for various purposes
  – Integrating maps into business applications
- Demand to integrate maps and data from cloud-based services
  – making use of available datasources
- Identical terms in different systems don‘t necessarily mean the same thing
  – Leading to incorrect or inconsistent results

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Solution approach: Open standards on all levels

OGC standards for Geospatial data

- Using open standards at database level
  - OGC Simple Features specification, ISO SQL/MM
  - Allowing data access from many tools and components through SQL
  - Conversion to and from GML, KML (or GeoJSON as OGC candidate standard)
  - Supporting semantic queries using GeoSPARQL
- Using OGC Webservices standards
  - WMS to provide maps, WMTS to provide map tiles (both available through MapViewer)
  - WFS and WFS-T to retrieve or manipulate data (available as part of Spatial and Graph license)

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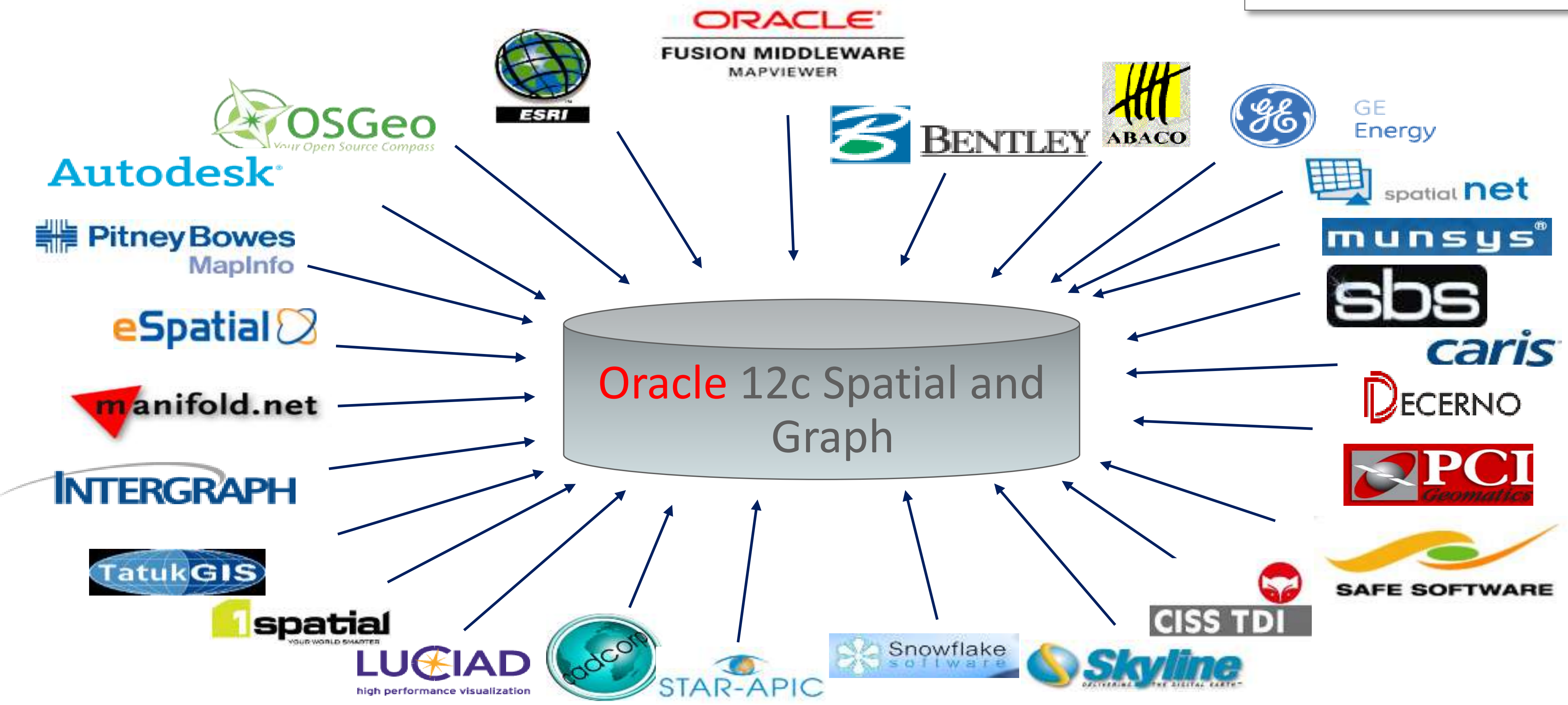
Open and Interoperable spatial database



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Open Source Tools integrated with Oracle Spatial and Graph

OSGeo
Your Open Source Compass

GDAL

GeoServer

GeoTools

MapGuide
Open Source

MapServer

QUANTUM GIS

OpenLayers™

gvSIG

Kosmo

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Case Study: Crossrail, UK

Spatial Data Warehouse, Bentley and Esri clients

- Large Engineering & Construction project in UK
- 21 km twin tunnel under City of London, 90 km of new railway line
- Visualization and Analysis, incl. 3D data management
- Oracle Spatial and Graph as „single source of truth“
  - Database for 300+ staff and contractors as well as the public
  - Serving Bentley Map, Geo Web Publisher, ESRI ArcMap
  - 500+ layers of information, 45.000.000+ records
  - integrated security
- using London Survey Grid for accuracy

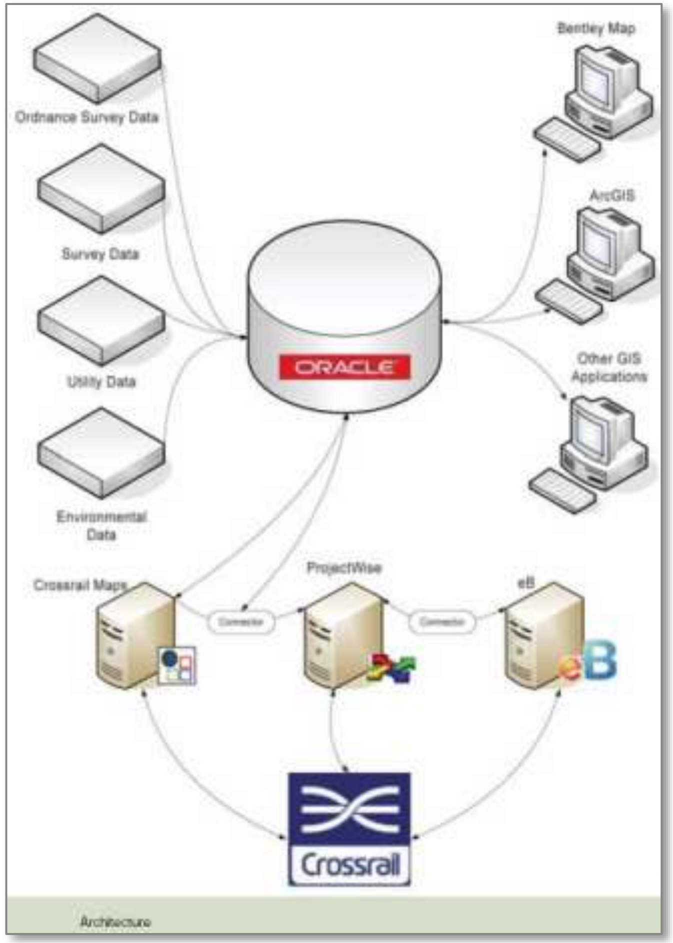

Image courtesy of: Crossrail, UK

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Semantic technologies

Using linked data concepts to associate data with meaning

- Automated integration of data from different sources
  - Creating a semantic layer across silo‘d systems
  - Using well-defined vocabularies and ontologies
  - Based on W3C standards including the Resource Description Framework (RDF), the Web Ontology Language (OWL), SPARQL, RDB2RDF, ...
  - Allowing consistent query, reporting and analysis
- Enabling inferencing to gain new knowledge
  - Derive new information or verify consistency
- Functionality in Oracle database since Oracle 10gR2
  - Triple store, inferencing engine, SPARQL/GeoSPARQL support, RDB2RDF support, ...

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Summary

IT Infrastructure for BIM and GIS

- Create a Single-Source-of-Truth for BIM and GIS
  - Vector data in 2D and 3D, raster imagery, point cloud data
  - Including metadata catalog for search
- Integrate spatial data into business processes
  - Supporting entire asset management lifecycle
  - Automated workflows across systems (eg. work orders, invoices, ...)
- Ensure interoperability on data-, process- and application-level
  - Technical interoperability to supply more than one solution with geospatial data
  - Semantic interoperability by using a common Vocabulary/Ontology

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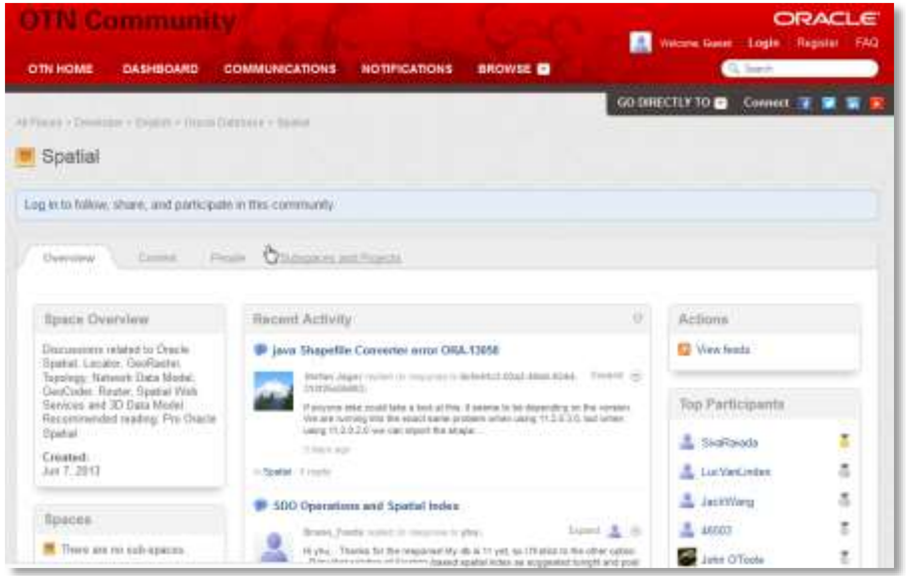
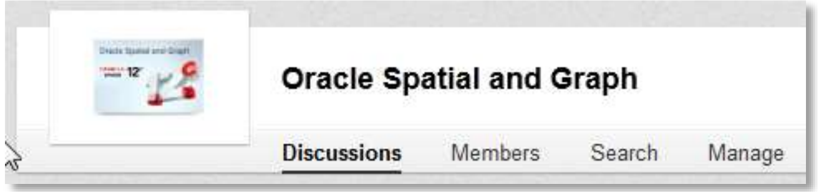
More resources

- Further information on oracle.com
  – www.oracle.com/goto/spatial
- Blogs
  – https://blogs.oracle.com/oraclespatial
- Developer forums on OTN
  – https://community.oracle.com/community/database/oracle-database-options/spatial
- LinkedIn community
  – „Oracle Spatial and Graph“ group
- Google+ community
  – „Oracle Spatial and Graph SIG“





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