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Oracle Spatial
11g Planned features

Overview

- 3-D Types and Functions
- Web Services
- GeoRaster
- Network Data Model
- Q&A

Planned functionality for 3D Data Management in Oracle Spatial

Background on 3-d Spatial

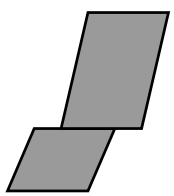
- 3D Types for points/lines/polygons
- Specialized types for large volumes of 3D point data
  - Represent scenes as a set of 3-d points obtained using laser scanners etc. (point clouds)
  - surface representation using TINs
- Address growing number of 3-d applications
  - GIS, CAD/CAM
  - VR, Medical Applications
  - City Modeling

Oracle Spatial 3D Functionality

- SDO_GEOMETRY for 3D Data
- SDO_POINT_CLOUD
- SDO_TIN
- 3D Coordinate Systems

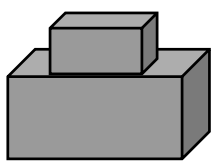
SDO_GEOMETRY for 3D Data

- Points
- Lines
- Simple Surfaces
  - All points of a surface lie in a 3D plane
  - A 3 point 3D polygon is the simplest surface
  - A simple surface can have any polygonal shape
- Composite surfaces
  - has one or more connected simple surfaces
  - It can be closed or open
  - The simple surfaces in a composite surface can not cross each other
  - surface of a cube is an example of a composite surface
    - Cube has six simple surfaces
    - Each simple surface is a 3D square



SDO_GEOMETRY for 3D Data

- Simple Solids
  - Solids are composed of closed surfaces
  - It has to have one outer surface and one or more interior surfaces
  - Cube is an example of a simple solid
  - A pyramid is an example of a simple solid
- Composite Solids
  - Consists of n simple solids as a connected solid
  - Can be represented as a simple solid with a composite surface
  - Topologically there is an equivalent simple solid, but the composite solid representation is easier



SDO_GEOMETRY for 3-D

- Support for multi-points, multi-lines, multi-surfaces, multi-solids
  - Multi-solid is different from composite solid
- No arcs supported
- No parametric surfaces supported
- Follows GML3, ISO 19107 Specifications

Operations on 3D SDO_GEOMETRY

- Spatial Indexing: R-trees
- SQL Operator support
  - SDO_FILTER, SDO_ANYINTERACT, SDO_WITHIN_DISTANCE, SDO_NN only
- PL/SQL Functions
  - VALIDATE_GEOMETRY
  - SDO_DISTANCE, SDO_GEOM.ANYINTERACT
  - SDO_AREA, SDO_LENGTH,SDO_VOLUME
  - SDO_CS.TRANSFORM

JGeometry: Java API

- 2D Simplify
- Projection to Local Tangent Plane for Geodetic data
  - And its inverse operation
- Arc Densification
- Affine Transformations
  - Shift, rotate, translate, scale
- Element Extractor
- 2D Buffer

J3D_Geometry: Java API

- Extends JGeometry class
- Supported Methods:
  - Validate(tolerance): Returns true or false
  - Distance(J3D_geometry): Returns distance
  - Anyinteract(J3D_Geometry): Returns true or false
  - Length(): returns length for 3D line
  - Area(): returns area for a surface geometry
  - Volume(): returns volume of a solid geometry

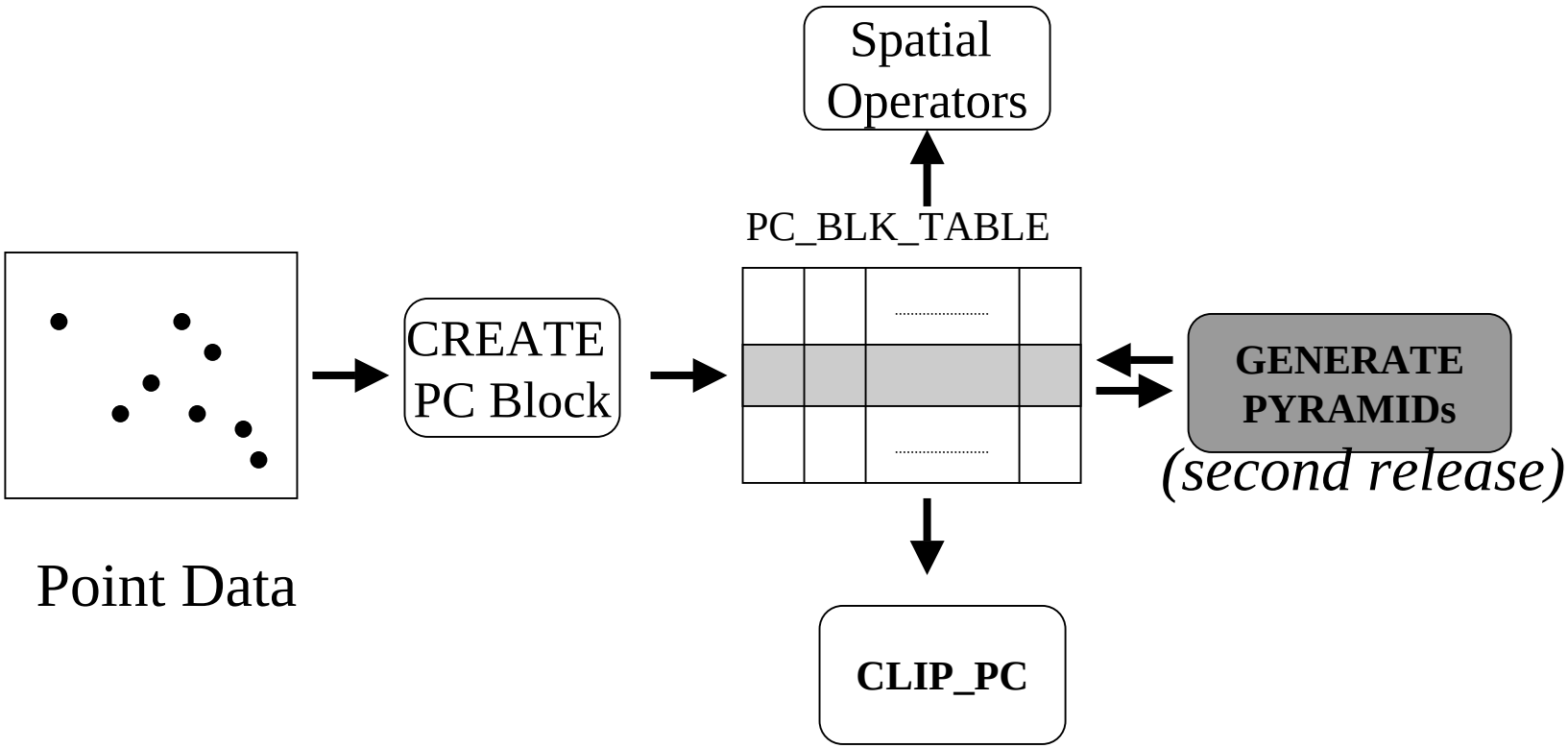
Specialized Types for High Density 3D Point Data

- Large volumes of point data acquired by sensors
  - LIDAR
  - Sensors used to collect data inside buildings
- Millions of points used to model a scene
- SDO_GEOMETRY is not suitable for such data
- POINT CLOUD data type introduced to efficiently manage this type of point data
- TIN data model is built on top of this type

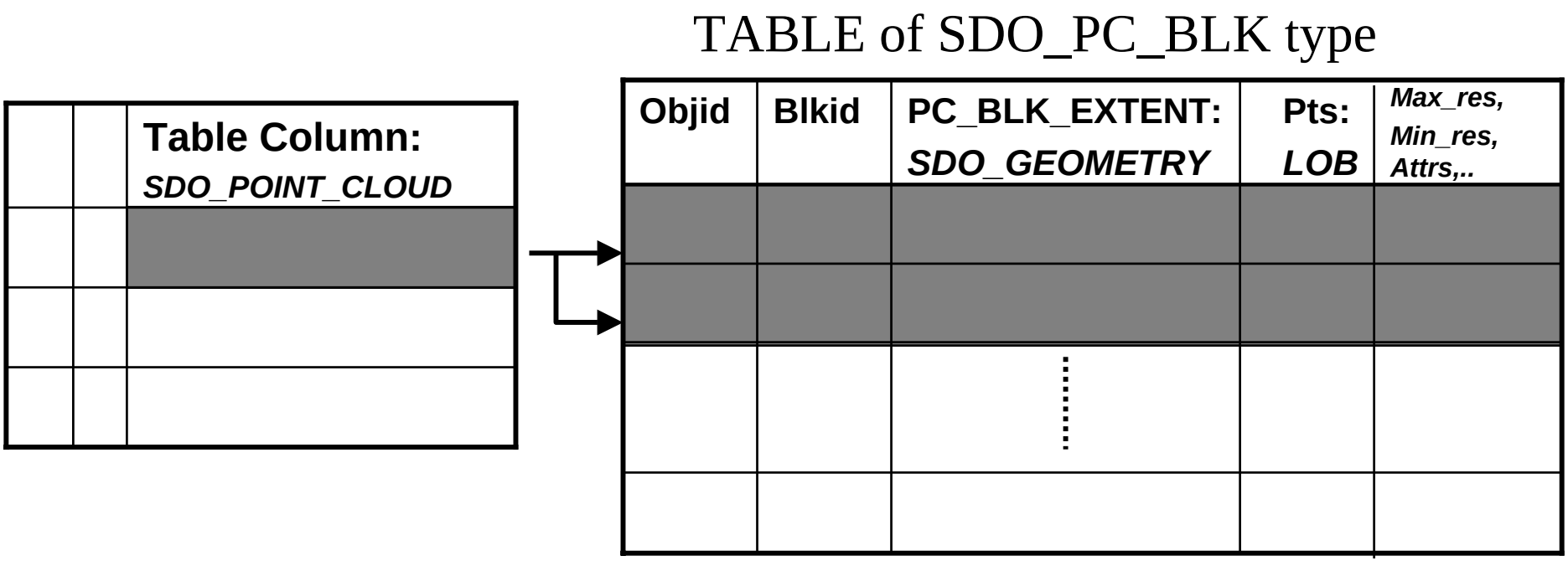
SDO_POINTCLOUD

- Features:
  - Points in a block can be stored in a “compressed” format w.r.t MBR
  - Block associated with an “interval” of resolution levels
  - Can store LIDAR data (LAS format)
  - Partition into multiple blocks for granularity of access
  - Spatial query with <frustum window, interval range>
  - Clipping, other operations

Operations

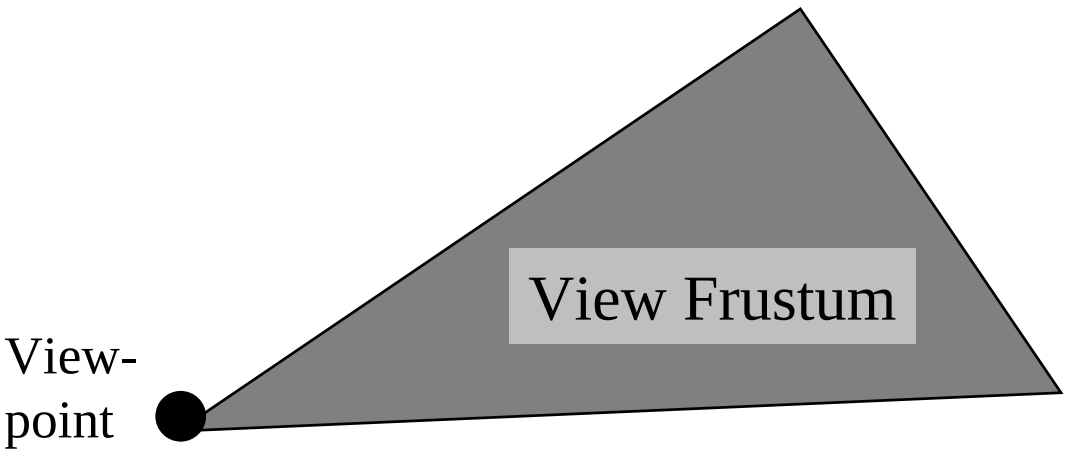

Spatial Operators
PC_BLK_TABLE
CREATE PC Block
GENERATE PYRAMIDs
(second release)
Point Data
CLIP_PC

SDO_POINT_CLOUD: Storage



- Not all columns shown. Exact details may change
- <Min_Res, Max_res> associated with blocks
- Pts can be stored w.r.t. pc_blk_extent (to reduce # of digits/space)

Visibility Query

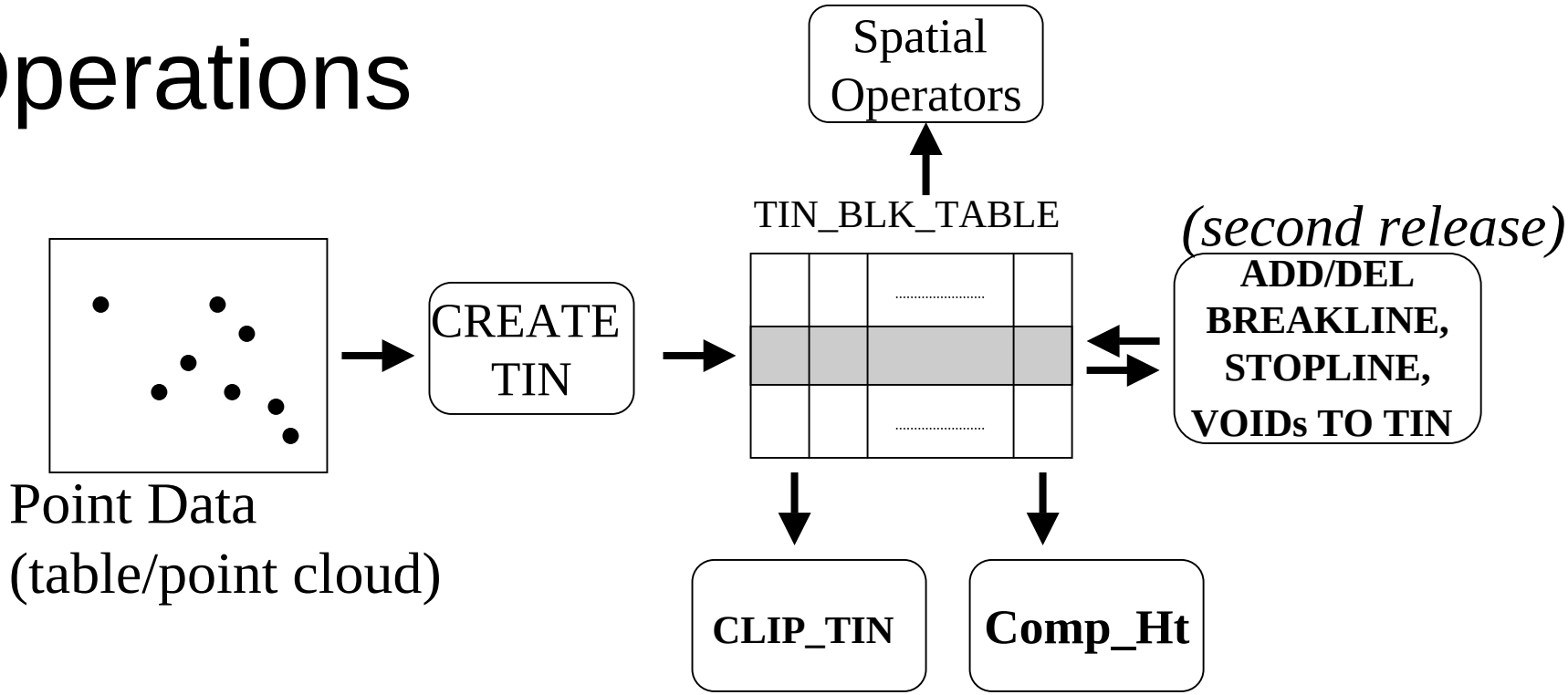


- Farther objects in lower resolution
- Nearer objects in higher resolution
Query specifies one or more
<query solid (frustum), [min_res, max_res]>

SDO_TIN

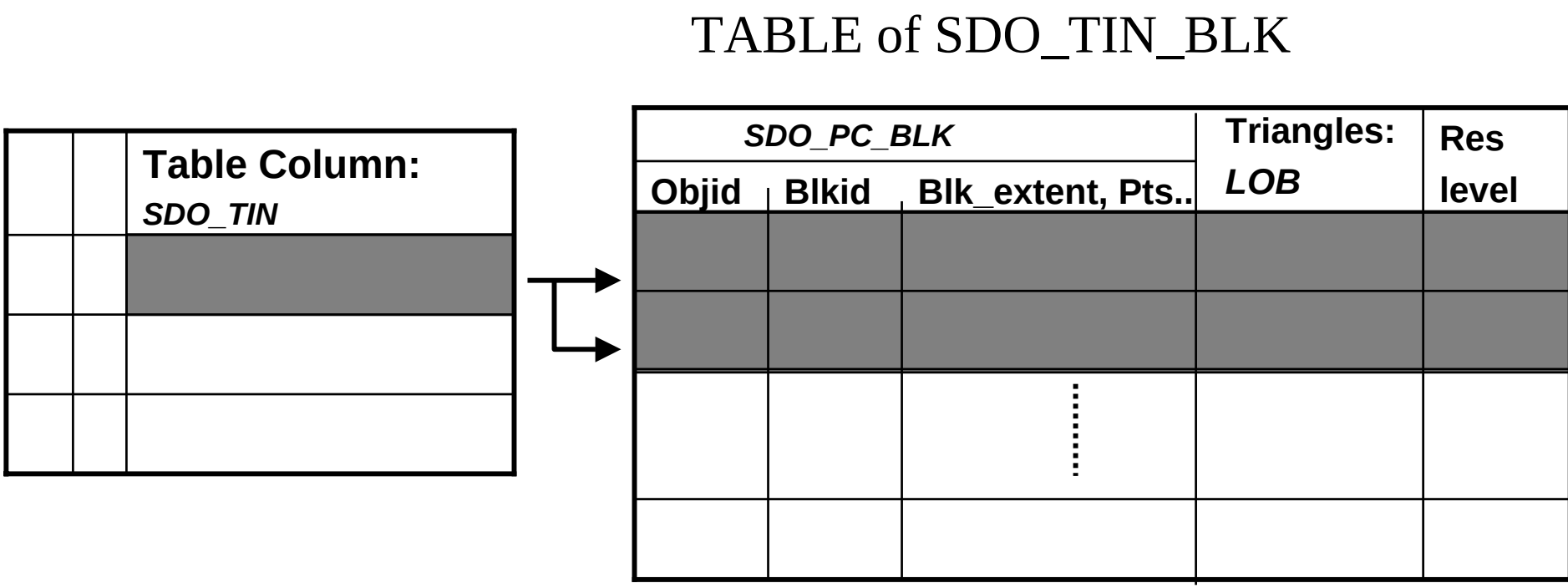
- Triangulated Irregular Network for representing surfaces
- Operations/Functions
  - Create TINS using points, break lines, stop lines and void regions
  - Validation
  - Add/delete breaklines, stoplines associated with a TIN
  - Clipping, compute_height, multi-resolution (future)

Operations



- TIN Creation for a given set of points, breaklines,…
- Read/Write Point/Triangle Data to the TIN_BLK_Table
- (Re-)Compute Triangles for a set of blocks using the points
- Querying the TIN to retrieve/clip the blocks
- Update TIN: add/delete points/lines/voids

SDO_TIN: Storage



- Not all columns shown. Exact details may change
- Res_level is set to 0. Future versions will use it to denote multi-resolution blocks.
- Pts can be stored w.r.t. tin_blk_extent (to reduce # of digits/space)

SDO_TIN

- Compact and scalable representation/storage for large TINS
  - 4Billion*4Billion Points
- Querying functions
  - Querying using a window + resolution-level
  - Clipping of the appropriate TIN blocks
- More functionality in subsequent releases
  - Storage of Multi-resolution TINs

3D Coordinate Systems

Following EPSG types are to be supported:

- Vertical Coordinate Systems
  - w.r.t to sea-level, essentially 1-d coordinate system
- Geocentric: 3-d Cartesian
- Geographic-2d: 2-d ellipsoidal
- Geographic-3d: 3-d ellipsoidal
- Compound Coordinate System

3D Coordinate System

Same use as 2D Coordinate Systems:

A reference system for spatial operations

- Associate a coordinate system with 3D data
  - SDO_GEOMETRY
- Support transformations from one to another coordinate system, wherever applicable
- Compute distances, and other spatial relationships between two objects within the same coordinate system

Planned functionality for geospatial web services in Oracle Spatial

Web Feature Service 1.0

Requirements

- Access/search/update/delete geo-spatial feature instances based on spatial/non-spatial search criteria using a standard interface over the web
- Access/Update in a secure way with proper authentication and authorization
- Manage feature privileges at a instance level
- Real-time transfer of feature instances in a platform/programming language independent way

Our Approach

- Use SOAP/XML over HTTP for Request/Response
- Oracle Spatial for Feature instance Storage/Retrieval
- Implement GML filter specification for feature search
- Use LDAP for authentication
- Oracle Label-based security for instance-level privilege mgmt
- WSS/SSL for secure transfer of feature data

Our Approach (Contd)

- Support publishing feature types from database data sources(tables, views)
  - Complex Type columns
  - Nested Table/VARRAY columns
  - XMLType Columns
- Support publishing feature types from external data sources (external XSDs
- Implement token-based locking of feature instances
- Feature cache in middle-tier to reduce volume of spatial data transfer from DB to middle-tier
  - makes WFS request processing more efficient

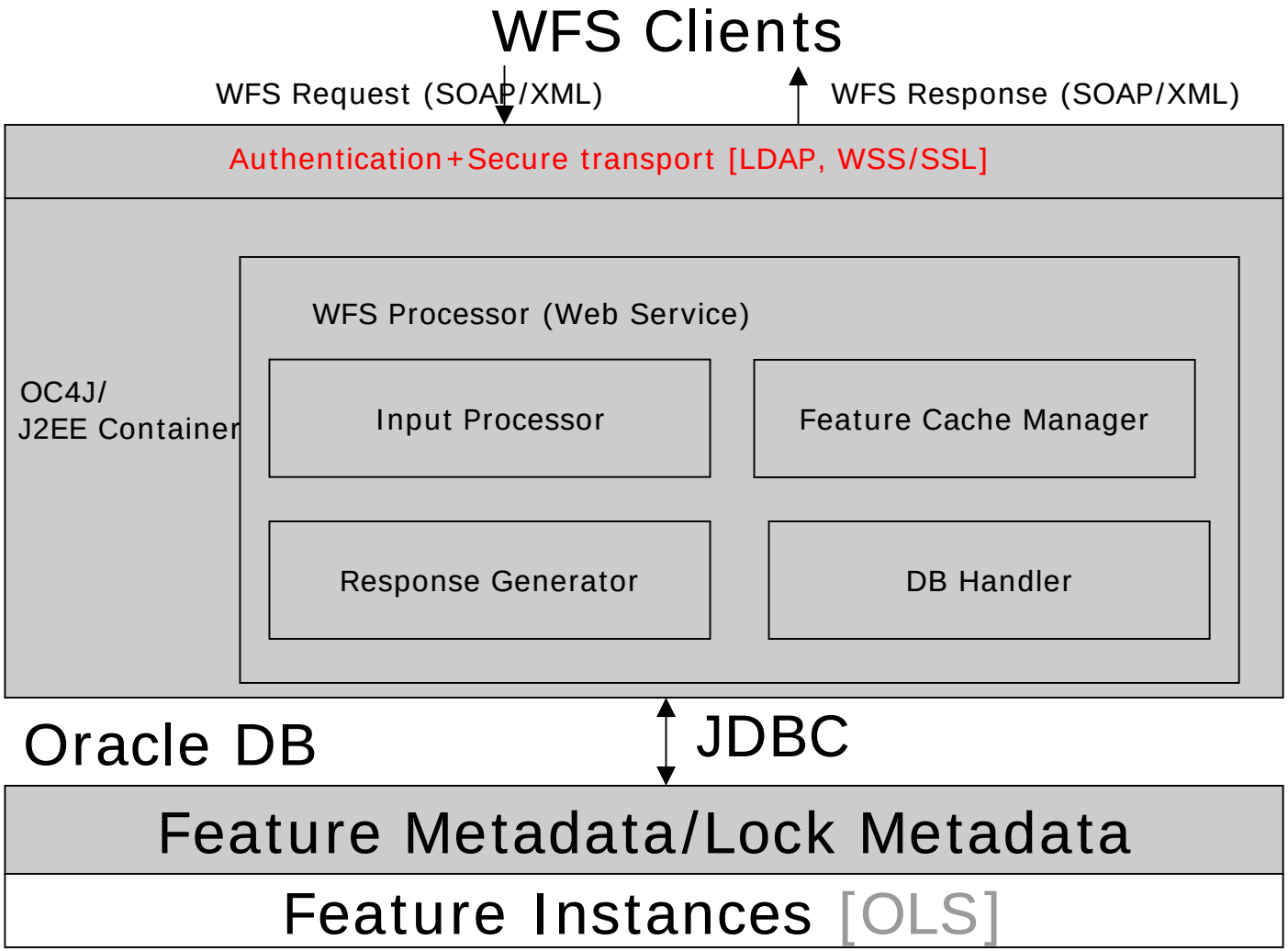
WFS Operations

- Basic
  - Get Capabilities – get the metadata about the types / operations a feature server supports
  - DescribeFeature - get the structural information about a feature type
  - GetFeature – query different parts of feature instances

WFS Operations (Contd.)

- Transactional WFS
  - GetFeatureWithLock – get a set of features, and lock some/all of them for a certain period of time.
  - LockFeature – lock a set of feature instances
  - Transaction
    - Insert new feature instances
    - Update existing feature instances based on filter criteria
    - Delete existing feature instances based on filter criteria

Architecture



Caching

- Provide main-memory storage of spatial objects
- Helps reduce frequent transfer of spatial object from database to memory
- In-memory locks for update cache entries consistently.

Caching APIs

- Lookup (type, IdList)
- Insert (feature rows)
- Update (type, propertyList, IdList)
- Delete (type, IdList)
- loadCache(Connection)
- loadCache(Connection, type)
- Lookup/Update/Delete (filter-based)

Locking

- DB Locking
- Lock duration in minutes
  - Spans db transaction boundary
- Token-based locking semantics
- Unlock rows when lock expires

Locking APIs

- lockRows(type, filter) return token;
- transferToken(token);

…update/delete feature rows

- unlockRows(type, filter);

Update/Delete without proper lockRows/transferToken will be unsuccessful

Locking Approach

- Define triggers on feature tables/views to make sure that the user in the current session has shown a non-expired lock token, which was obtained previously for updating/deleting the concerned rows.
- Locking logic will be enforced uniformly for Java or PLSQL interfaces.

WFS Metadata

- Feature Types
- Feature Type Tags
- Feature Type Attributes
- Complex Types
- Spatial Operators supported
- Functions supported
- Service Metadata

Publish Feature Types

- Default
  - Publish the content of a table with Spatial Column to a feature type which is a subtype of gml:_Feature
  - Columns Map to Feature Type Tags
  - Column Types Map to Tag Types in XML
  - User-defined object map to ComplexTypes in XML
  - Type naming in chosen by default
  - Java/PLSQL APIs

Publish Types (Contd.)

- Custom
  - Feature Type Mapping
  - Feature Type Tag Mapping
  - Feature Type Attribute Mapping
  - Complex/Nested Types Mapping
  - GML feature fields map to SDO_GEOMETRY type in the db
  - Complex type maps to db object types
  - Custom Storage Mapping XSD

Summary

- WFS 1.0 (GML 2.1.2)
- Basic:
  - GetCapabilities
  - GetFeature, DescribeFeature
- Transactional:
  - Transactions (Insert, update, delete)
  - LockFeature
  - GetFeatureWithLock

Catalog Service Web 2.0

Requirements

- Access/search/update/delete geo-spatial catalog records based on spatial/non-spatial search criteria using a standard interface over the web
- Access/Update in a secure way with proper authentication and authorization
- Manage catalog record privileges at a instance level
- Real-time transfer of catalog instances in a platform/programming language independent way

Our Approach

- Use SOAP/XML over HTTP for Request/Response
- Oracle Spatial for Record instance Storage/Retrieval
- Implement GML filter specification for record search
- Use LDAP for authentication, Oracle Label-based security for instance-level privilege mgmt, and WSS/SSL for secure transfer of record data
- Support brief/summary/full output views of record instances.We will also support custom views of record instances, by dynamically generating XSL transformations based on the CSW Query specification

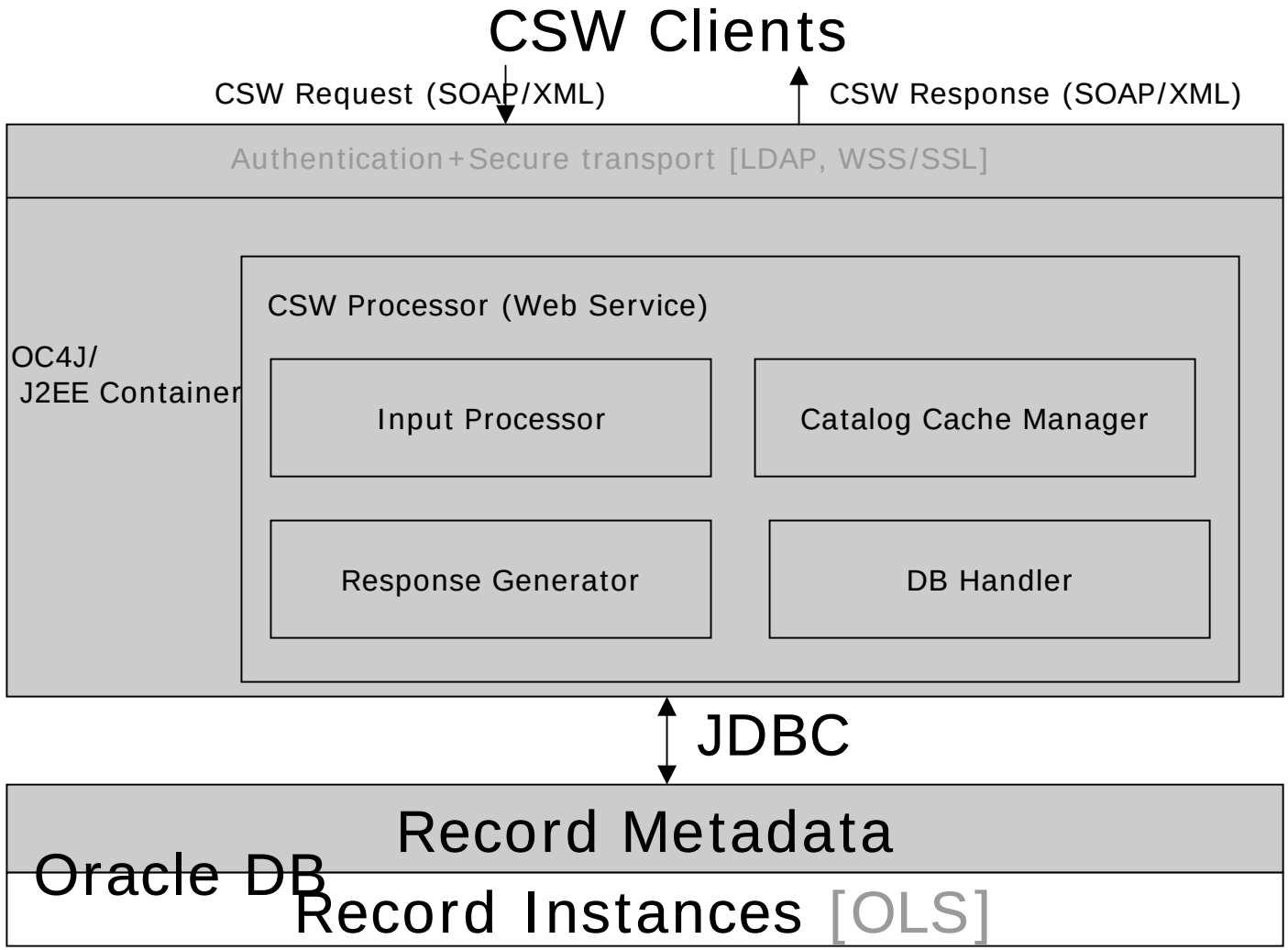
CSW Operations

- Discovery
  - Get Capabilities – get the metadata about the types / operations a catalog server supports
  - DescribeRecord - get the structural information about a catalog record type
  - GetRecords– query different parts of record instances

CSW Operations (Contd.)

- Publication WFS
  - Transaction (Push records)
    - Insert new record instances
    - Update existing record instances based on filter criteria
    - Delete existing record instances based on filter criteria
  - Harvest (Pull records from external source)

Architecture

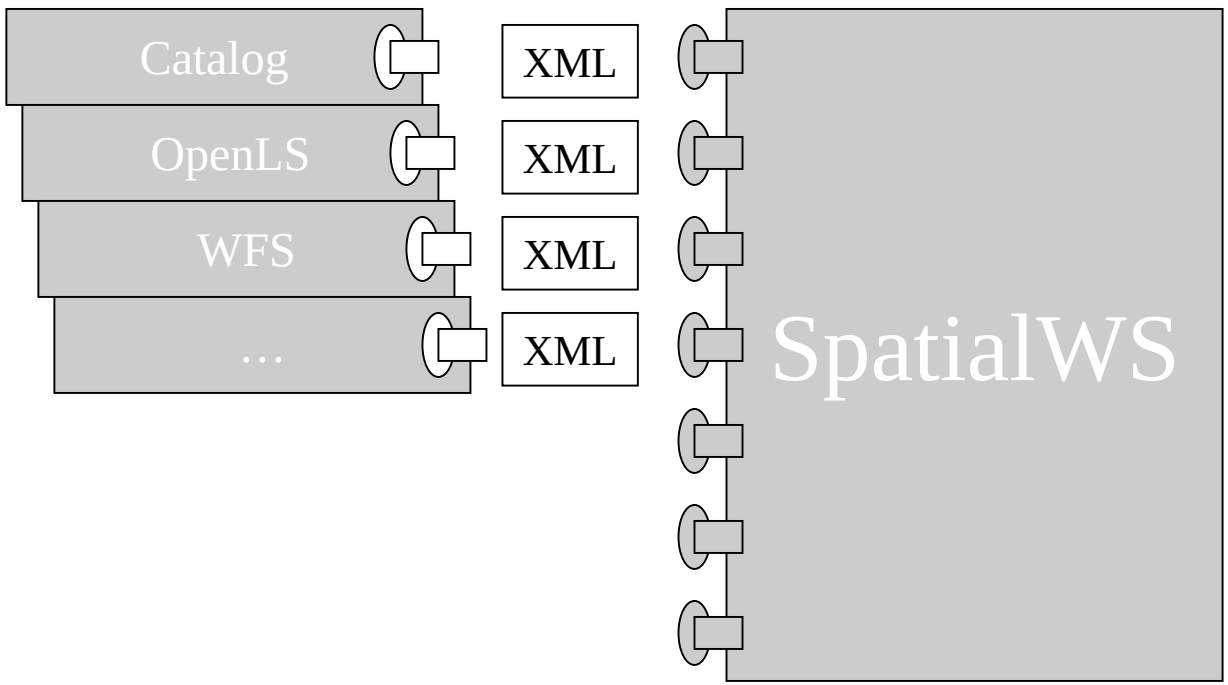


Summary

- CSW 2.0 (GML 2.1.2)
- Discovery:
  - GetCapabilities
  - DescribeRecords, GetRecords
- Publication:
  - Transactions (Insert, update, delete)
  - Harvest

SpatialWS Security Integration Pluggable Components

What…



OGC compliant
SOAP
WSS,
VPD

Proxy Auth/App user mgmt

(Multi user login)

Functionality

- Pluggable component handles
  - XML request / response
- Component can ignore:
  - SOAP envelope
    - Will comply w/ OGC
    - User name & pwd/certificate
    - Encryption & signatures
  - User authorization
    - Managed by DB including VPD
    - When needed: J2EE security model
  - Connection mgm
    - Proxy authentication
    - App user mgmt
    - Multi-user login

Propagation Of Identity

1. Client
   - JAX-RPC
     - Username
     - Password
2. SOAP header
   - WSS
3. Oracle JAZN/LDAP/XML
4. SpatialWS
   - Proxy Auth
   - App User mgm
   - (Group of users)
5. DB connection
   - Grant
   - VPD

GeoRaster: 11g enhancements

- Raster processing
  - GeoTIFF import, export
  - New georeferencing techniques (RPC, DLT)
  - partial raster updates, multiple NODATA values, sparse raster support
- Compression
  - JPEG 2000
  - Plugin architecture for 3rd party formats
- Workspace Manager Support
- OLS Support

NDM: 11g Enhancements

- Scalable Searching on large networks
  - Large networks are supported (millions of nodes/links)
  - Network is partitioned using logical or spatial keys
  - Partitions are loaded on demand to keep the in memory foot print small
- New Features
  - Trace out
  - Partial links as end nodes in a path result
- Workspace Manager Support

Product Development Contacts

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