
ORACLE®

Oracle's Spatial Technologies

Oracle Locator

Oracle Spatial

OracleAS MapViewer

Presenters

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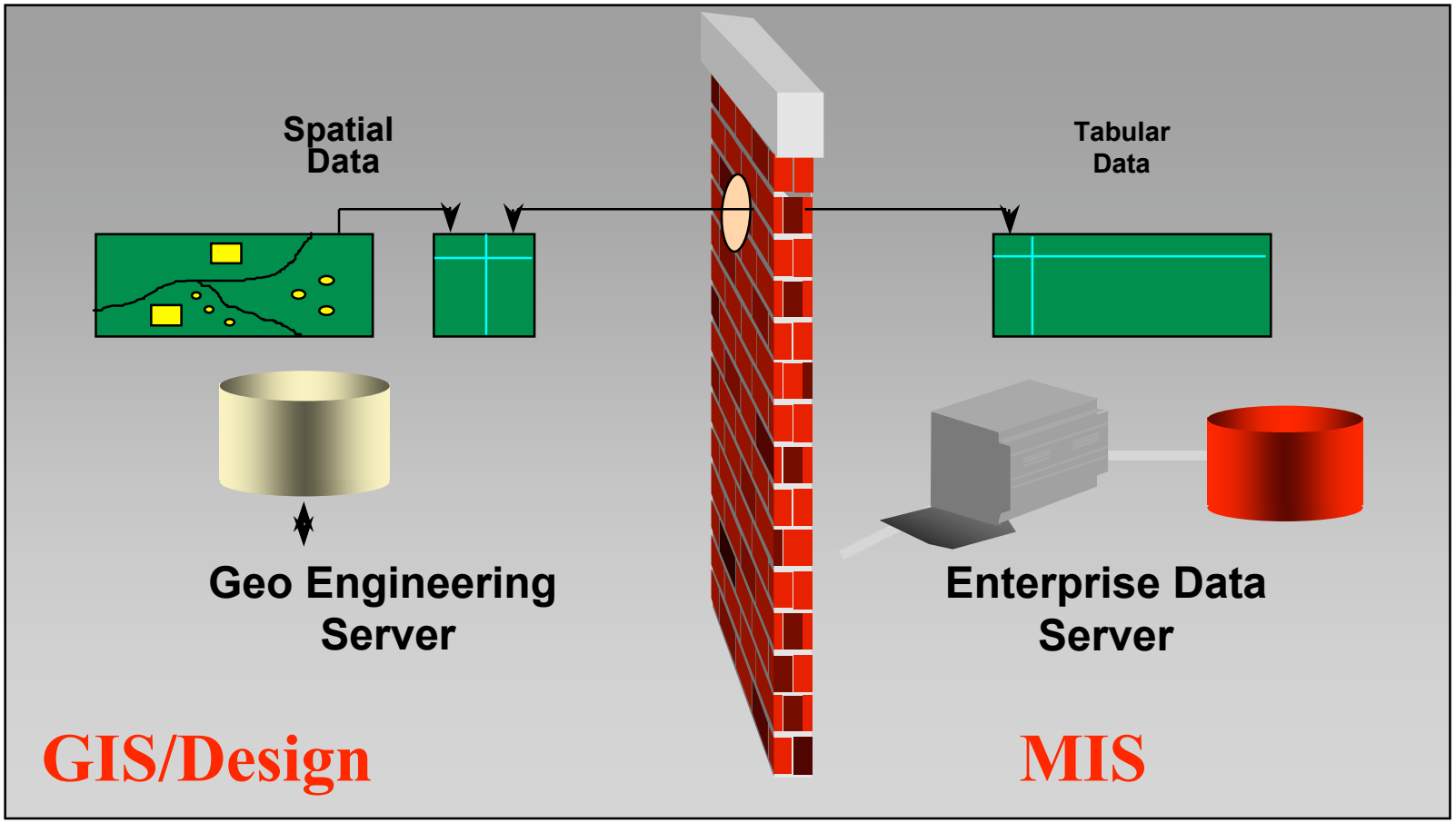
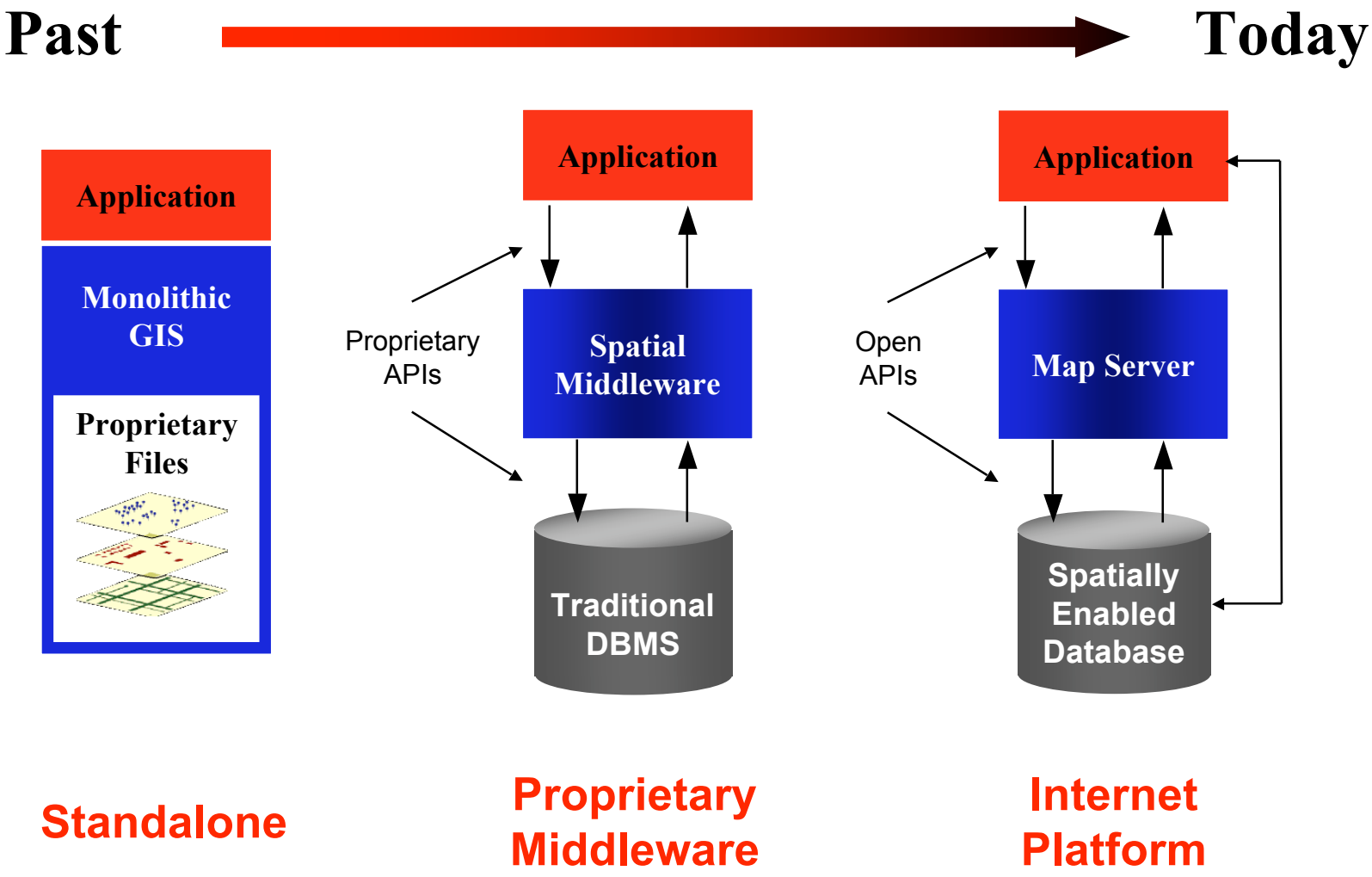
Agenda

- Spatial Data Challenges
- Oracle Spatial
  - Linear Referencing Systems
  - Spatial Aggregate Functions
  - Spatial and Locator
  - Oracle Application Server MapViewer
- Oracle Spatial Technology Partners
- New Major Release: Oracle 10*g*
- Oracle Spatial – Beyond 10*g*

In the Past
Challenge of Integrating GIS & MIS

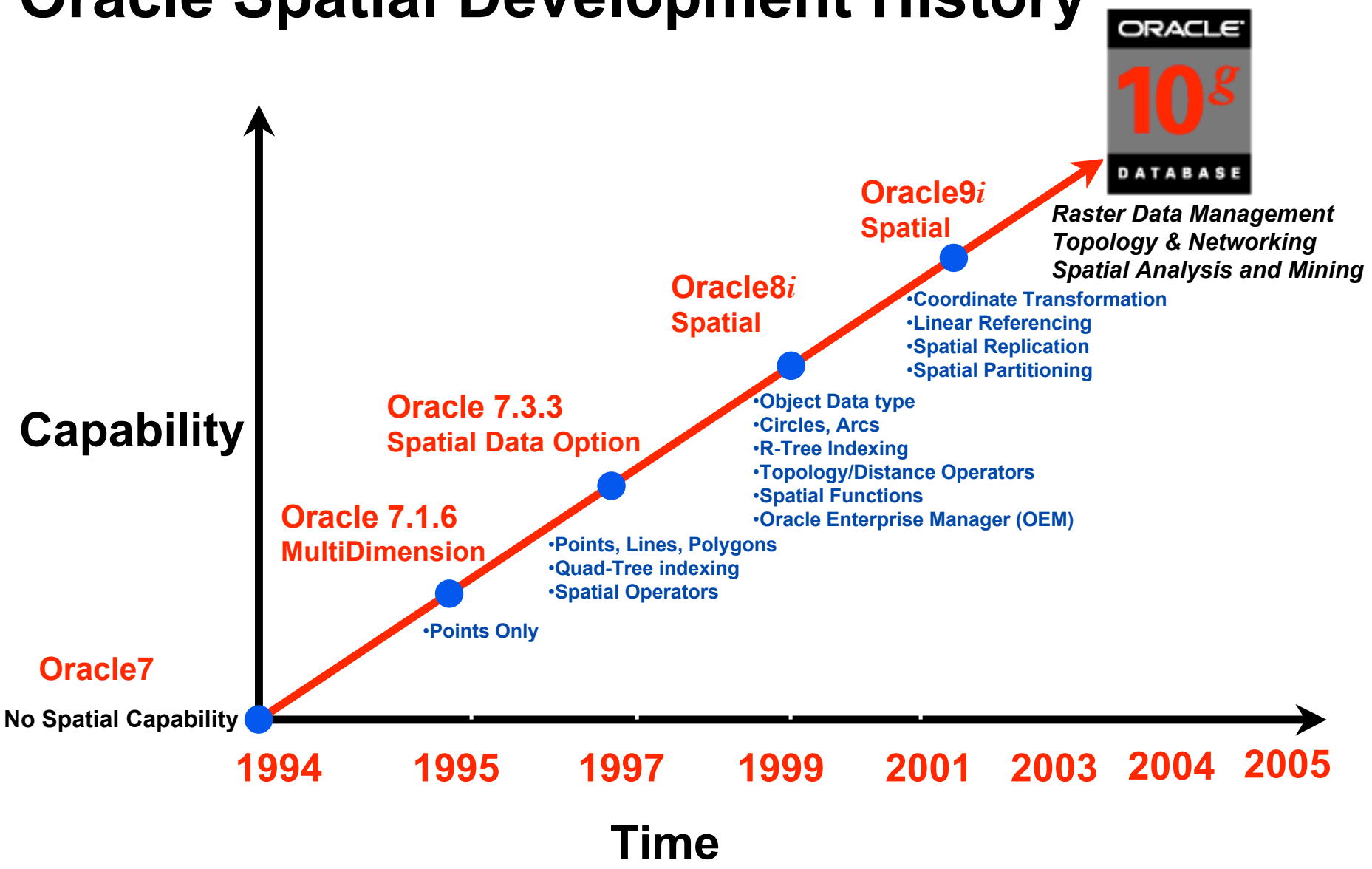


Evolution of GIS



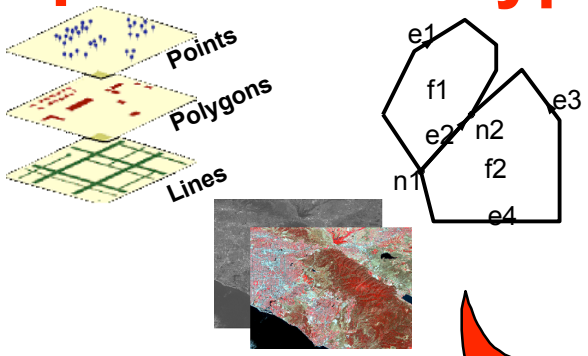
Oracle Spatial 10*g*

Oracle Spatial Development History



Oracle10^{g} Core Spatial Capabilities

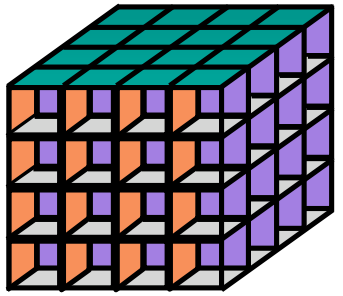
Spatial Data Types



All Spatial Data
Stored in the Database

Oracle Spatial 10^{g}

Spatial Indexing

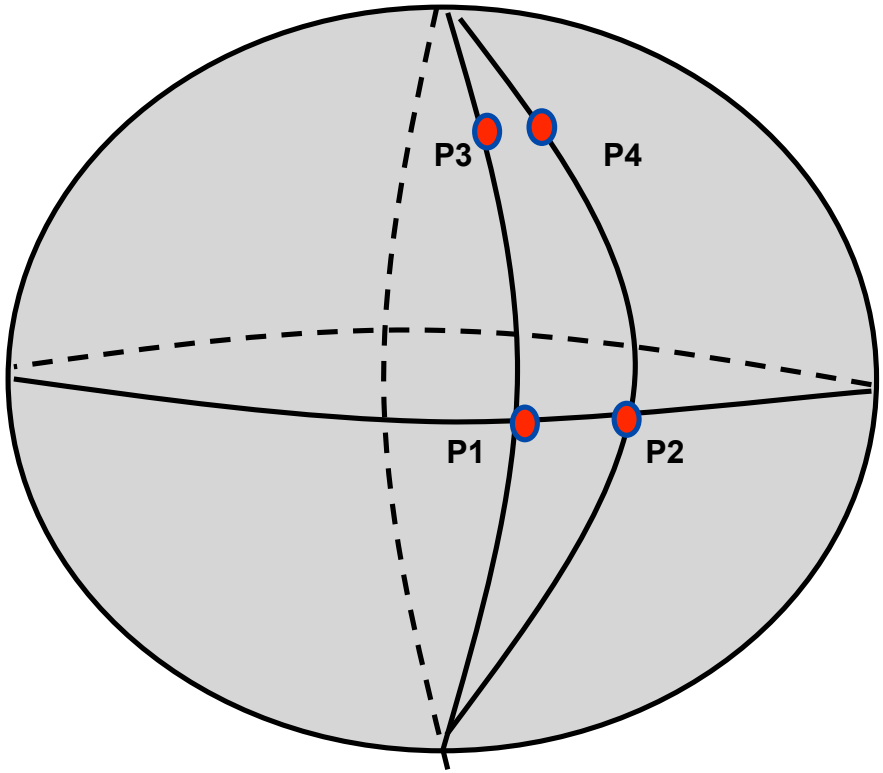


Fast Access to
Spatial Data

Spatial Analysis Through SQL

```
SELECT a.customer_name, a.phone_number
FROM policy_holders a
WHERE sdo_within_distance( a.geom, hurricane_path_geom,
          'distance = 10 unit = mile') = 'TRUE';
```

Longitude/Latitude Data Considerations Whole Earth Model

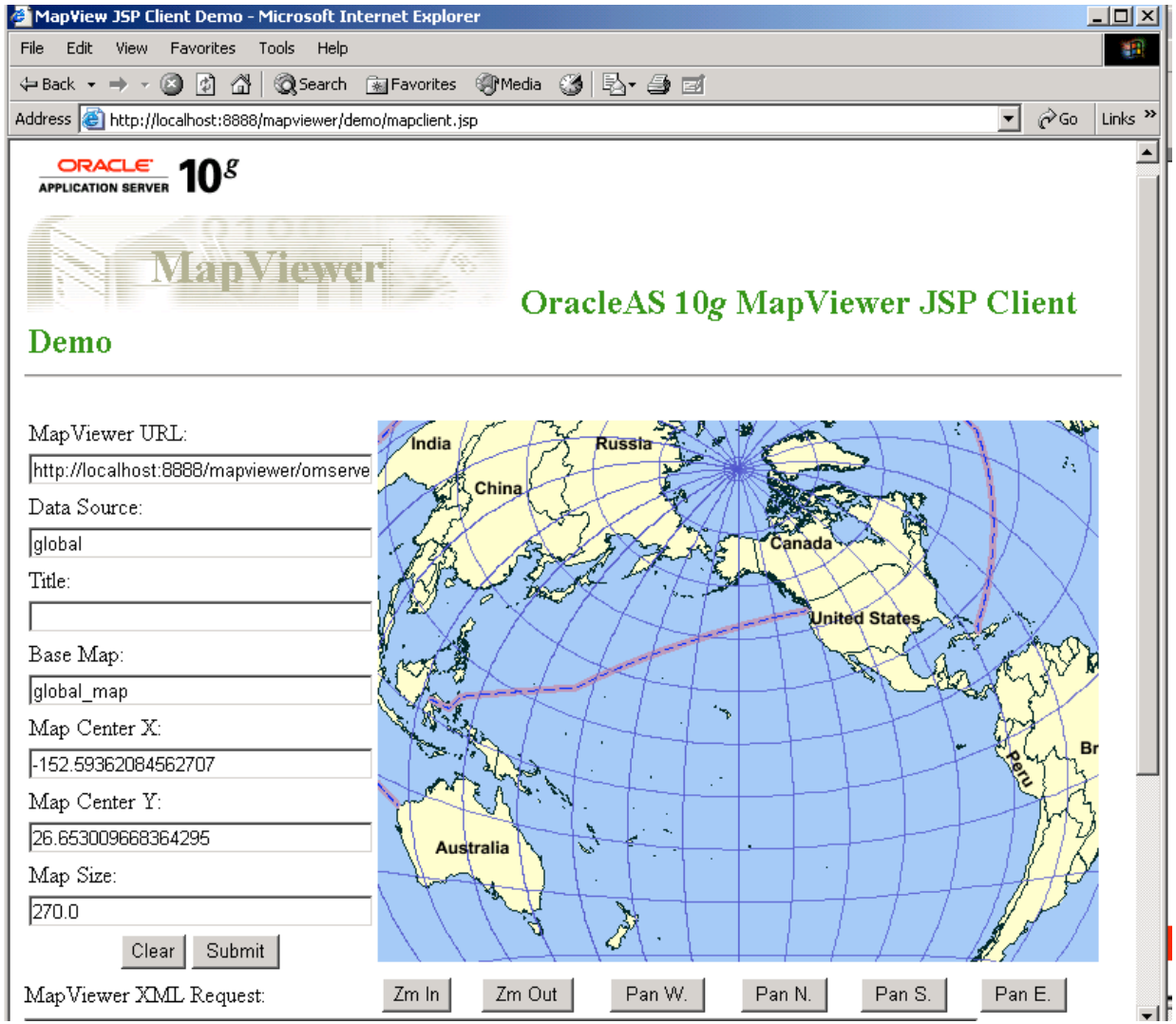


- P1 and P2 are 1 degree apart (about 111 Km apart)
- P3 and P4 are 1 degree apart (about 10 Km apart)
- Oracle Spatial can operate on Longitude/Latitude data

Coordinate Systems

- Support for whole Earth model (latitude/longitude)
  - Ellipsoidal computations
  - Accurate distance and area calculations (unit support)
  - Support for geometries that span the poles and the 180 meridian
- Support for projected coordinate systems
  - Cartesian computations
  - Many supported: UTM, State Plane, and many more…
  - Geometries fall off the edges of the projection
- Support for non-Earth coordinates (e.g., floor plan)

Ship Track That Crosses the 180 Meridian

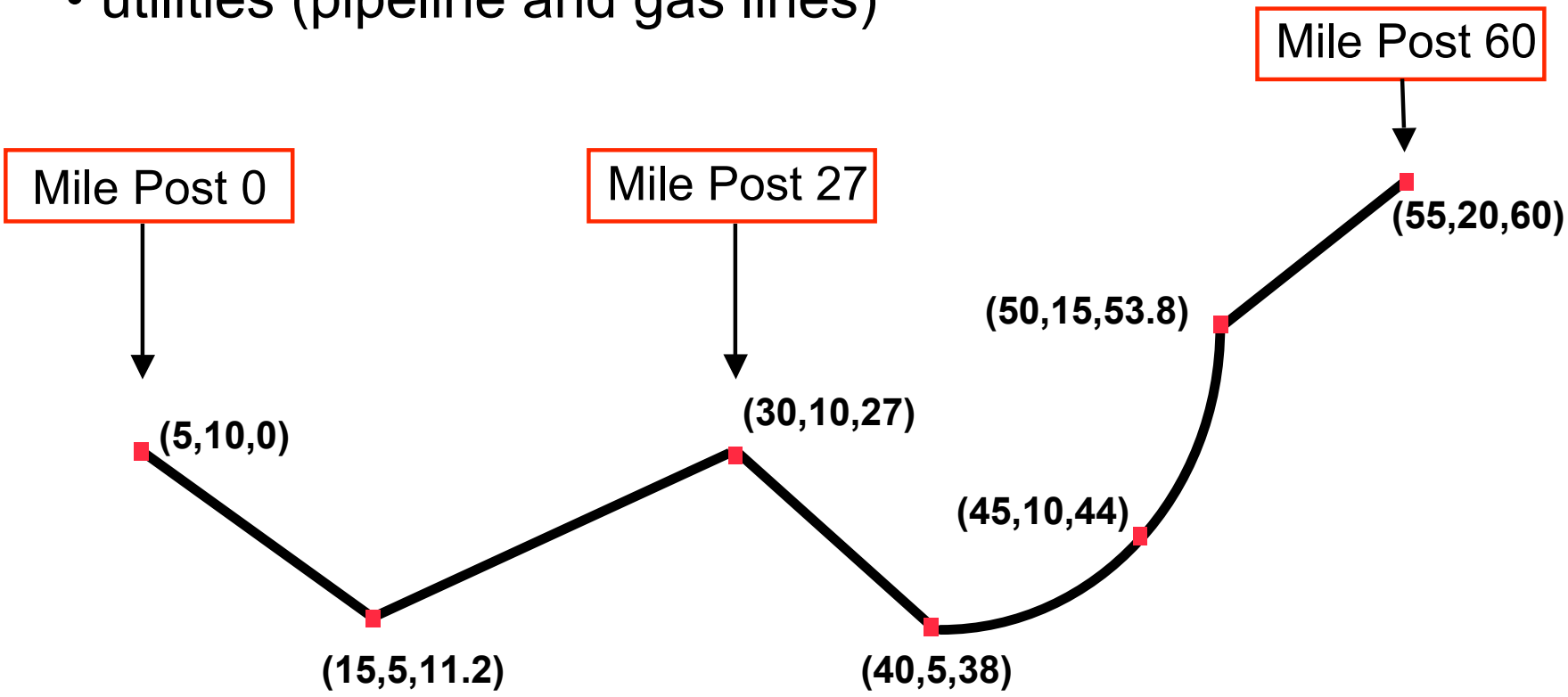


Oracle Spatial
Linear Referencing Systems (LRS)

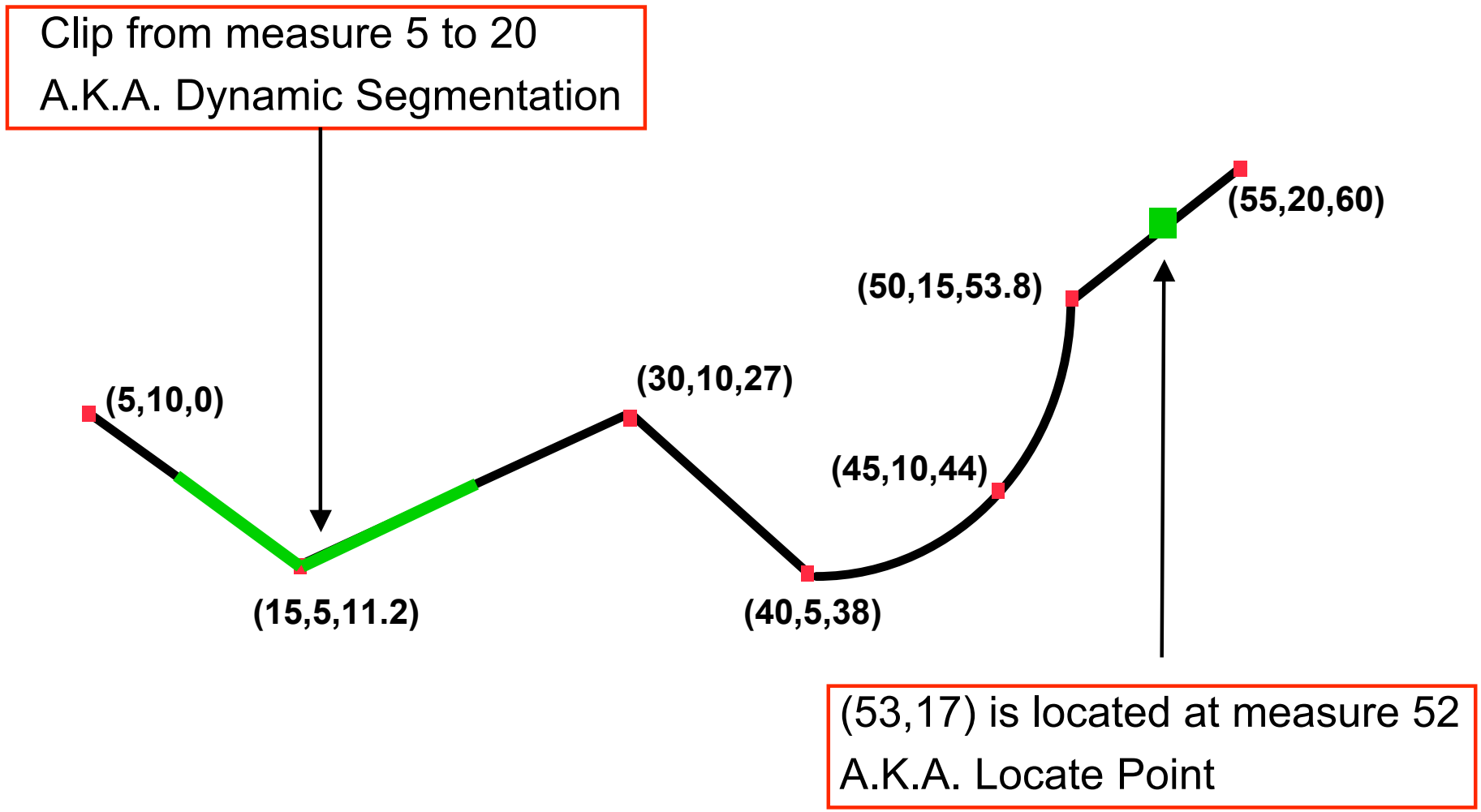
What Is Linear Referencing (LRS)?

Commonly used in many GIS applications such as:

- transportation (road network)
- utilities (pipeline and gas lines)

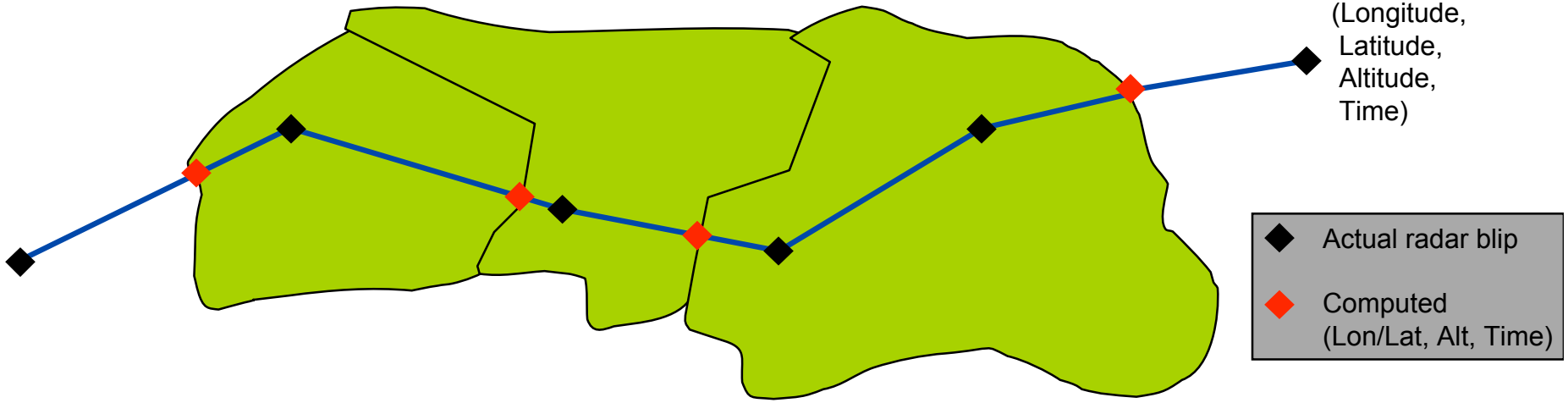


LRS Concepts



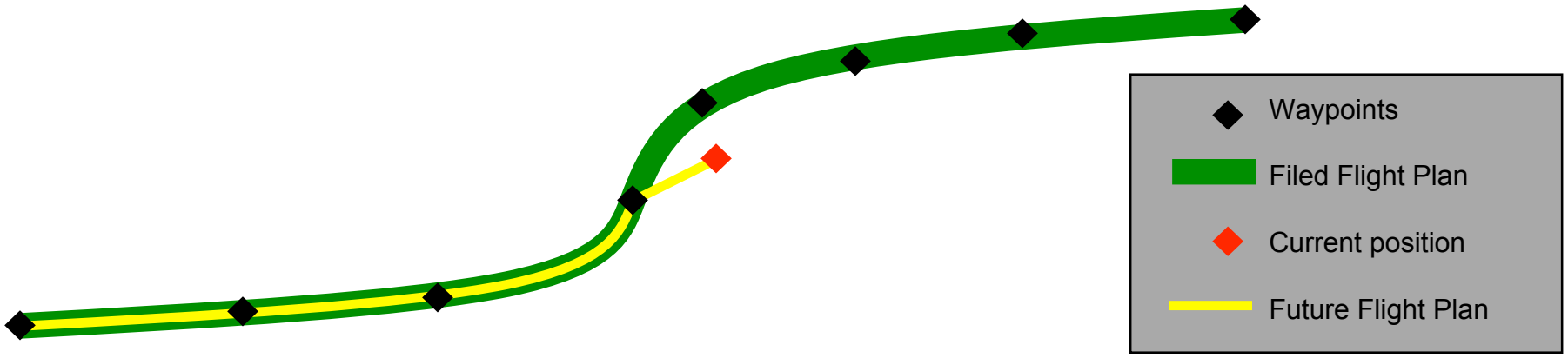
LRS Application – Oracle Spatial

- US Airspace Boundary Crossing Application
  - Oracle Spatial functions to calculate intersection of flight paths and US airspaces.
  - Linear Referencing to interpolate the time and altitude for entry/exit points of US airspace.
  - Accurately charge foreign carriers for the amount of time in US airspace.



OracleAS MapViewer and Oracle Spatial LRS

- MapViewer application for flight plan visualization
- Spatial analysis to project current flight position to next waypoint of original flight plan.
- Another example of LRS functionality

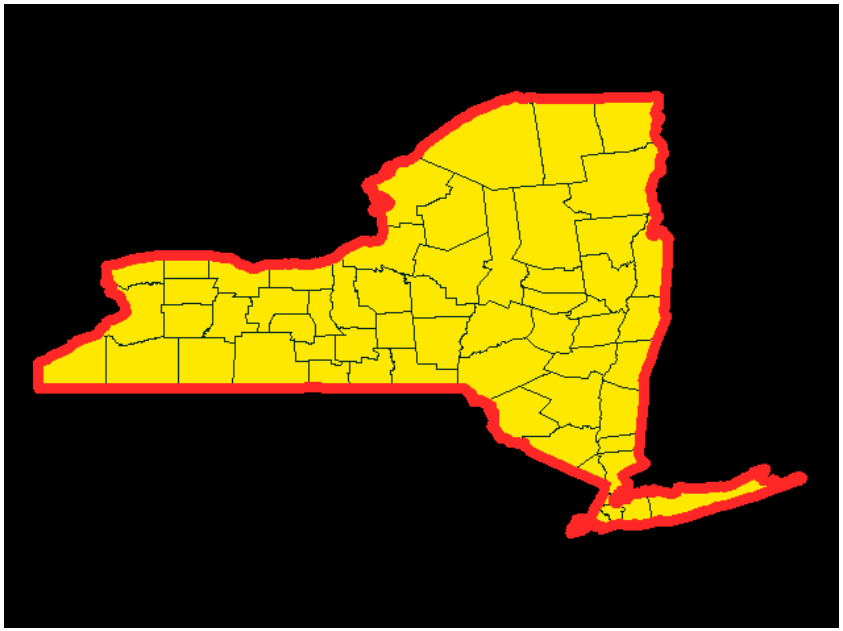


Oracle Spatial
Spatial Aggregate Functions

Spatial Aggregate Functions - Example

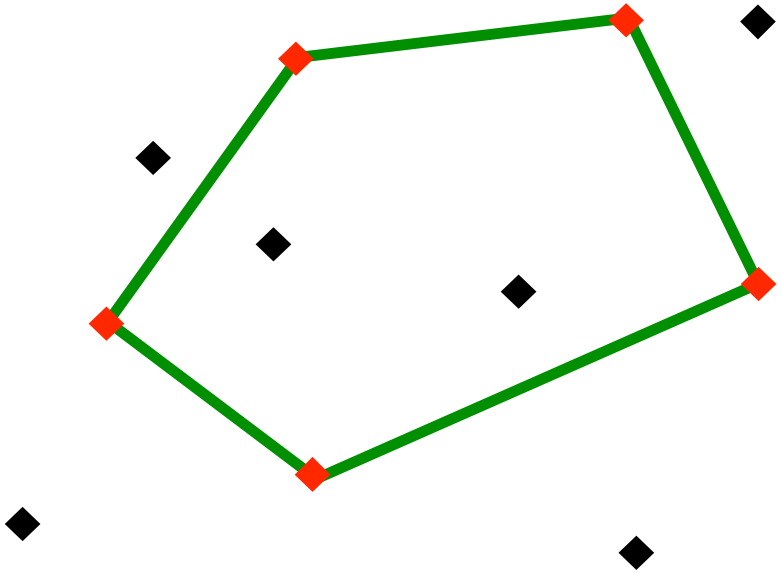
Generate New York state boundary by aggregating counties

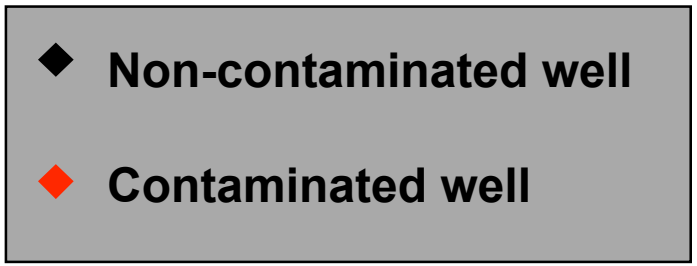
```
SELECT SDO_AGGR_UNION(sdo_aggr_type(a.geometry, 0.5)
FROM counties
WHERE state = 'New York';
```



SDO_AGGR_CONVEXHULL

- Snap a rubber band around contaminated wells
- Dynamically generate new region
- Further analysis with new region, e.g.
  - Search for chemical plants within 5 miles of new region



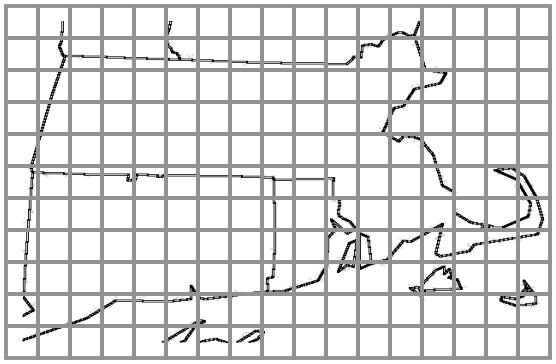


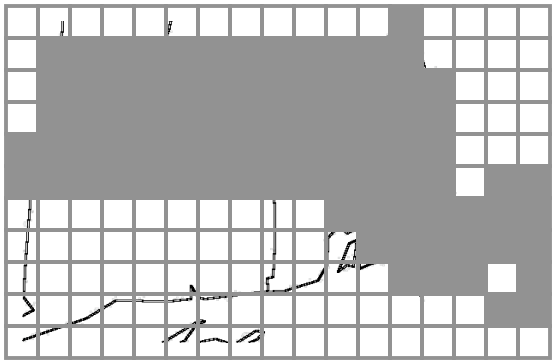
Oracle Spatial Partners

Oracle Spatial 10*g*
New Feature - GeoRaster

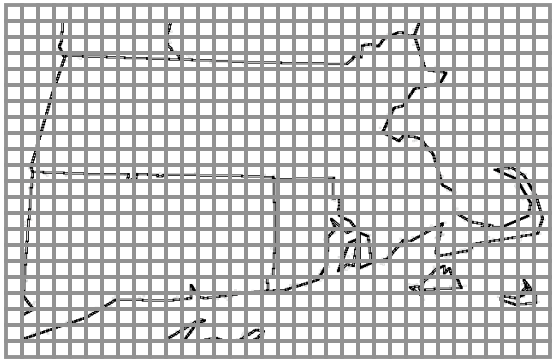
Raster Data and Cell Size

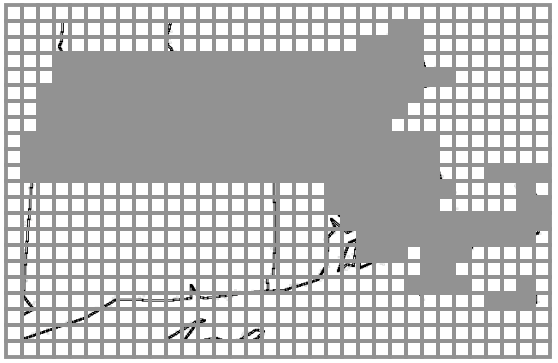
Coarser resolution



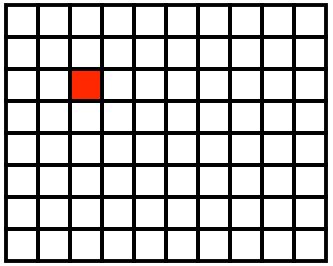
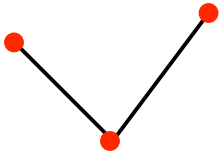
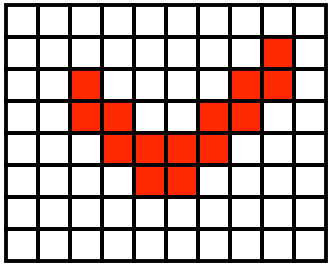
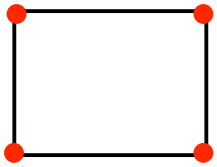
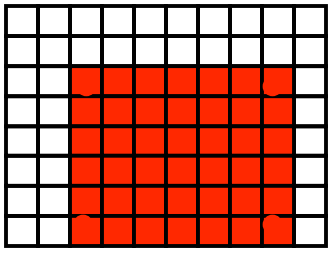


Finer resolution





Raster/Vector Data Differences

Vector Data	Vector Coordinates	Raster Data
	-74.1651749, 41.339141	
	-74.1651749, 41.339141, -73.4284481, 40.678193, -72.9792214, 41.686228	
	-74.1651749, 41.339141, -74.1651749, 39.559004, -72.9792214, 39.559004, -72. 9792214, 41.339141	

Grid Raster Data

A Value Attribute Table (VAT) is used to map the stored numeric values to the meaning of that value

- An example value attribute table for geological raster data

CELL VALUE	GEOLOGICAL PERIOD
1	Quaternary
2	Tertiary
3	Paleocene-Cretaceous
4	Mesozoic
5	Gondwana
6	Early Palaeozoic
7	Proterozoic
8	Early Proterozoic
9	Archaean
0	Blank Cell (no data)

Stored cell values

2	5	4	9	1	9	7	6
6	1	1	1	1	1	6	6
1	3	8	7	9	7	9	1
3	1	8	3	3	5	9	1
3	3	3	9	8	7	9	1
0	3	3	3	9	9	1	0
0	8	8	9	9	1	0	0
0	0	2	9	1	0	0	0

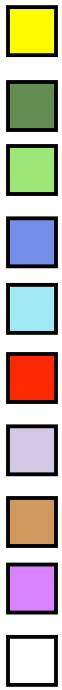
A value attribute table can also contain user-defined columns

Grid Raster Data

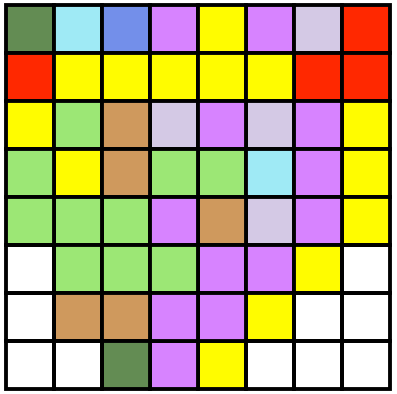
A COLORMAP table is used to map the stored numeric values to the display characteristics of that value

- An example COLORMAP table for geological raster data

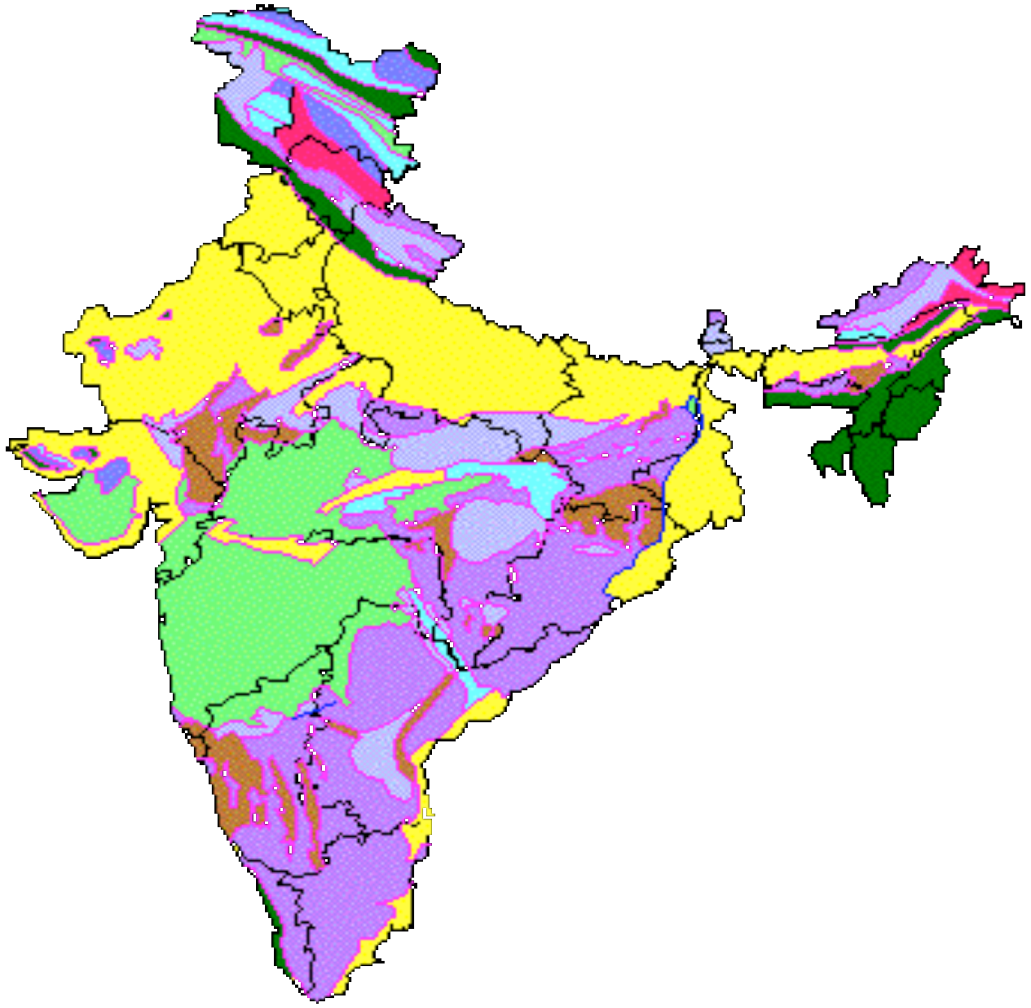
CELL VALUE	Red	Green	Blue
1	255	255	0
2	82	123	67
3	142	230	98
4	96	121	228
5	145	231	243
6	255	51	0
7	203	188	224
8	195	135	75
9	204	102	255
0	0	0	0



2	5	4	9	1	9	7	6
6	1	1	1	1	1	6	6
1	3	8	7	9	7	9	1
3	1	8	3	3	5	9	1
3	3	3	9	8	7	9	1
0	3	3	3	9	9	1	0
0	8	8	9	9	1	0	0
0	0	2	9	1	0	0	0



Geological Map of India (Grid Raster Data)



- Quaternary
- Tertiary
- Paleocene-Cretaceous
- Mesozoic
- Gondwana
- Early Palaeozoic
- Late Proterozoic
- Early Proterozoic
- Archaean

Raster Data Concepts – (Digital Imagery)

- **Digital Imagery** - a specialized type of raster data
  - Examples include:
    - Satellite imagery
    - Airborne photographs
    - others…

Raster Data: Digital Images

Each band collected at different wavelength for later processing and/or display

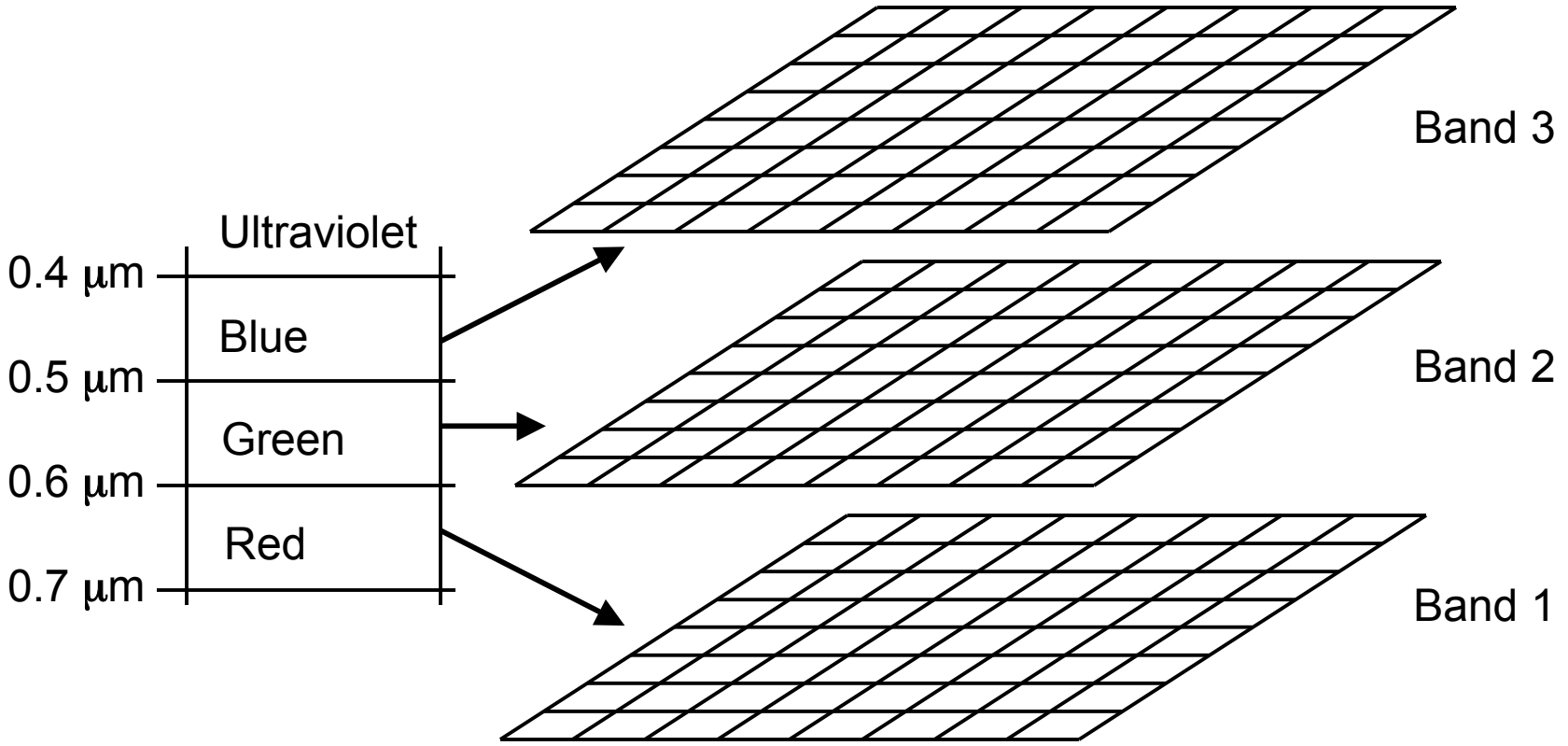
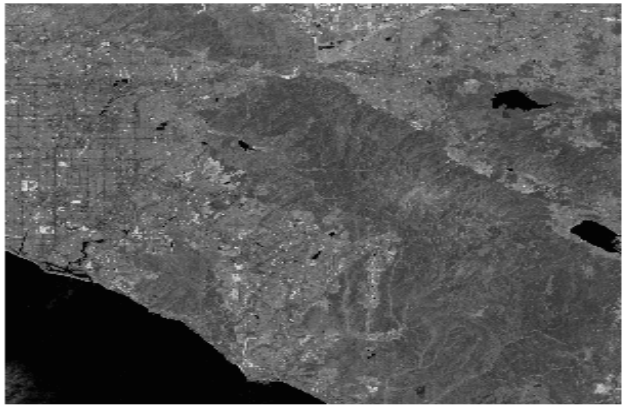
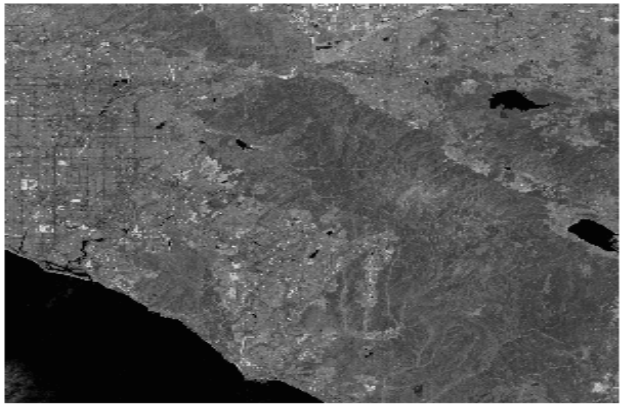


Image Data

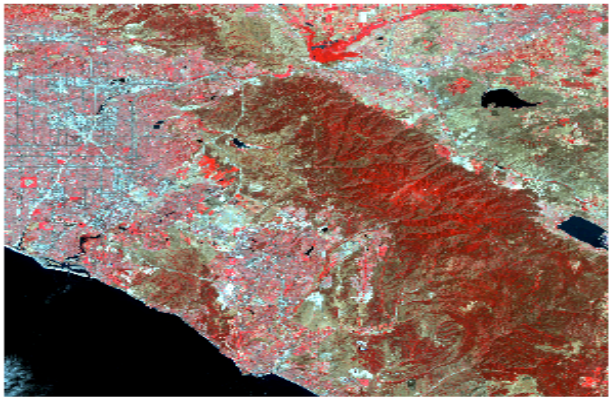
TM Band 2



TM Band 3



TM Band 4

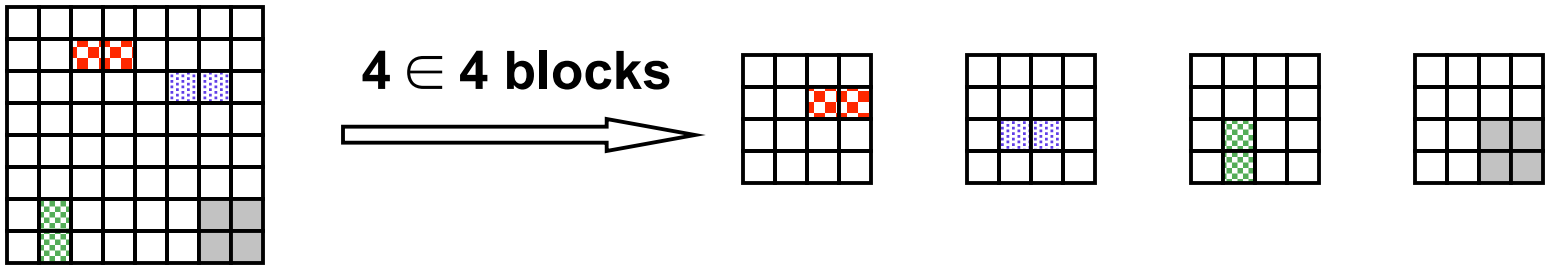


TM Band 432

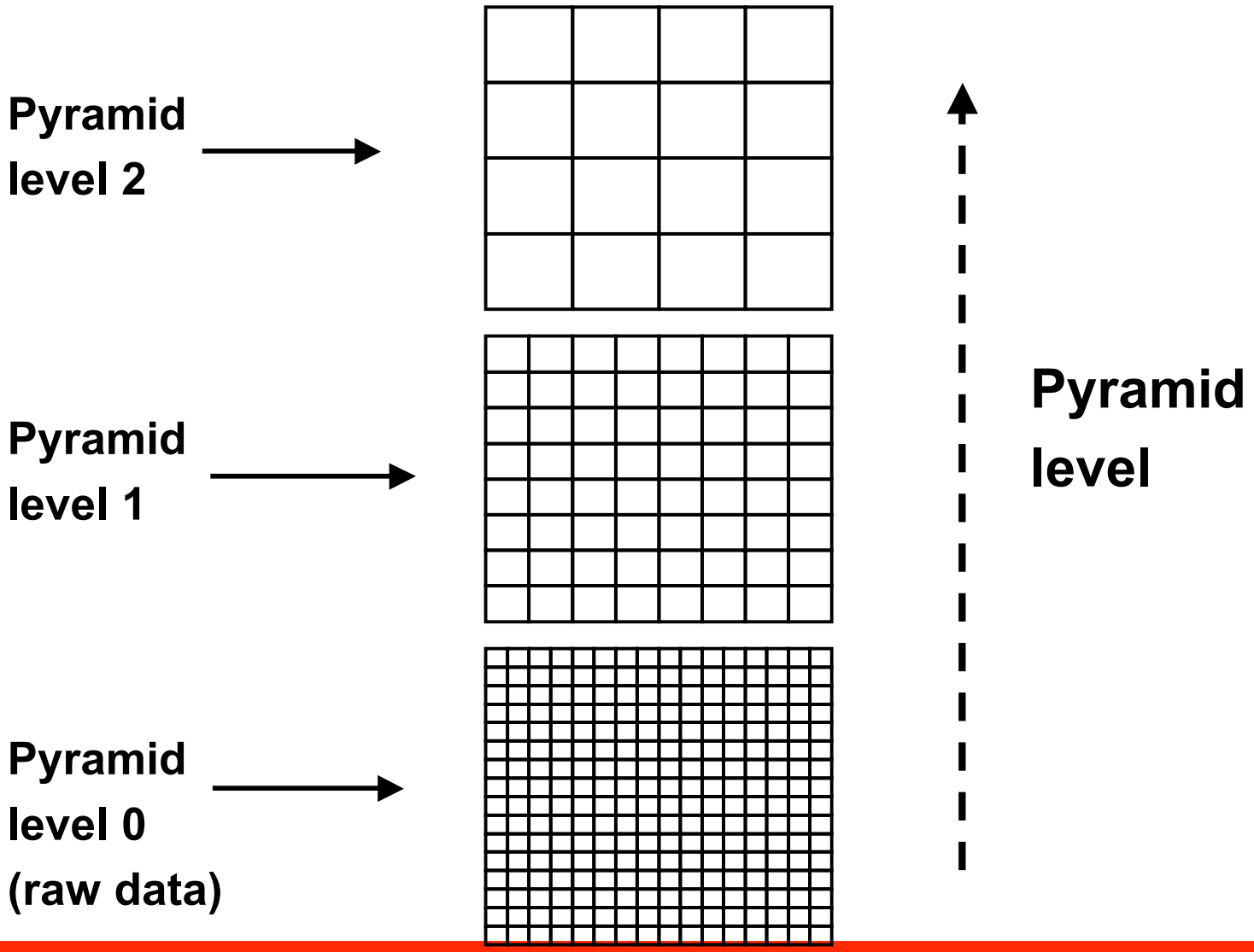
Some bands may accentuate different features

Blocking

- Index very large rasters into smaller blocks
- Interleave multi-band raster
  - Band sequential (BSQ)
  - Band interleaved by pixel (BIP)
  - Band interleaved by line (BIL)



Pyramids


Pyramid level 2
Pyramid level 1
Pyramid level 0 (raw data)
Pyramid level

GeoRaster: Oracle's Raster Loader

- Oracle's minimum support for loaders and exporters includes:
  - TIFF/GeoTIFF
  - ESRI World File
  - JPEG
  - GIF
  - BMP
  - PNG
- Oracle relies on partners to import from / export to many formats

GeoRaster - Features/Functionality

- Store, index, and retrieve raster data
- Store, maintain, and retrieve GeoRaster metadata
- Analysis functionality:
  - Generate pyramids
  - Copy
  - Change format: Interleaving, blocking
  - Subset: Crop, cut, clip by band or layer
  - Scaling: Enlarge or reduce
  - Generate the spatial extent of an image
  - Tile adjacent images to build a mosaic of the data
  - Georectified/Georeferenced images supported
- MapViewer supports visualization of GeoRaster data

Oracle Spatial 10^{g} New Feature
Geocoder

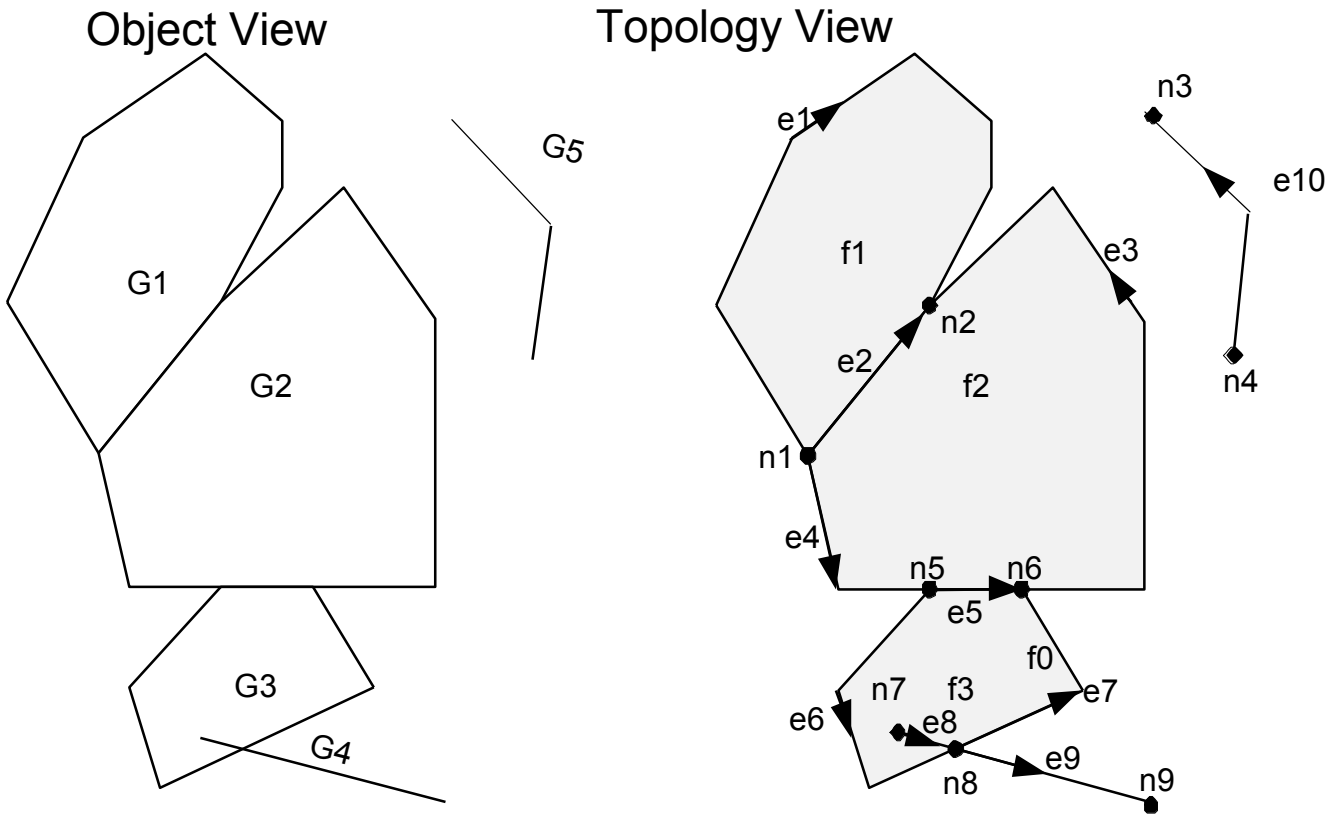
- Geocoding Engine included in Oracle Spatial
- Generates latitude/longitude (points) from address
- Supports:
  - International addressing standardization
  - Formatted and unformatted addresses
  - Fuzzy matching
  - Transaction and batch capabilities
- Data dictionary completely extensible
- Base data available from NAVTEQ & Tele Atlas
  - Download sample data from NAVTEQ

Oracle Spatial 10^{g} New Feature
Router

- Routing algorithms included in Oracle Spatial
- Generates driving directions
- XML API
- Base data available from NAVTEQ & Tele Atlas
  - Download sample data from NAVTEQ

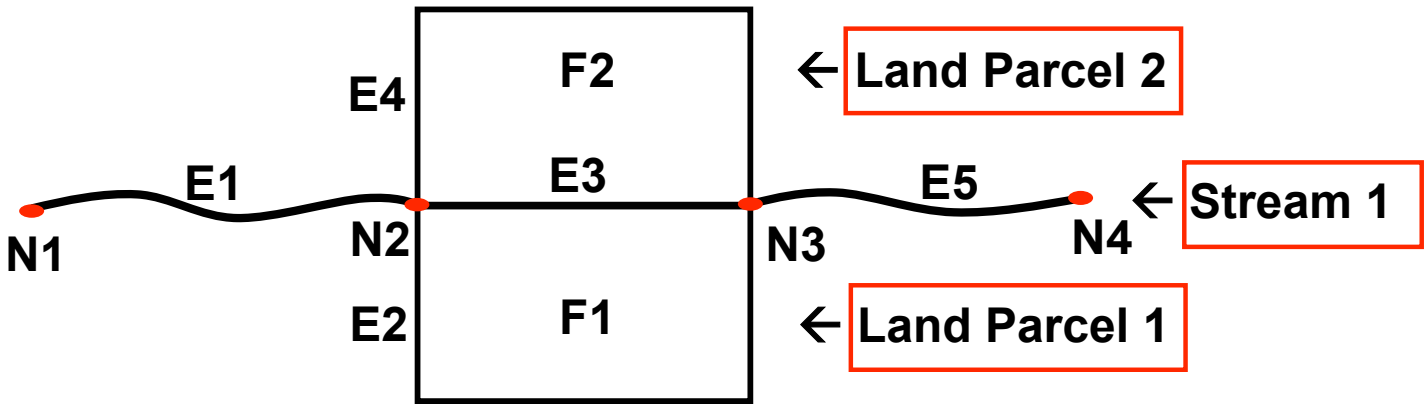
Oracle Spatial 10*g*
New Feature
Persistent Topology

Introduction



Topology Example

- Land parcel features
  - Land Parcel 1 associated with face F1
  - Land Parcel 2 associated with face F2
  - Both faces include edge E3.
- Stream features
  - Stream 1 associated with edge E3 (and edges E1 and E5)

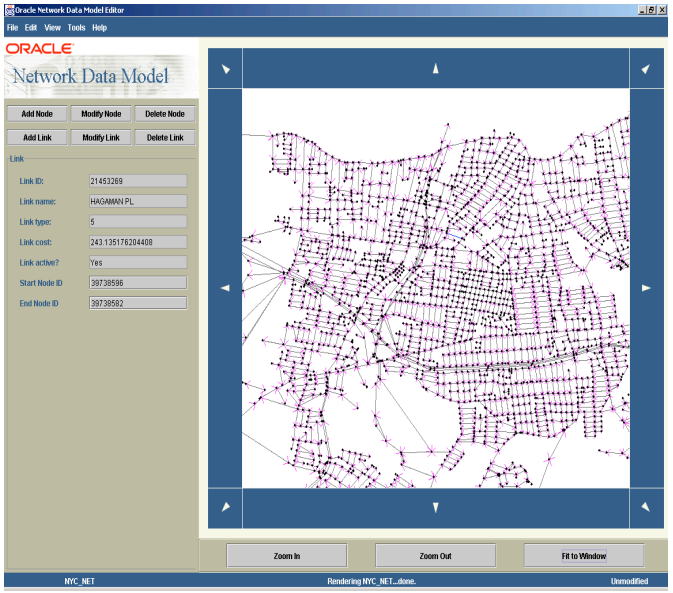


Oracle Spatial 10*g*

New Feature Network Data Model

Network Data Model

- Open Data Model For Graph Analysis
  - Store network (graph) structure in the database
  - Maintains connectivity of the network
  - Attributes at link and node level
- Supports Network solutions (Tracing & Routing)
  - Transportation and Transit Solutions
  - Field Service, Logistics
  - Location based Services and Telematics
- Bio-Info Pathways (Life Sciences)
  - Biological Pathways
  - Protein-Protein Interaction
- Network Viewer



Oracle Spatial 10*g*
Spatial Analysis and Mining

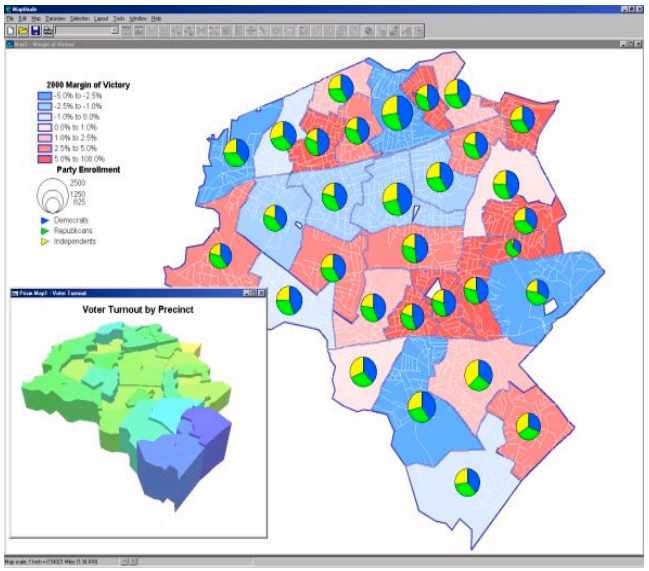
Spatial Analysis and Mining

- *Everything is related to everything else, but nearby things are more related than distant things.*

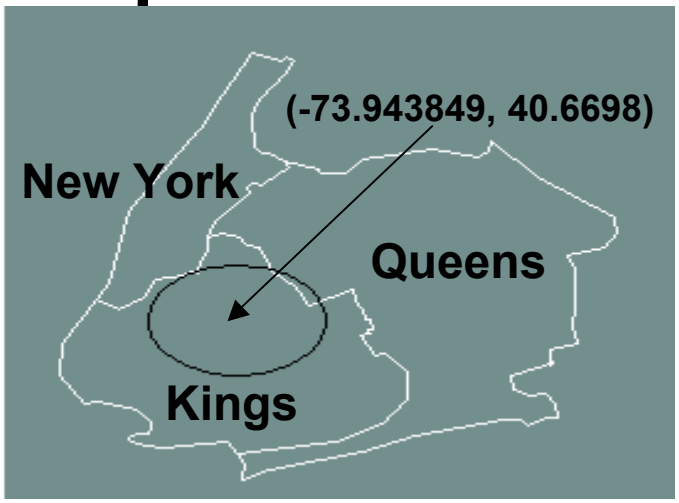
  Tobler's first law of geography

Spatial Analytic Functions

- Discovery based on Spatial Patterns
  - Cluster analysis
  - Location prospecting



SDO_SAM.AGGREGATES_FOR_GEOMETRY: Example

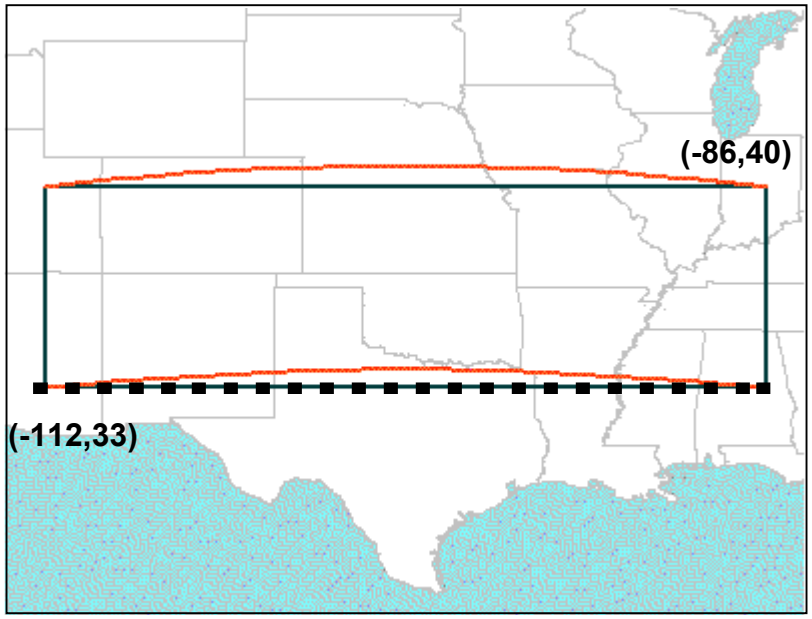


COUNTY	ST	TOTPOP	% COUNTY COVERED BY WINDOW
Queens	NY	1951598	00.5437756
Kings	NY	2300664	31.0430579
New York	NY	1487536	00.0188785

```
SELECT SDO_SAM.AGGREGATES_FOR_GEOMETRY(
  'GEOD_COUNTIES', 'GEOM',
  'sum', 'totpop',
   SDO_GEOMETRY(2001, 8307,
     SDO_POINT_TYPE(-73.943849, 40.6698,NULL),
     NULL, NULL),
  'distance=3 unit=mile')
FROM DUAL;
-----------------------
723570.362
```

Oracle Spatial 10*g*
Some Miscellaneous New Features

Geodetic Optimized Rectangle Densified Along Latitude Lines



- `SDO_CS.VIEWPORT_TRANSFORM` no longer necessary
- Backported to 9.2.0.6
- Can span the 180 meridian

New SQL/MM Methods for SDO_GEOMETRY

- GET_WKB() – Get Well Known Text
- GET_WKT() – Get Well Known Binary

```
set long 500;
SELECT A.GEOM.GET_WKT()
FROM polygon_table a
WHERE id = 1;


A.GEOM.GET_WKT()
----------------
POLYGON ((146.0 66.0, 148.0 66.0, 148.0 68.0, 146.0 68.0,
          146.0 66.0))
```

New SQL/MM Constructors for SDO_GEOMETRY

- Constructor input can be either:
  - **SQL/MM Well-Known Text (WKT)**
  - **SQL/MM Well-Known Binary (WKB)**
- These constructors return an **SDO_GEOMETRY** object:

```
SELECT SDO_GEOMETRY(
         'POLYGON ((146.0 66.0, 148.0 66.0,
                    148.0 68.0, 146.0 68.0, 146.0 66.0))', 8307)
FROM dual;


Return value
SDO_GEOMETRY(2003, 8307, NULL,
  SDO_ELEM_INFO_ARRAY(1, 1003, 1),
  SDO_ORDINATE_ARRAY(146,66, 148,66, 148,68, 146,68, 146,66))
```

Oracle Spatial 10^{g} New Features: Summary

- GeoRaster data type
- Persistent Topology data type
- Network Data Model
- Spatial Analysis and Mining
- Geocoder in the database
- Routing Engine
- Core Feature
  - Transportable Tablespace Support for Spatial Indexes
  - New Functions
    - Point_At_Bearing
    - Simplify
    - others…

Oracle Application Server 10*g*
MapViewer

Oracle Application Server 10^{g} MapViewer

- Web Map Server
  - Standard feature of the Oracle Application Server
  - Integrated with Oracle Spatial and Oracle Locator
- Easily publishes data stored in Oracle's native spatial data type (SDO_GEOMETRY) to the web
- Provides an XML API, Java API and JSP Tag library

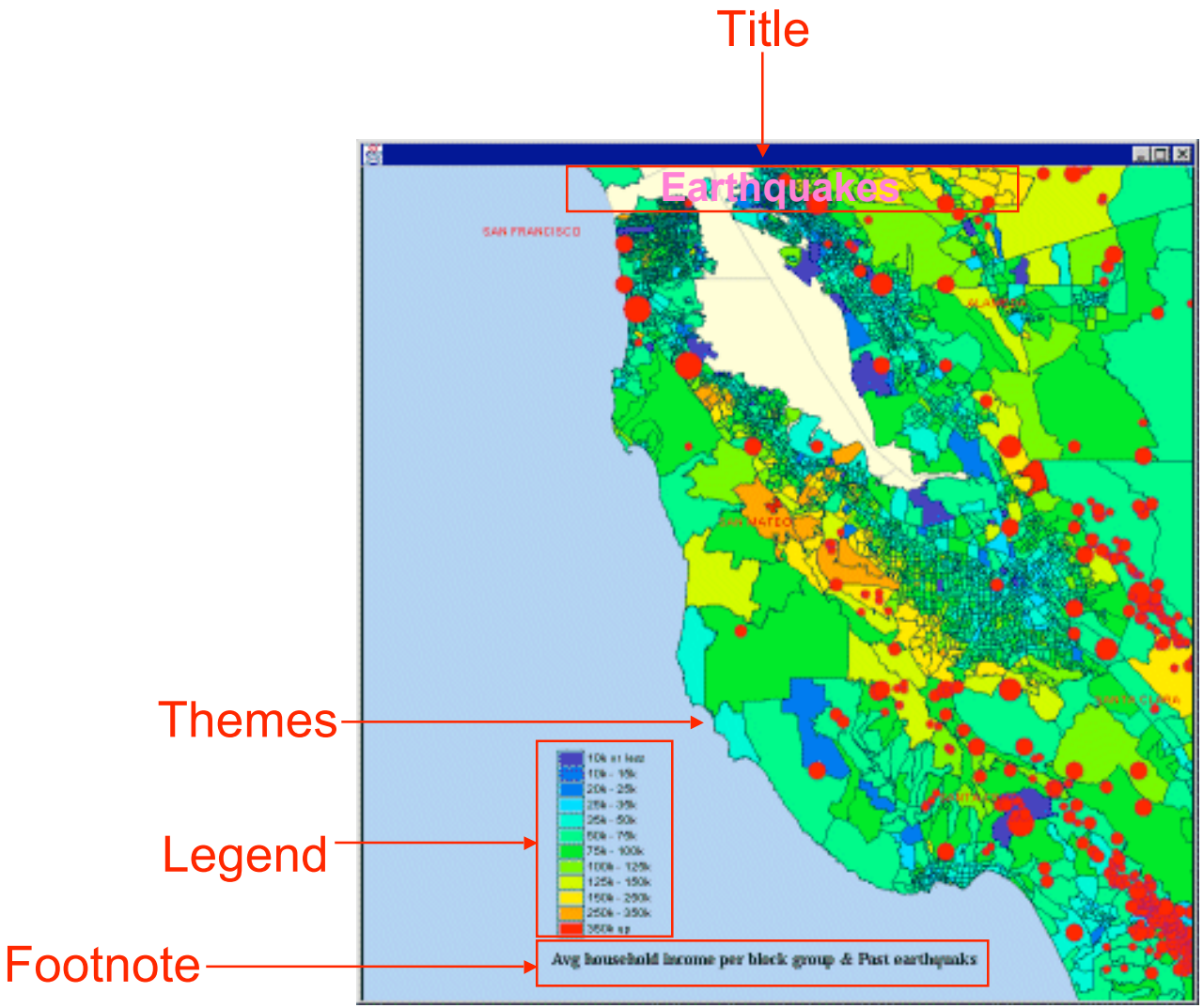
OGC Compliant Web Map Service (WMS)

- Supports the following requests:
  - **`GetMap`**
  - **`GetFeatureInfo`**
  - **`GetCapabilities`**
- MapViewer can:
  - Generate OGC WMS compliant maps
  - Render OGC WMS compliant maps generated by another OGC compliant WMS
  - Render vector and raster data on maps generated by another OGC compliant WMS

MapViewer Oracle Workspace Manager Support

- **Workspace Manager**
  - Oracle Database feature that lets you version-enable one or more tables in the database
  - Users can create workspaces
  - Users can go to workspaces
  - Edits to versioned enabled tables in a workspacace, can only be seen by users in that workspace
- **`MapViewer`** supports map requests from:
  - A specific workspace
  - A savepoint in a workspace

MapViewer: Map



Oracle10^{g} Locator & Spatial Features

Oracle Locator

- All Data Types
- Spatial Operators
  - Topological
  - Distance
- Distance Function
- Implicit Coordinate Transformations
- Long Transactions
- Table Partitioning*
- Object Replication*
- Oracle Label Security

Bundled Feature
Standard & Enterprise Edition

Oracle Spatial 10^{g}

- All Locator features
- GeoRaster Data Type
- Topology Data Model
- Network Data Model
- Geocoding
- Routing
- Coordinate Transforms
- Linear Referencing
- Spatial functions
  - aggregates
  - buffer, centroid, union,etc

Licensed Option
Enterprise Edition Only

Leverage Oracle's Spatial Technologies

- Every organization wants to cut costs
- Oracle Spatial Technologies Bundle
  - Oracle Locator
    - Oracle Standard Edition
    - Oracle Enterprise Edition
  - Oracle Application Server MapViewer
    - Java Edition
    - Standard Edition
    - Enterprise Edition
- Leverage what you own

Oracle Spatial 10*g* Release 2

GeoRaster: Compression

- Natively support two industry standard compression techniques
  - JPEG (lossy)
    - JPEG-B (abbreviated baseline JPEG format)
    - JPEG-F (full-format baseline JPEG format)
  - DEFLATE (lossless)
    - (a.k.a. ZIP)
  - each block is compressed and uncompressed individually
- All GeoRaster operations work on compressed/uncompressed GeoRaster objects
  - Automatic decompression on sub-set operations

For more information visit our web site at:
http://www.oracle.com/technology/products/spatial