



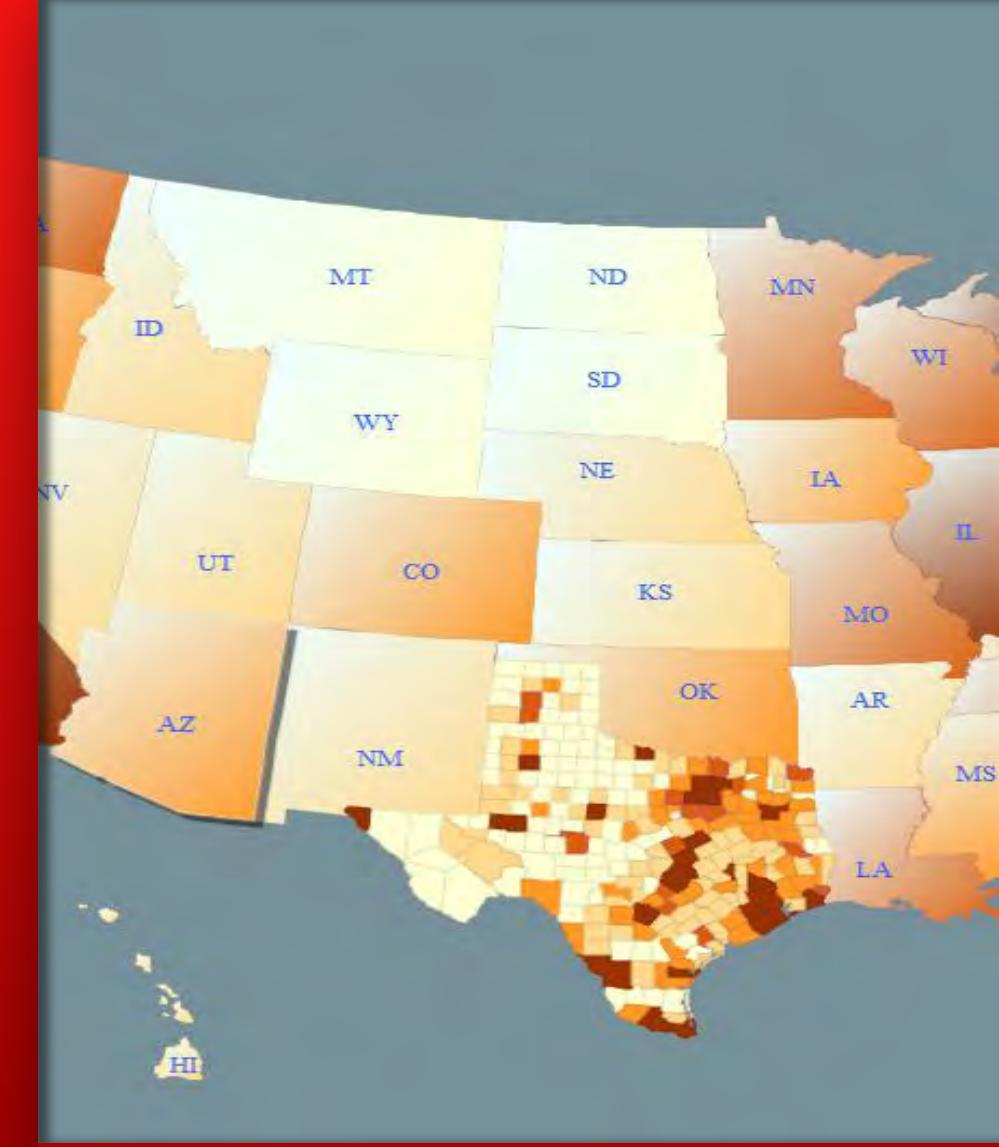
# Using Location Analysis in Large Scale Operational Systems

Siva Ravada

Senior Director of Development

Spatial and Graph & MapViewer

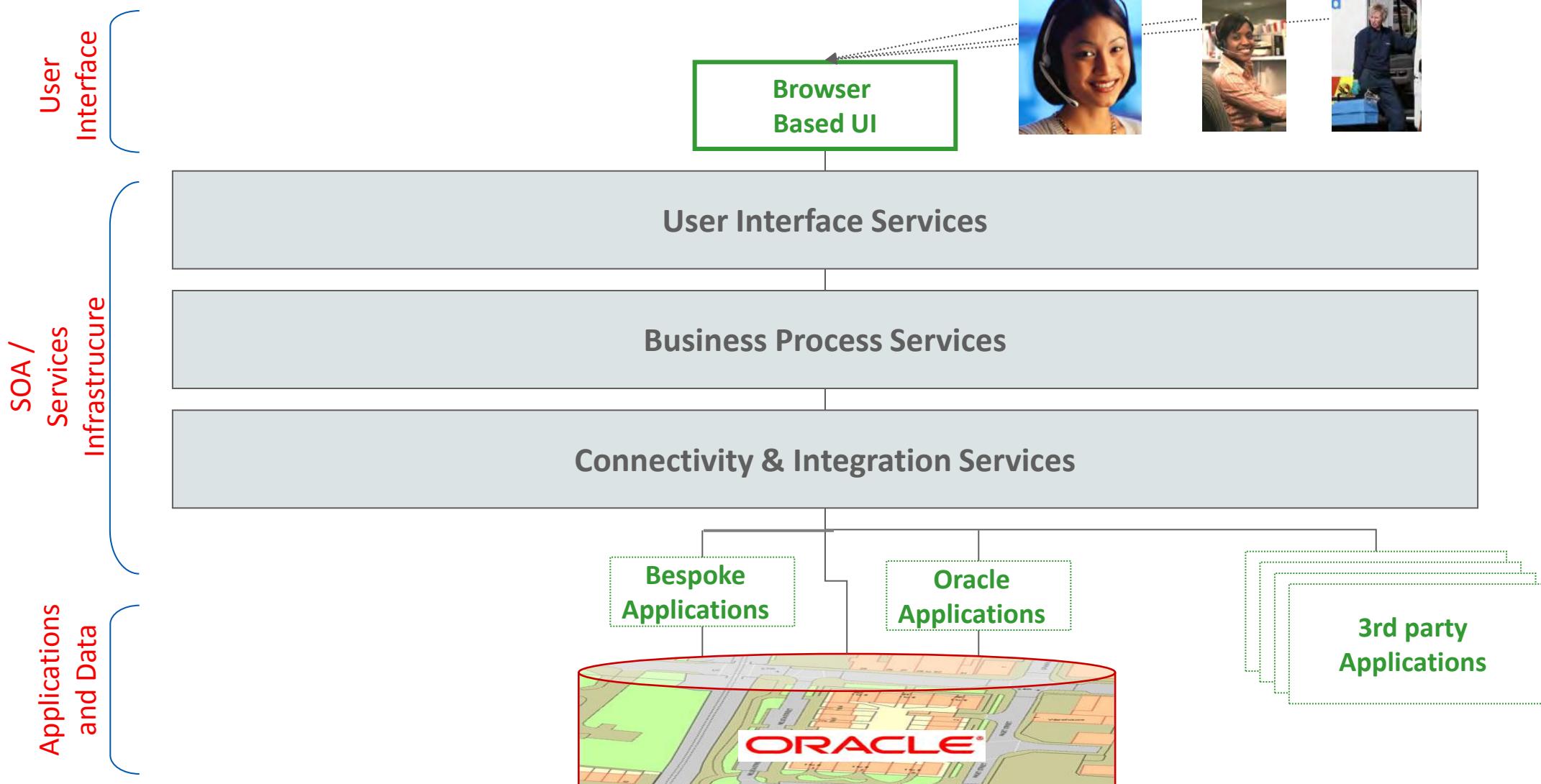
Oracle



# Program Agenda

- 1      Operational systems based on DBs
- 2      Location Analysis without a GIS
- 3      APEX and Maps
- 4      Custom Hierarchical Maps

# Conceptual Architecture

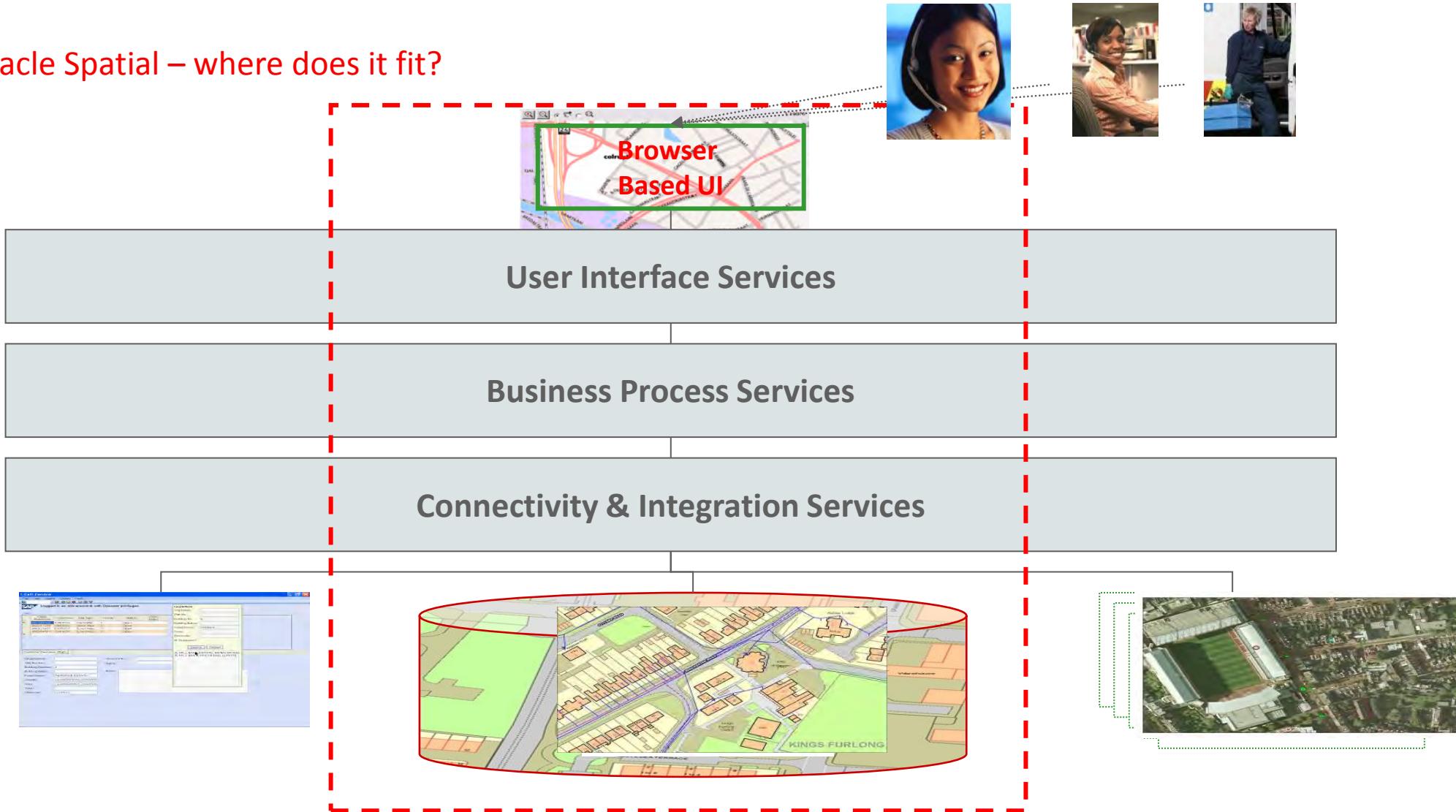


User Interface

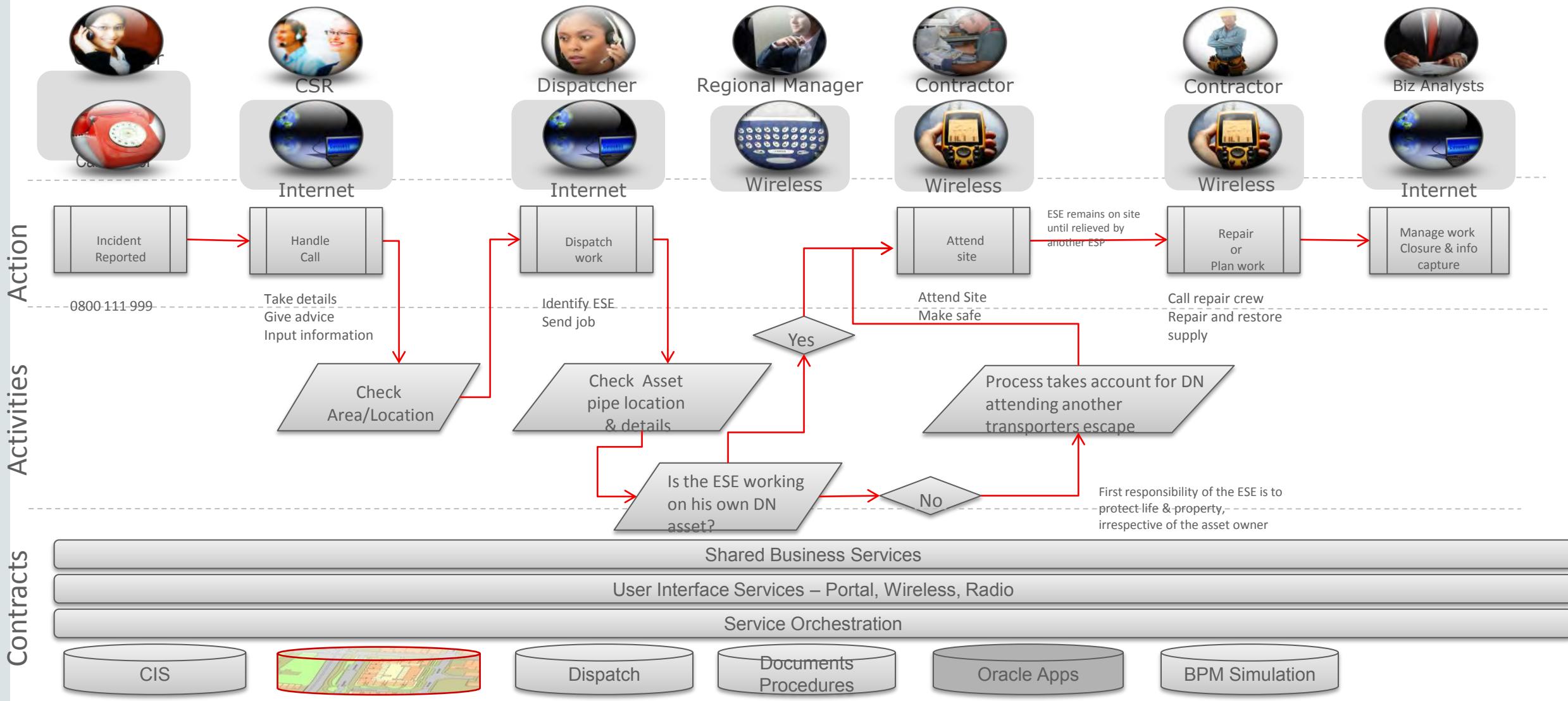
SOA / Services Infrastructure

Applications and Data

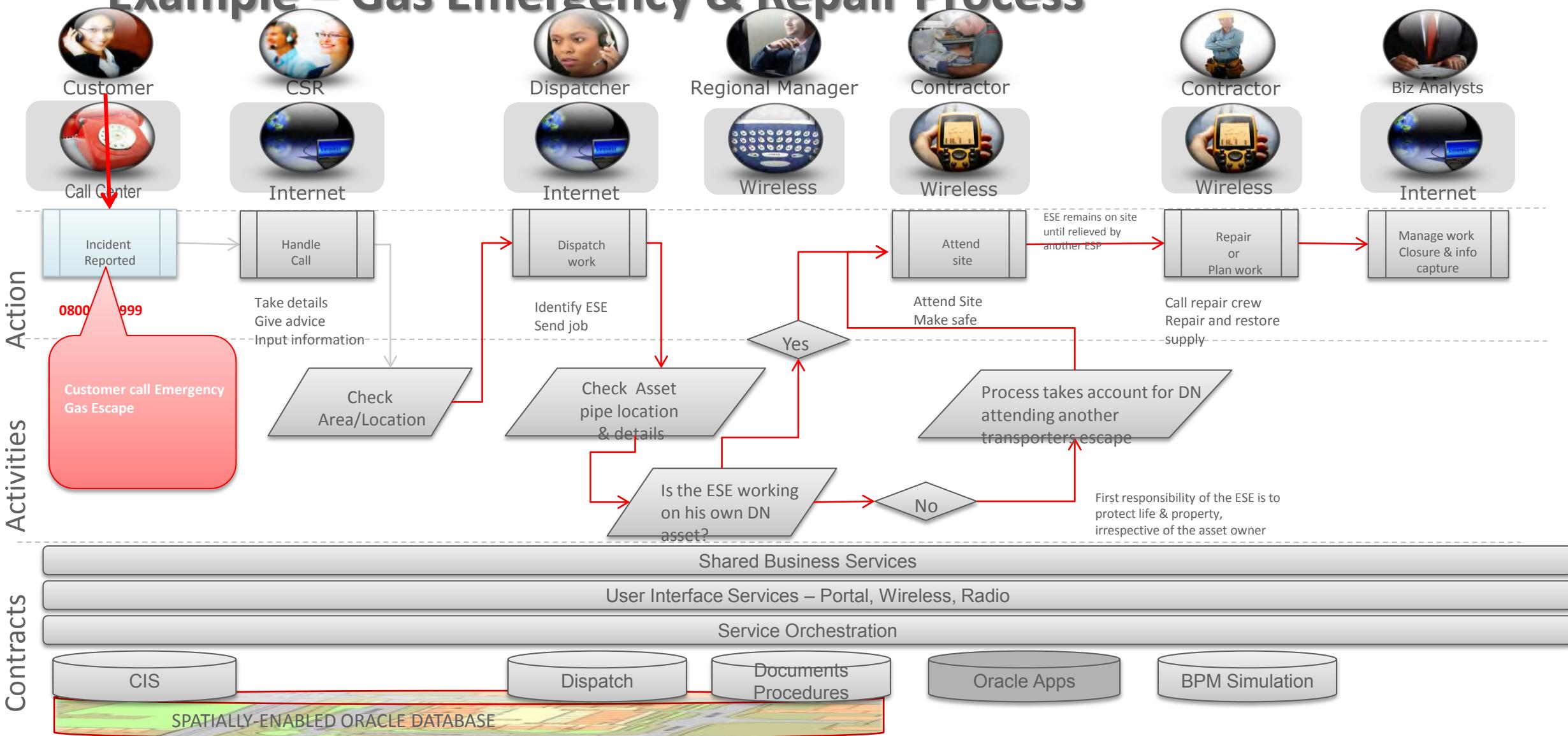
Oracle Spatial – where does it fit?



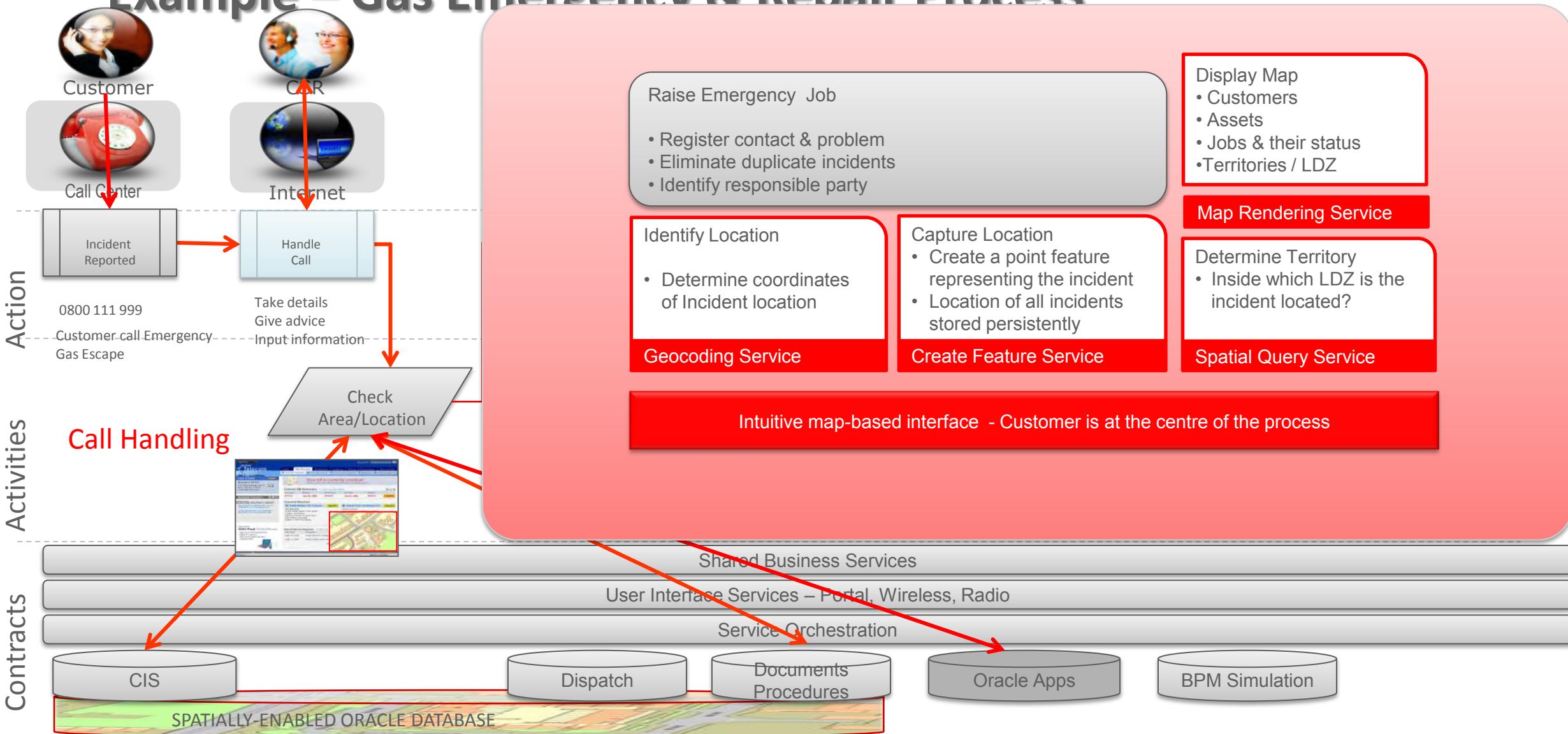
# Example – Gas Emergency & Repair Process



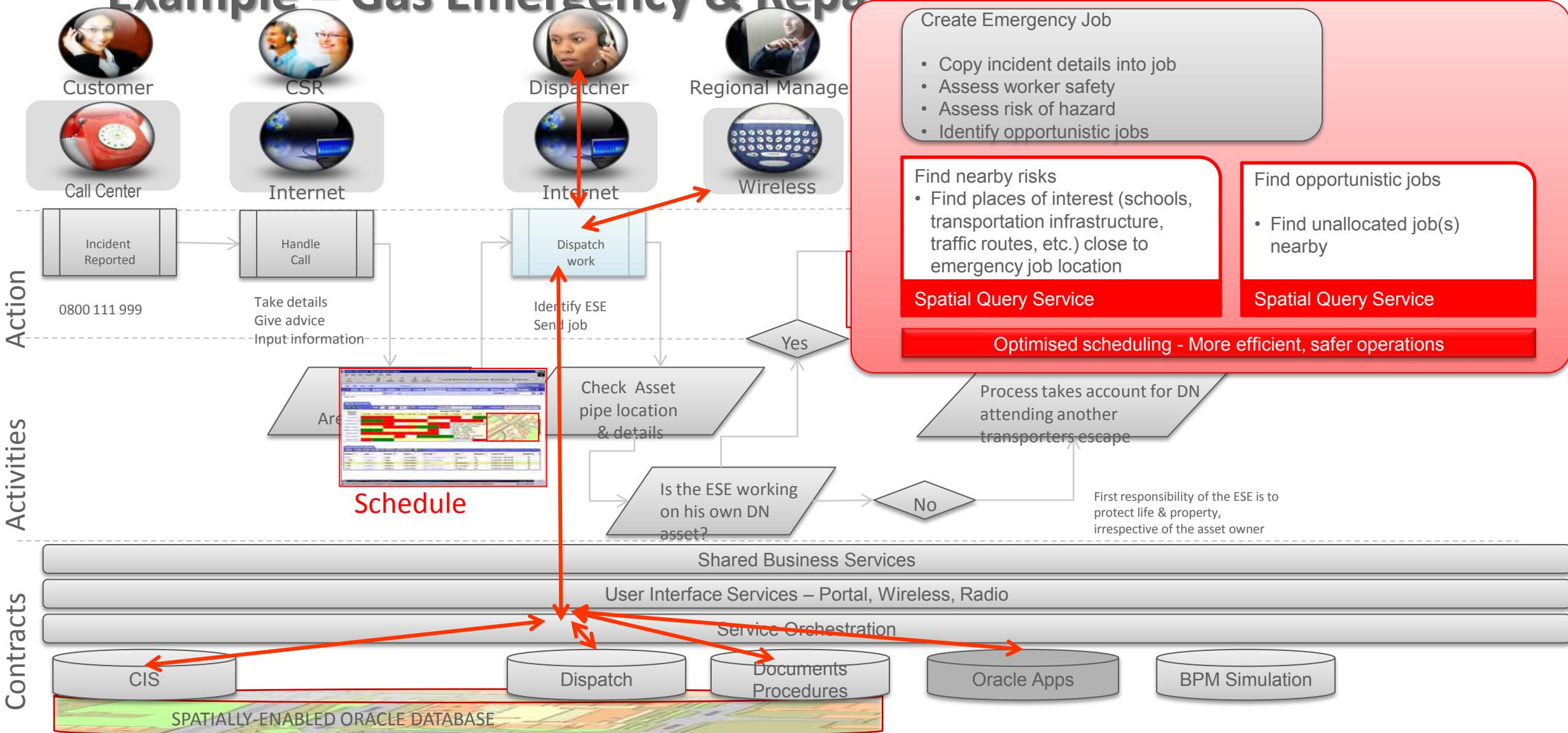
# Example – Gas Emergency & Repair Process



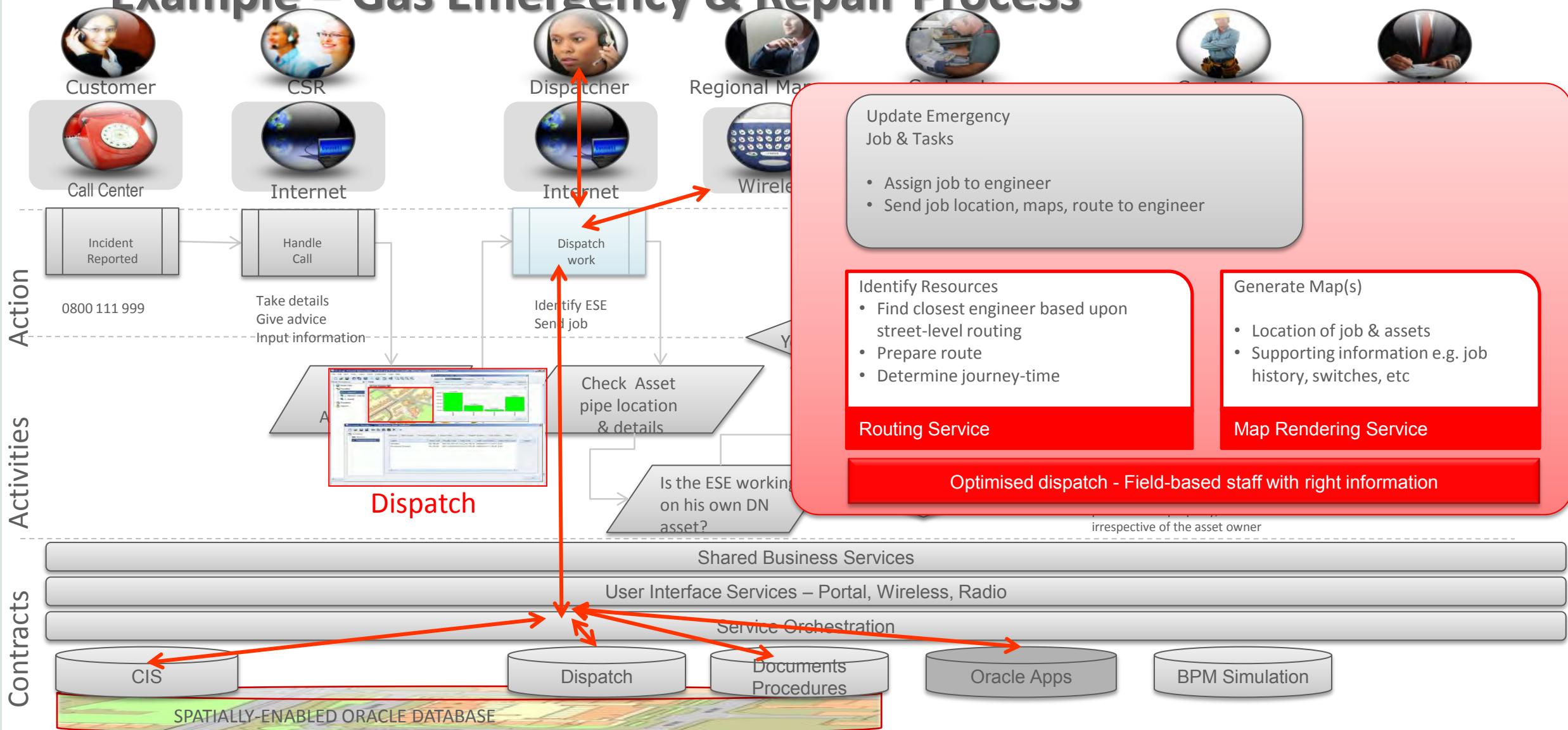
# Example – Gas Emergency & Repair Process



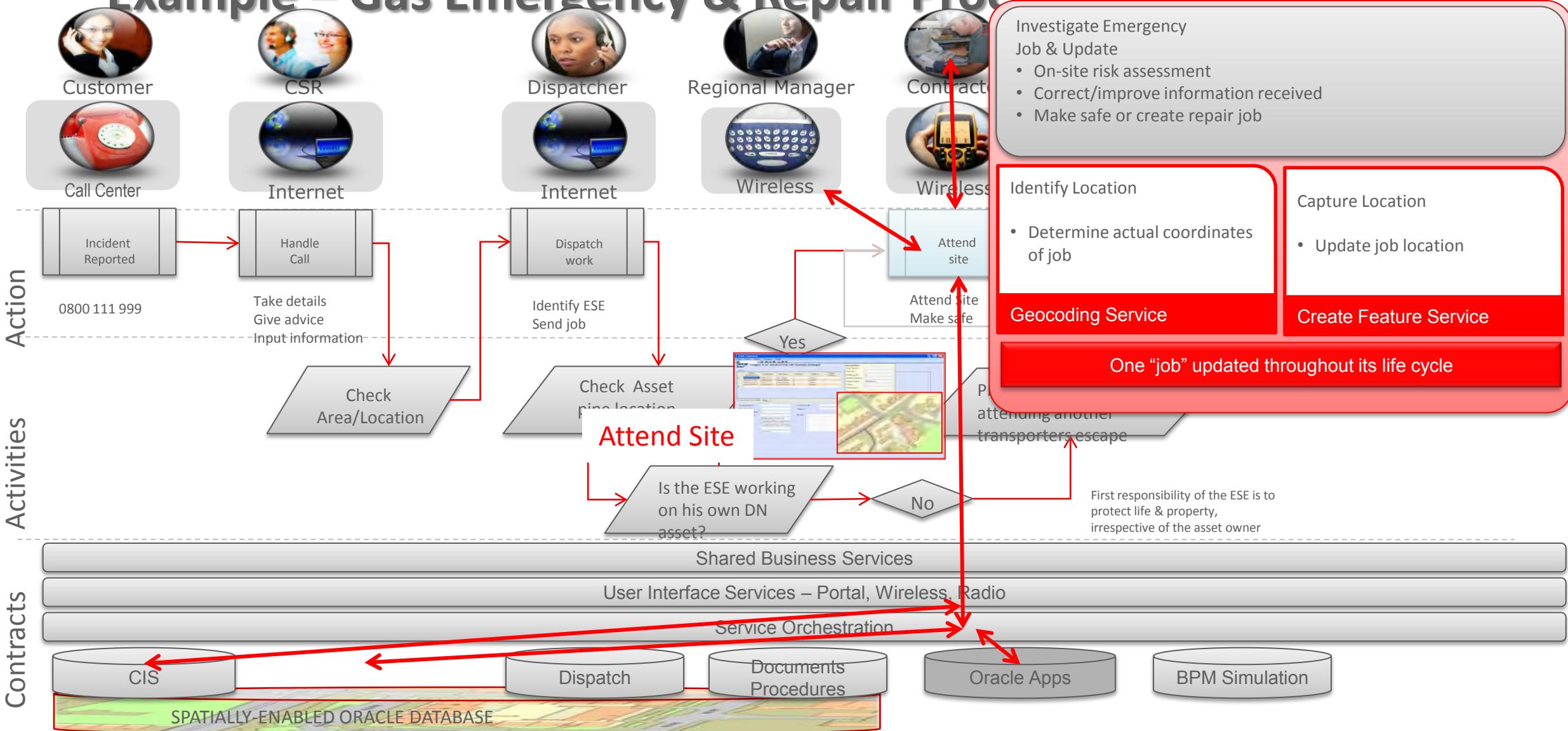
# Example – Gas Emergency & Repair Process



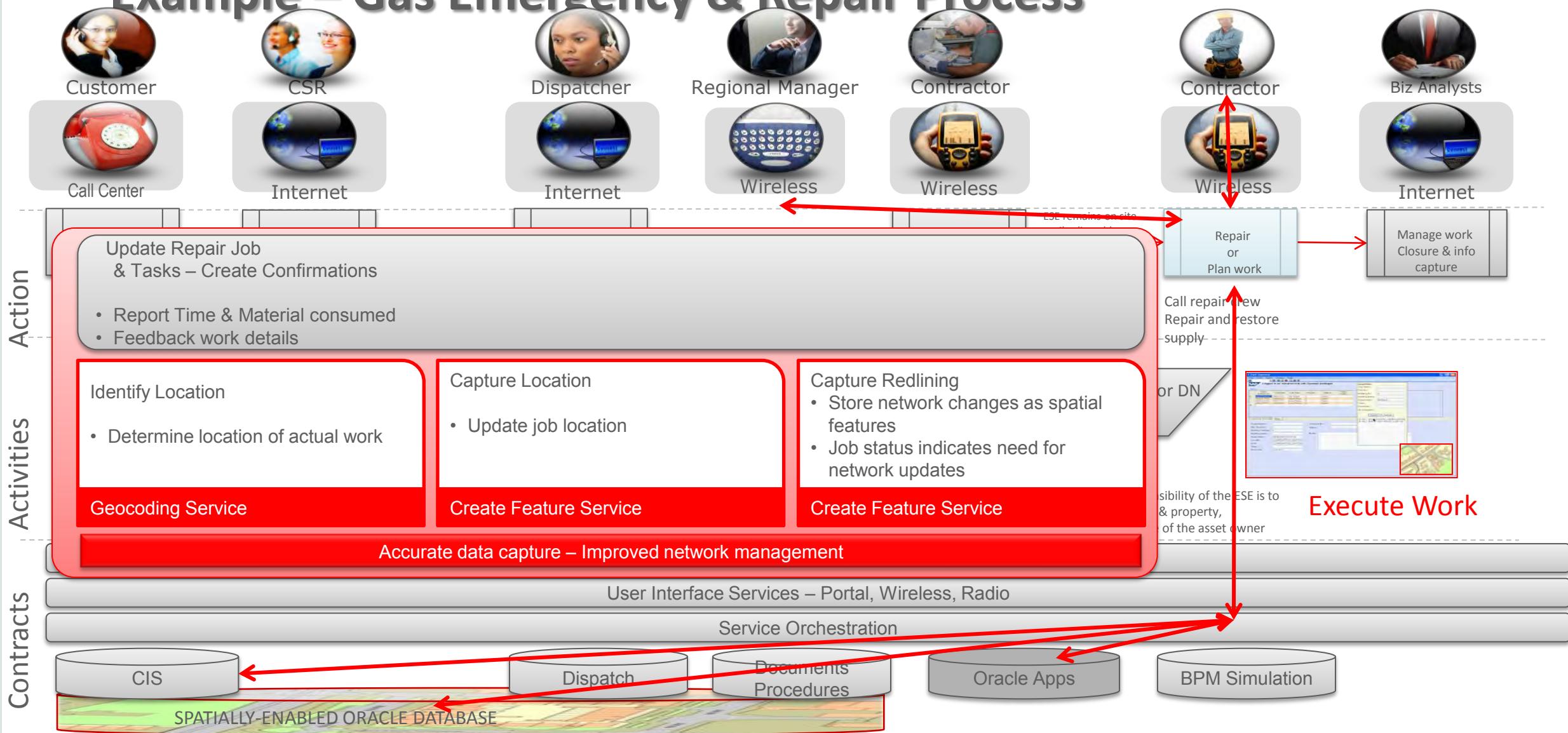
# Example – Gas Emergency & Repair Process



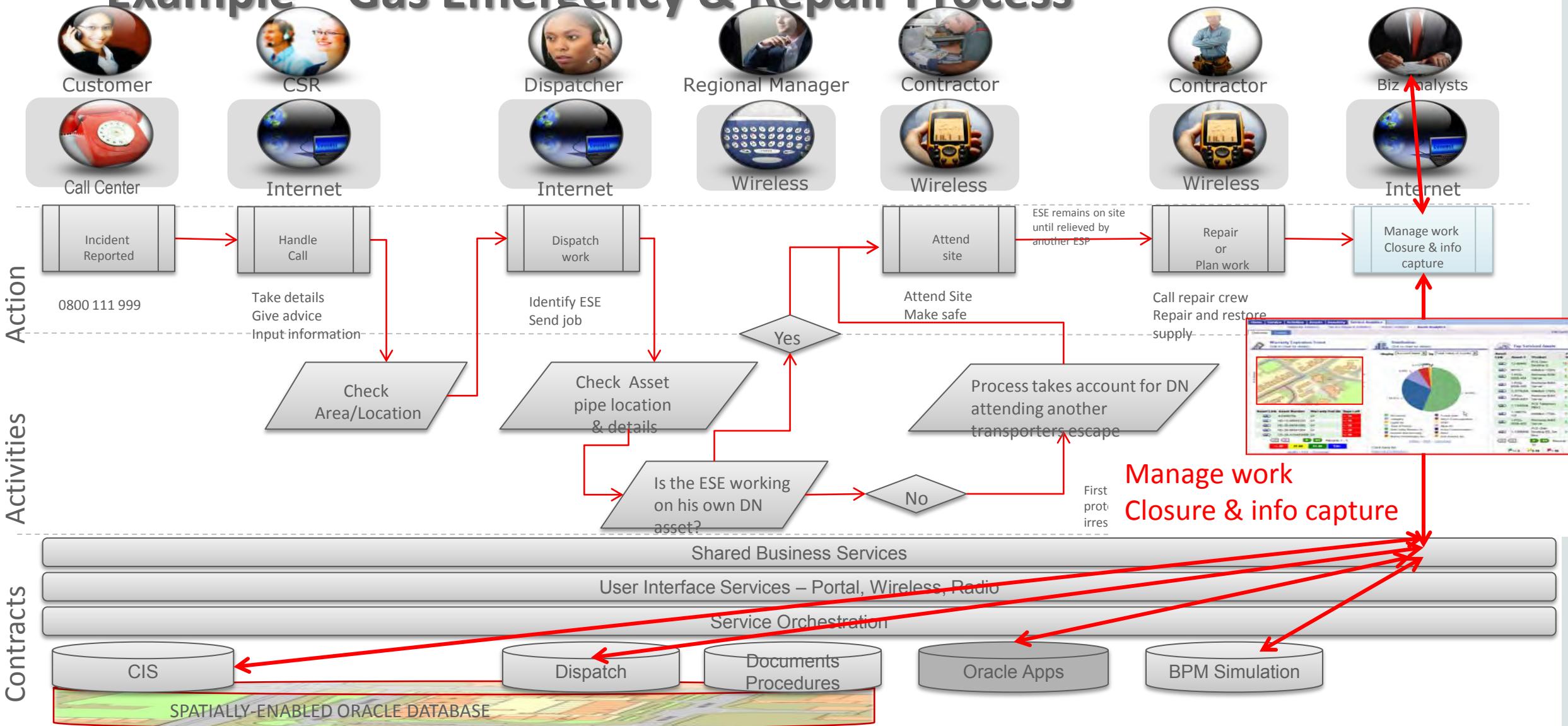
# Example – Gas Emergency & Repair Process



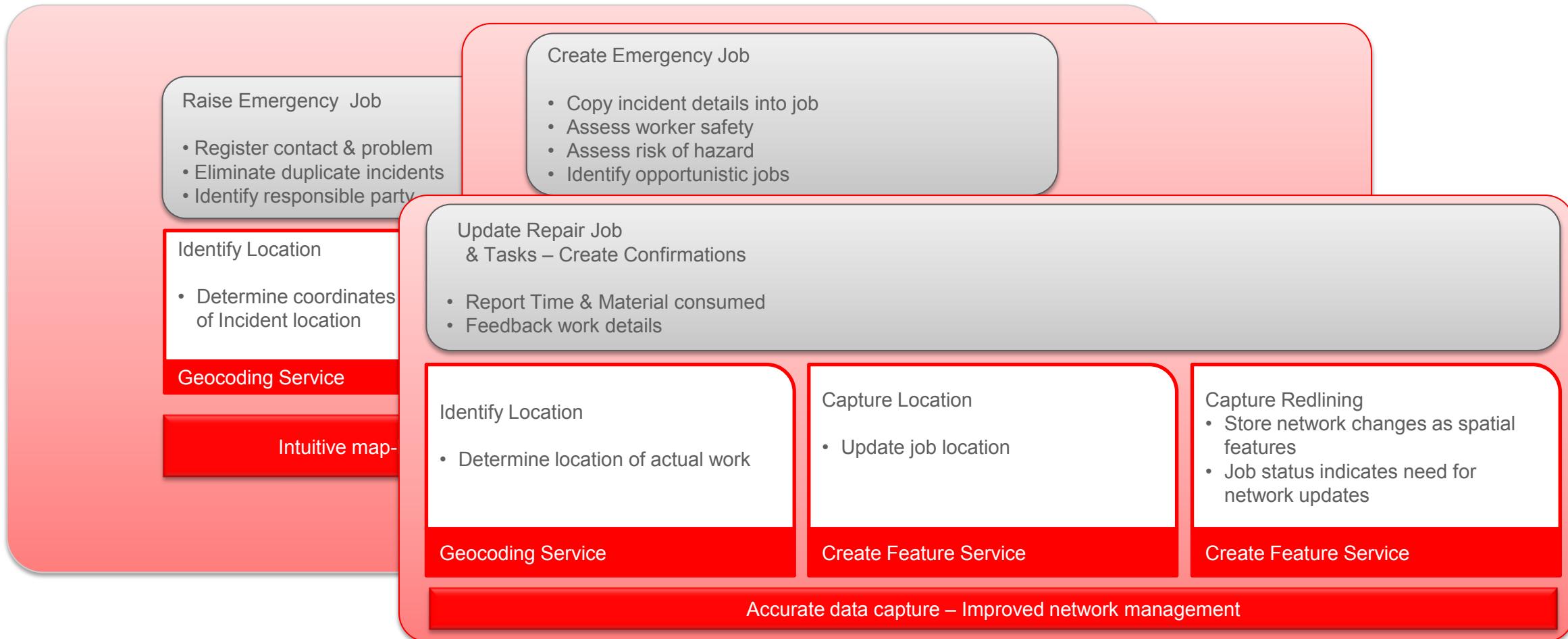
# Example – Gas Emergency & Repair Process



# Example – Gas Emergency & Repair Process



# Spatial Analysis in the System

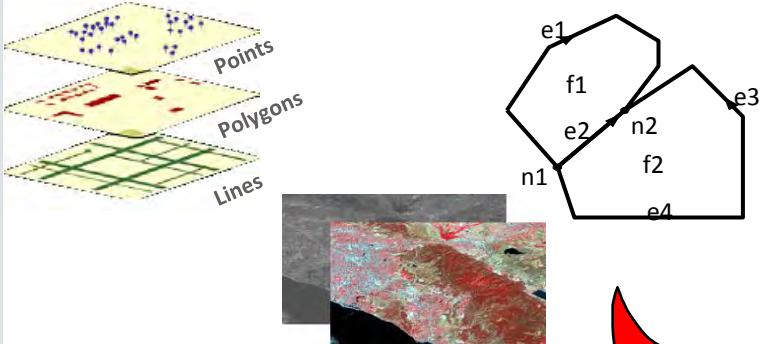


# Program Agenda

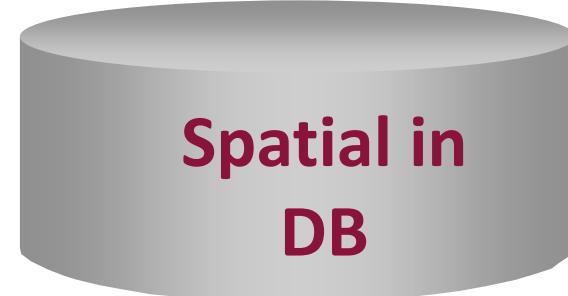
- 1      Operational systems based on DBs
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# Oracle Spatial Technology in the DB

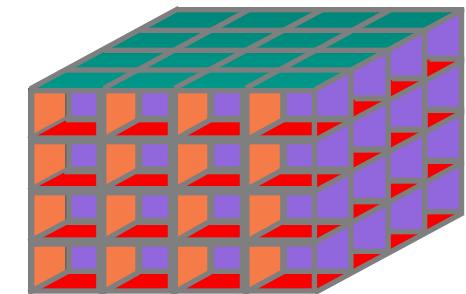
## Spatial Data Types



All Spatial Data  
Stored in the Database



## 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' ;
```

# Extend Spatial functionality with PL/SQL Web Services

## Simple Search and DML interfaces

- PL/SQL packaged functions can be exposed as simple web services
- Easy to develop XML-based protocol for accessing services on the Web by using XML syntax to send commands over HTTP
- JDeveloper provides many features to help create and deploy web services
- These web services can be deployed in any J2EE container or APEX
- These are useful to expose specific database search or DML operations as web services to other components in a system

# Simple Search Example

## Create a PL/SQL function

```
CREATE FUNCTION FIND_NEARBY_RISKS( LONGITUDE NUMBER, LATITUDE NUMBER) RETURN VARCHAR2
AS
Result varchar2(3000);
BEGIN
  SELECT XMLEMENT( ... xmlagg(feature_name) ...)  into result
  FROM features_of_interest a
  WHERE SDO_ANYINTERACT(a.geometry,
    sdo_geometry(2001,8307, sdo_point_type(longitude,latitude,null), null, null)) = 'TRUE';
  return result;
END;
```

# Publishing and Using the web service

- JDeveloper makes it easy to take the PL/SQL function and publish it as a web service
  - No code required, all widget driven
  - OTN JDeveloper pages have examples
- Use HTTP GET methods to use the service
  - <http://localhost/getNearbyRisks?long=-121.34&lat=37>
  - This will return an XML document with potential features of interest that are at risk near the incident location
- These type of services are easy to integrate into the workflow of a system that requires results based on spatial searches

# Simple DML Example

## Create a PL/SQL function

```
CREATE FUNCTION CREATE INCIDENT( LONGITUDE NUMBER, LATITUDE NUMBER) RETURN VARCHAR2 AS
Result incident_number;
BEGIN
incident_number := service_incidents_seq.nextVal;
INSERT INTO service_incidents values (incident_number,
sdo_geometry(2001,8307, sdo_point_type(longitude,latitude,null), null, null)) ;
commit;
return incident_number;
END;
```

# Publishing and Using the web service

- A field technician wants to report an incident at a certain location
- Use HTTP PUT method to use the service
  - [http://localhost/createIncident -d "{longitude: -121.37 longitude: 37}"](http://localhost/createIncident -d '{longitude: -121.37 longitude: 37}')
  - This will create an entry in the incidents table and trigger an event to generate a service request to process the event
  - Database triggers should be used to automatically trigger these services requests based on the incidents

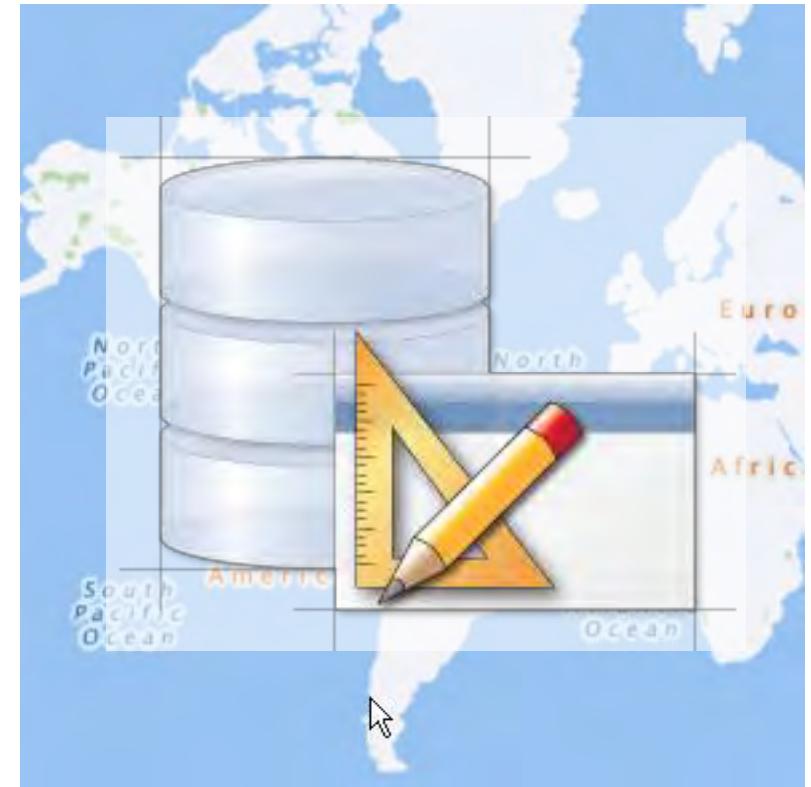
# Provide Spatial analytics as web services

- Do not need to have SQL access to add spatial capabilities to an application
- Many times simple spatial search interfaces can be integrated into different components of a system using PL/SQL based web services
- Don't need a separate GIS system if the application does not have direct access to the Spatial database
- Use the database services as much as possible to truly take advantage of enterprise wide spatial data

# Program Agenda

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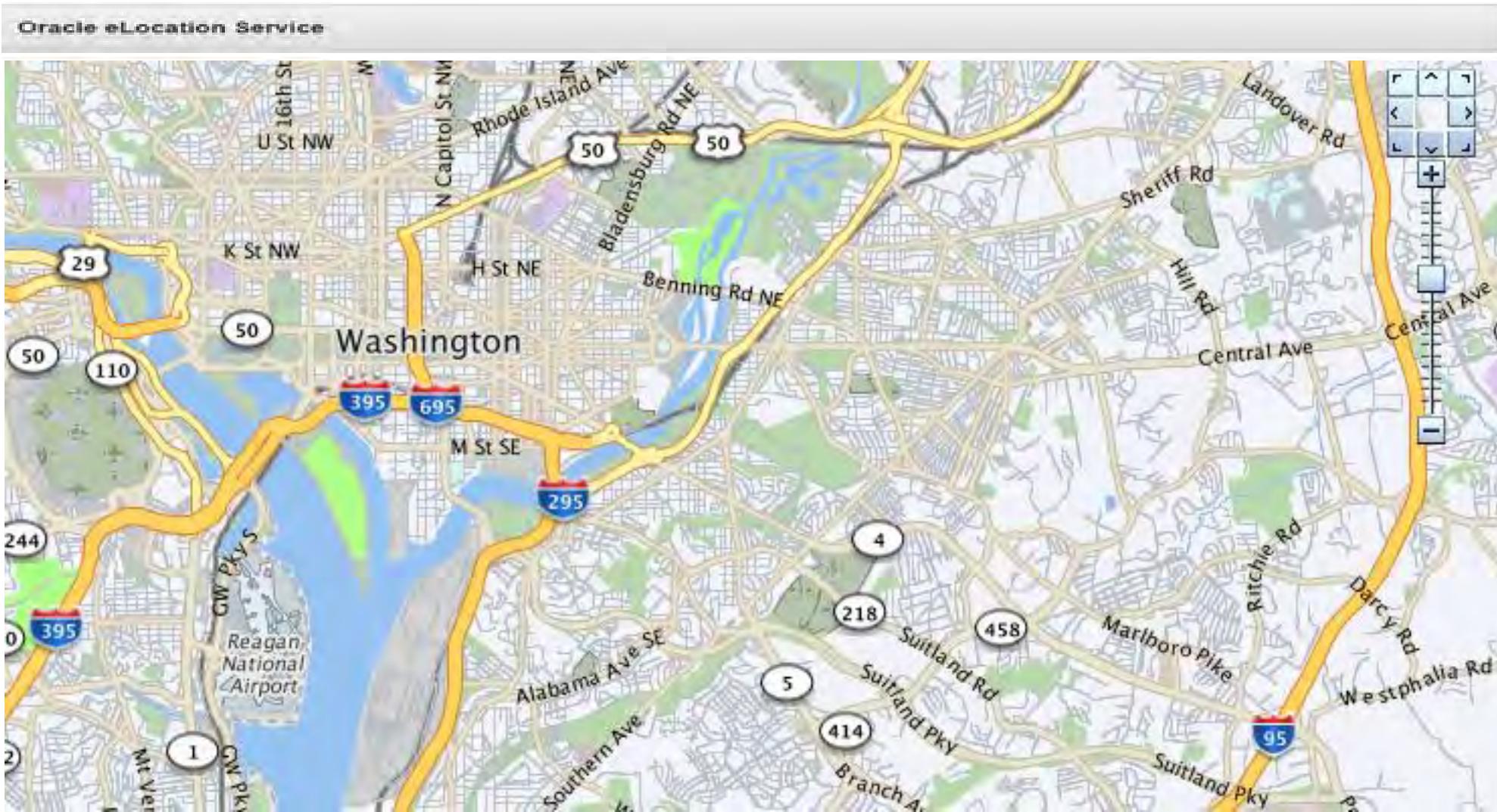
# APEX Map Application



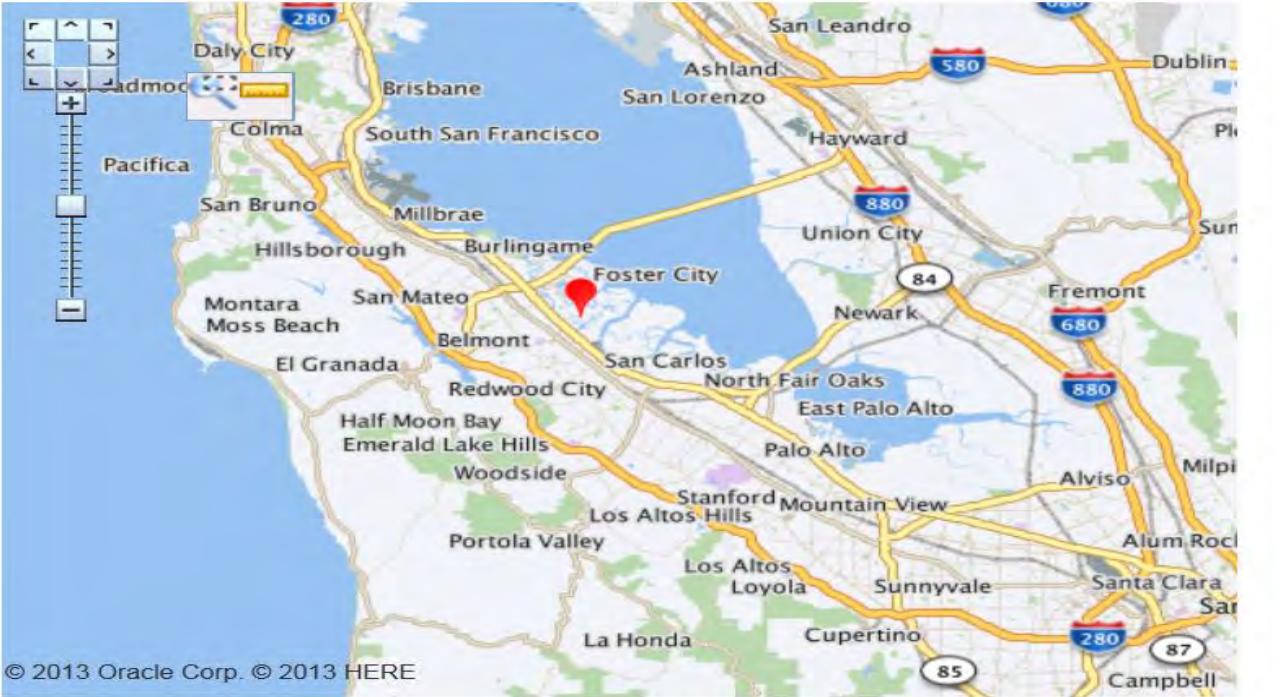
# Spatial enabled Applications in APEX

- Spatial data in tables
  - First approach: two NUMBER columns
  - What about lines and polygons?
- Spatial processing – SQL, PL/SQL
- Visualization on a map
- Adding new spatial data via the browser
- Geocoding
- Spatial queries:
  - Within Distance
  - Nearest Neighbors
  - Spatial Intersections

# 1) Map



## 2) Geocoder

Edit address					<a href="#">Delete</a>	<a href="#">Clear</a>	<a href="#">Save</a>	<a href="#">Geocode</a>
<b>Name *</b> <input type="text" value="Oracle Corporation"/>					<b>Oracle eLocation Service</b>			
<b>Country *</b> <input type="text" value="USA"/>					<a href="#">Current location</a>			
<b>Street address</b> <input type="text" value="500, Oracle Pky"/>								
<b>Zipcode</b> <input type="text" value="94065"/>					<b>City *</b> <input type="text" value="Redwood City"/>			
<b>State or Province</b> <input type="text" value="CA"/>								
<b>Geocoder results</b>								
Street	Housenumber	Zipcode	Settlement	Municip				
 Oracle Pky	500	94065	Redwood City	Redwood				

### 3) Spatial Query: Within Distance

**Results** **Store as Area Of Interest**

Search objects within distance (km)

230

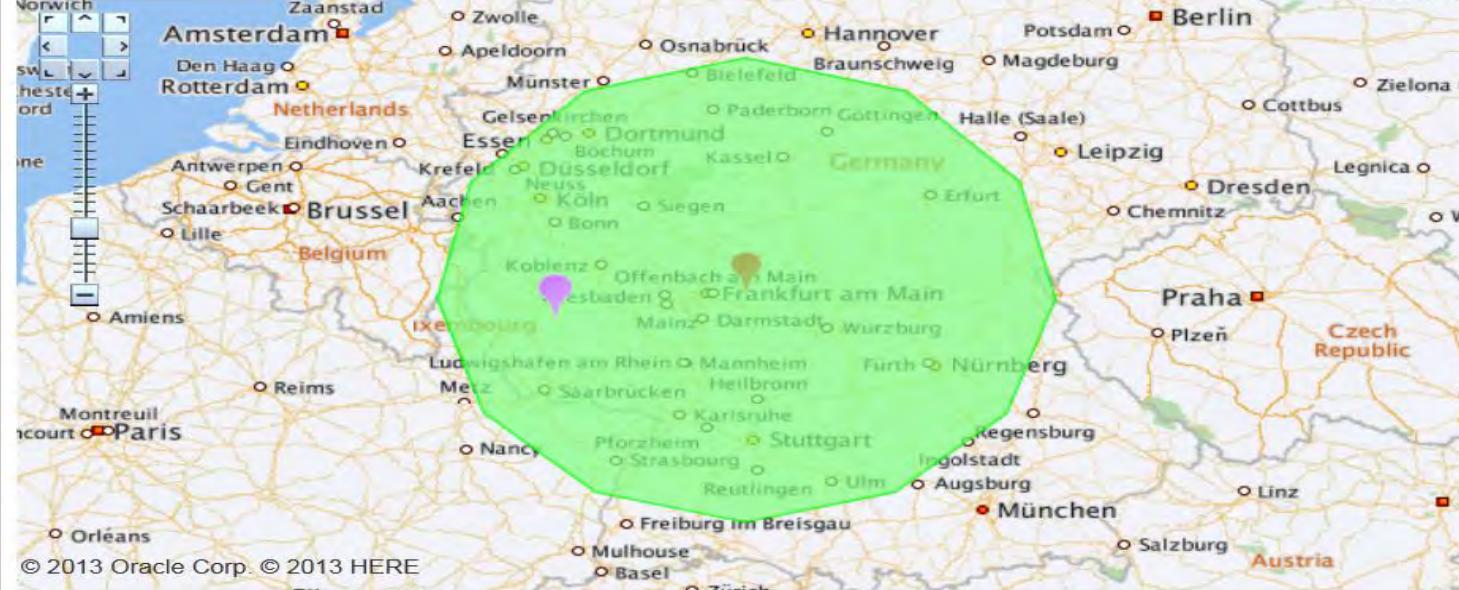
Show distance circle on map  Yes

Image Rating at least 

Type	Distance (km)	Name or title
Image	144.921	New image as of 2014-04-01 07:30

1 - 1

**Oracle eLocation Service** **Current Location**



© 2013 Oracle Corp. © 2013 HERE

# 4) Spatial Query: Anyinteract

**Images and Addresses**

Area of Interest

Middle Germany

Show Area Of Interest on map

Yes

Name	Position
Image	New image as of 2014-04-01 07:30 7°04'29" E - 49°54'56" N

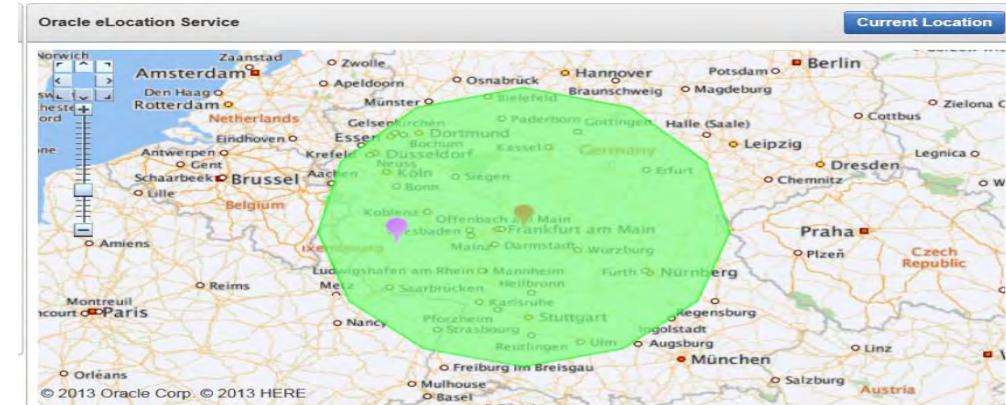
1 - 1

**Oracle eLocation Service**

© 2013 Oracle Corp. © 2013 HERE

# APEX and the Database provide everything you need ...

- Spatial Data Type: SDO\_Geometry
- Spatial functions in SQL and PL/SQL
- Oracle eLocation Map Service
- Oracle eLocation Geocoder Service
- APEX plugins and widgets
- APEX Sample application



# Sample Geolocation Showcase



## Sample Geolocation Showcase

### Sample Application

✓ Installed (Unlocked)

Run

Remove

Manage

This application demonstrates Spatial capabilities of the Oracle database. It has 3 main areas: Addresses, Images and Areas Of Interest.

- **Addresses** allows to add postal addresses which can be geocoded (converted to a coordinate) and then be displayed on the map.
- **Images** allows to upload images. If an image (e.g. a smartphone image) contains a location, it will be automatically extracted and being stored in the database.
- **Areas Of Interest** are polygons which can be drawn on the map and then be stored into the database

Based on this data, the application offers 3 kinds of spatial analysis

- **Within Distance Search:** After clicking a position on the map

## Geolocation Showcase

Home

Addresses

Images

Areas of Interest

About this application

### Addresses

Postal addresses can be maintained here. Use the geocoding capability in order to determine the spatial coordinate of your address.

### Overview Map

A map with stored addresses and uploaded images. Drag it around and observe the report's contents.

### Area-Of-Interest Search

Choose a stored Area Of Interest and find images and addresses within.

### Images

Upload or maintain images. The position data (if present) will be extracted upon upload and can be changed afterwards.

### Areas Of Interest

Create an "Area Of Interest" by clicking a polygon on a map. Use stored areas afterwards to find images and addresses within.

### Within-Distance Search

Click a position on the map and find addresses and images within a given distance.

### Nearest-Neighbor Search

Choose an address and find images, which are nearest neighbors.

The Navteq data accessible through this service is subject to [Oracle Legal Notices](#) and under these [Terms of Use](#).

[Set Screen Reader Mode On - 1.0.2](#)

## Sample Geolocation Showcase

ORACLE®

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# Oracle Maps Utility Plugins

Plug-ins   Utilization   History

Go   Actions ▾   **Plugin Repository**   Import >   Create >

[Filter Plugins](#)

<a href="#">Elocation Geocoder</a>	<a href="#">Oracle Maps - Get Data</a>	<a href="#">Oracle Maps - Get Redline</a>	<a href="#">Oracle Maps - Map Actions</a>	<a href="#">Oracle Maps - Refresh FOI</a>
<a href="#">Oracle Maps - Region</a>	<a href="#">Oracle Maps - get HTML5 Location</a>	<a href="#">Oracle Maps - remove Custom Marker</a>	<a href="#">Oracle Maps - set Center and Zoom Level</a>	<a href="#">Oracle Maps - set Custom Marker</a>
<a href="#">Oracle Maps - set Map Center</a>	<a href="#">Oracle Maps - set Zoom Level</a>			

# Spatial data

Step 1

# Create a table for spatial data

- Can store points, lines, polygons and complex geometries
- Database provides indexing, query and processing capabilities

```
create table my_spatial_images(  
    id          number(10) not null,  
    image       blob,  
    thumbnail   blob,  
    file_name   varchar2(200) not null,  
    mimetype   varchar2(200),  
    geometry   sdo_geometry,  
    exif        xmltype,  
    datetime    timestamp with time zone,  
    constraint my_spatial_images_pk primary key (id)  
)
```

# Spatial tables need additional tasks

- Maintain spatial metadata
- Create an index → mandatory for spatial queries

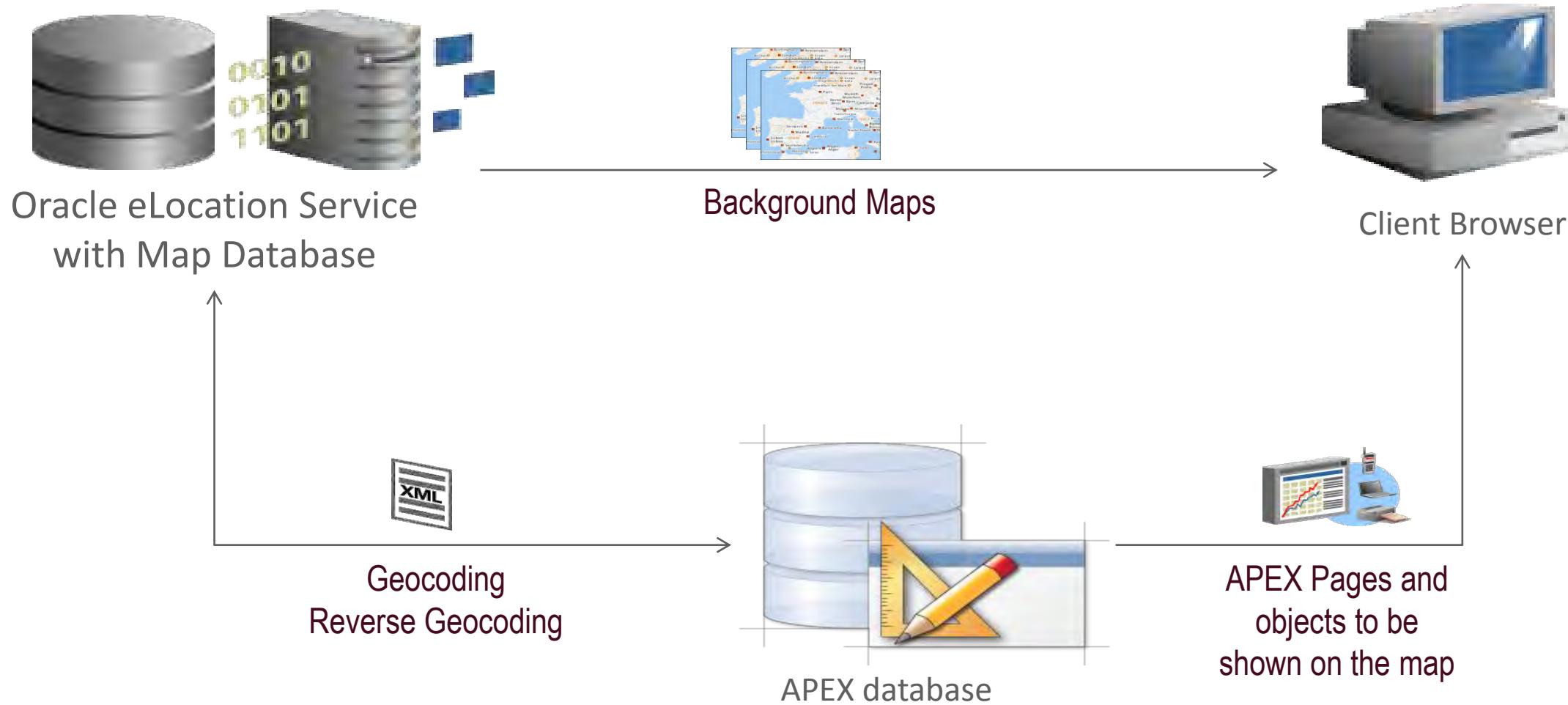
```
begin
  -- create metadata for spatial table
  -- coordinates are lon/lat - and over the whole world
  apex_spatial.insert_geom_metadata_lonlat(
    p_table_name  => 'MY_SPATIAL_IMAGES',
    p_column_name => 'GEOMETRY'
  );
end;

create index MY_SPATIAL_IMAGES_SX
on MY_SPATIAL_IMAGES (GEOMETRY)
indextype is MDSYS.SPATIAL_INDEX
```

# Visualization on a map

Step 2

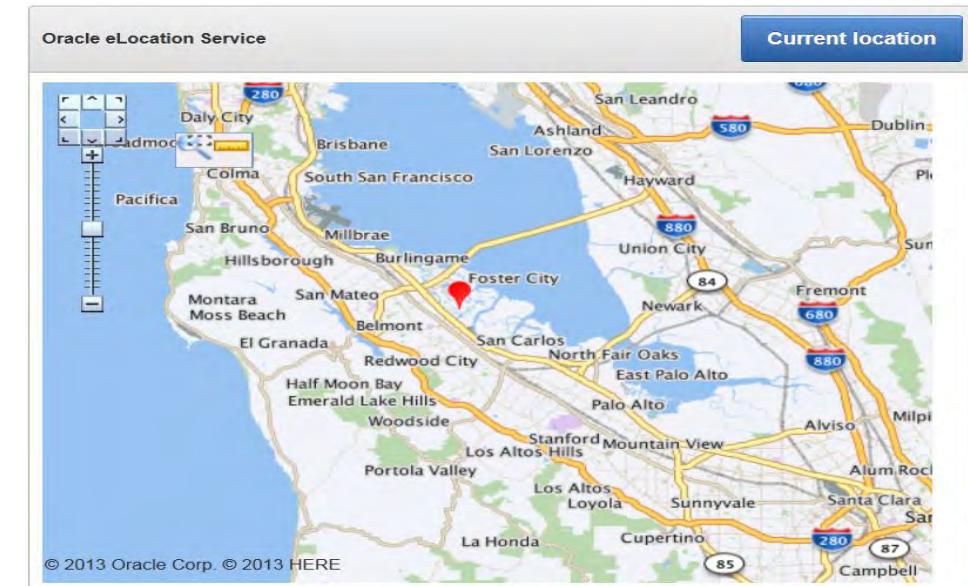
# Architecture



# Oracle MapViewer and Oracle Maps

- Map Rendering based on spatial data in the database
- Alternatives in APEX
  - Own Installation of Fusion Middleware MapViewer
  - Use Oracle eLocation Service [maps.oracle.com](http://maps.oracle.com)

- Programmers Interfaces
  - APEX Plugin
  - Oracle Maps JavaScript API



# Oracle Maps APEX Plugin

## Settings

\* Map Server URL (Host)

\* Map Server URL (Path)

\* Map Size (width, height)

### \* Map Tile Layers

## Feature Of Interest Layers

Map Center (lon, lat)

### Initial Zoom Level

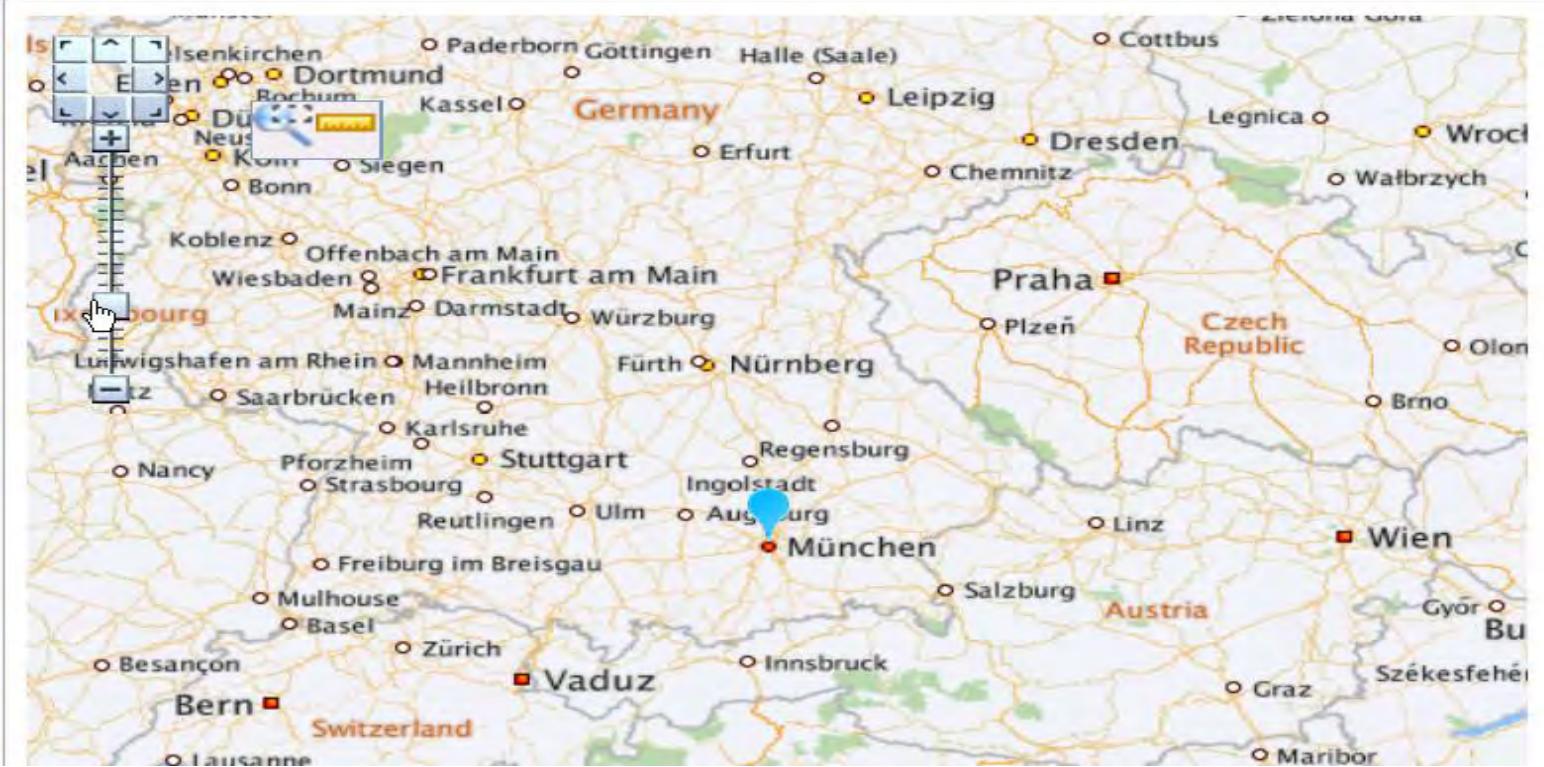
Save map position in Cookies

## Navigation Bar

## Navigation Bar Options

<https://elocation.oracle.com>

### Current location

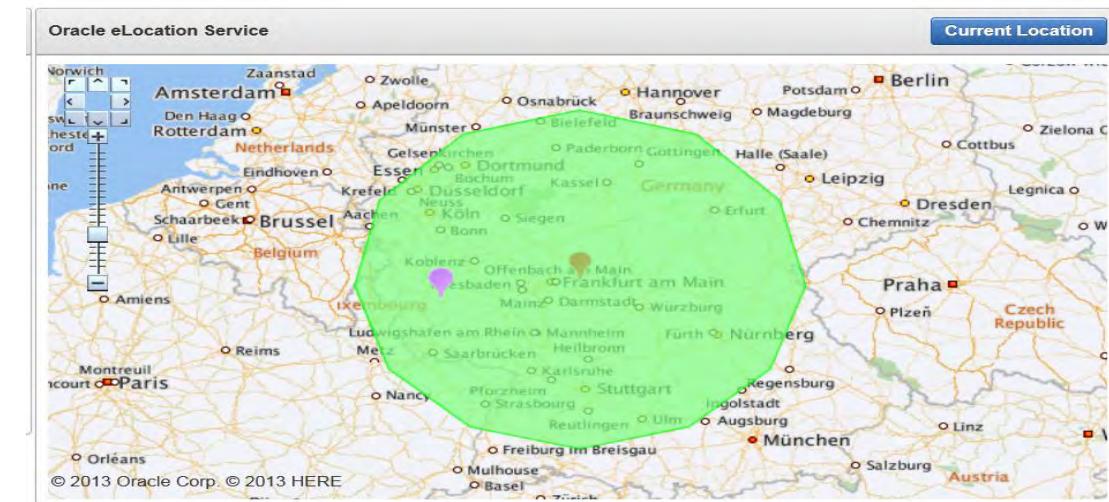


## Step 3

# Spatial query and analysis

# Within Distance Search

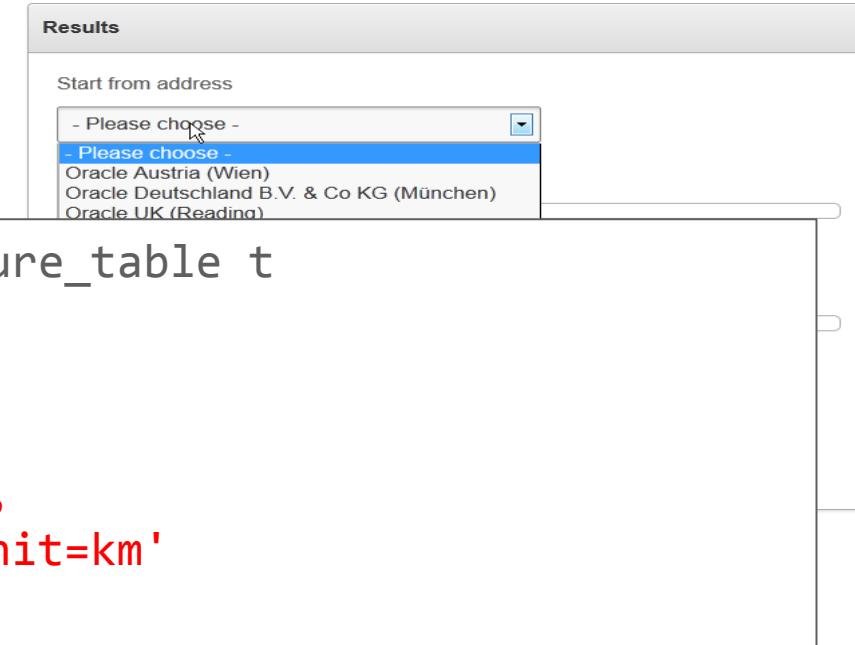
- WHERE Clause: SDO\_WITHIN\_DISTANCE
- Geometry column must be spatially indexed
- Input Parameters
  - Geometry column to search in
  - Search Geometry
  - Distance
  - Unit to use



# Nearest Neighbor Search

- WHERE Clause: SDO\_NN
- Geometry column must be spatially indexed
- Input Parameters
  - Geometry column to search in
  - Start geometry
  - Maximum Distance
  - Max. neighbors
  - Unit to use

```
select * from feature_table t
where
  sdo_nn(
    t.geometry,
    start_geometry,
    'distance=XX unit=km'
  ) = 'TRUE'
```



# Build your own application

# Your own application ...

**My Image Geotagging Application**

Home

Home > Upload Image

Upload Image

Image  No file selected.

**My Image Geotagging Application**

Home

Home > Uploaded Images

Uploaded Images

Search  Display 15

<u>Id</u>	<u>Datetime</u>	<u>Filename</u>
1	05-MAY-14 03.13.07.503888 PM +02:00	Bild01.jpg

1 - 1

[Spread Sheet](#)

Map



# APEX and the Database

## But you can go further ...

- Use *your own* map server ...
  - Use own map styles or own map data
  - Deep Integration between database and map server
- Use *your own* geocoding facility
  - Geocoder directly embedded in the database
  - No HTTP requests any more

*And you can still use the APEX plugins and widgets*

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# Hierarchical Report Generation

- Requirement
  - Generate reports and maps using custom or standard geographic entities
  - Provide drill down and drill up capabilities
  - Hierarchy can be geometry based or name based
- Solution
  - Use MapViewer for maps and reports
  - Use commercial or open source data sets to build the hierarchies
  - And associate these hierarchies with the application data

# Hierarchy Examples

- Customer locations have an address
  - Find the aggregate information for all customers in a city/county/state/country
  - Map interface to drill up and drill down to navigate through the hierarchy and visualize the aggregate information at different levels

# Creating Hierarchical Data Model

- Many data sources available for coarse level admin area boundary data
  - Oracle bundles HERE data (certain levels of administrative boundaries) sets with the database
  - Open source data sets are also readily available
- Create a COUNTRY\_HIERARCHY table with these columns  
(AREA\_ID, NAME, ADMIN\_LEVEL, PARENT\_AREA\_ID, GEOMETRY)
- Populate the parent\_area\_id column using SDO\_RELATE operations

# Using Hierarchical Data Model

## Geometry based hierarchy

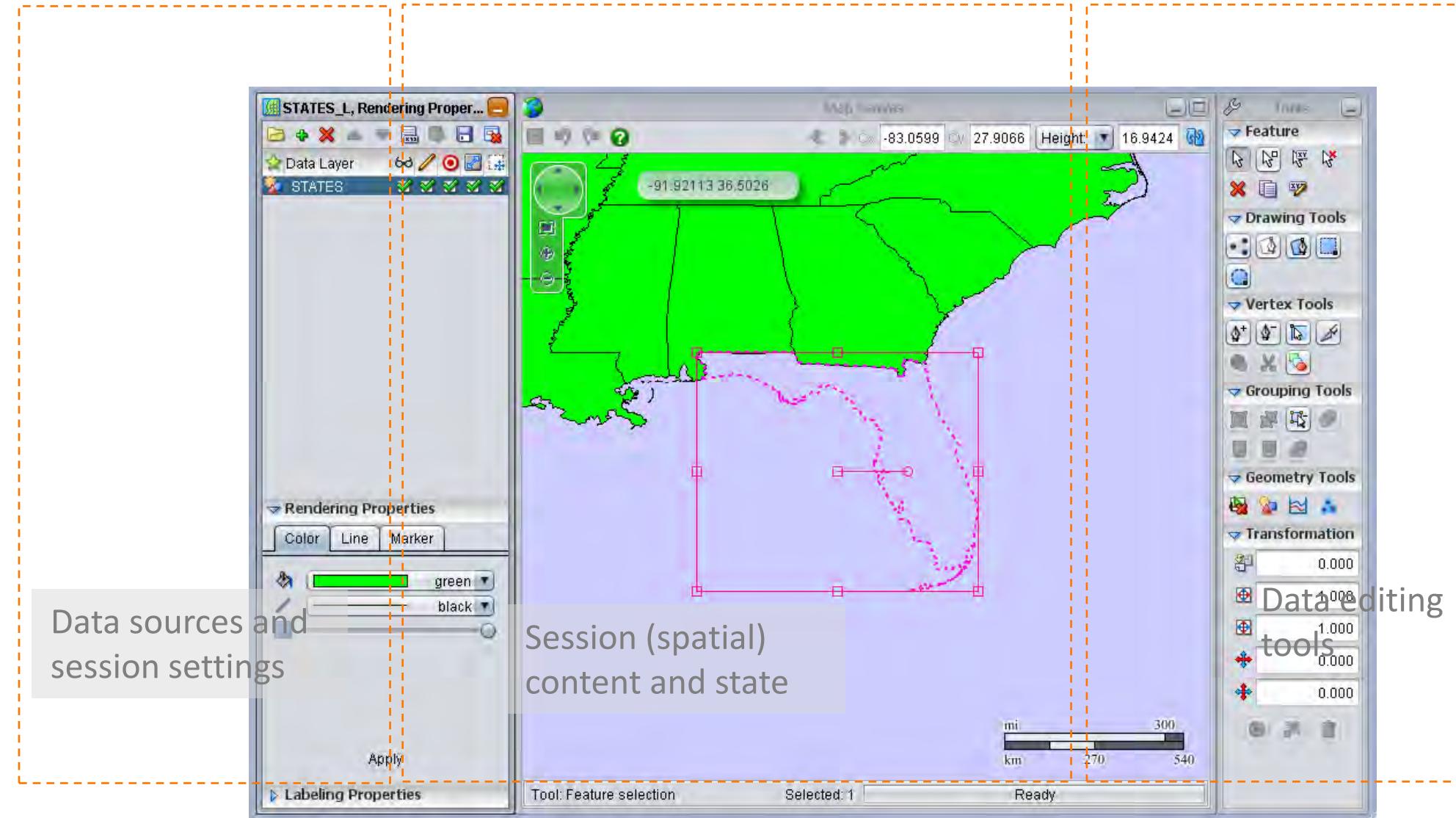
- Associate each customer with the lowest level of the hierarchy
  - In this example, lets say city is at level 4, county at level 3, etc.
  - Associate the customer records with the city level admin area
- Once this hierarch is established it is easy to calculate aggregate metrics for different customer attributes at different admin areas
- Using SQL it is then easy to find the number of customers in each city/county/state/country
- MapViewer api can be used to define themes that will show aggregate customer data at each level of the hierarchy
- All of this can be done dynamically on the operational data

# Custom Hierarchies

## Geometry hierarchy

- Users want to create own geometry regions
- Define hierarchies based on user defined collections of geometries
- Hierarchies are defined based on business rules and do not necessary follow admin hierarchies
- Examples: `postal_codes/sales_territories/sales_regions`, etc.

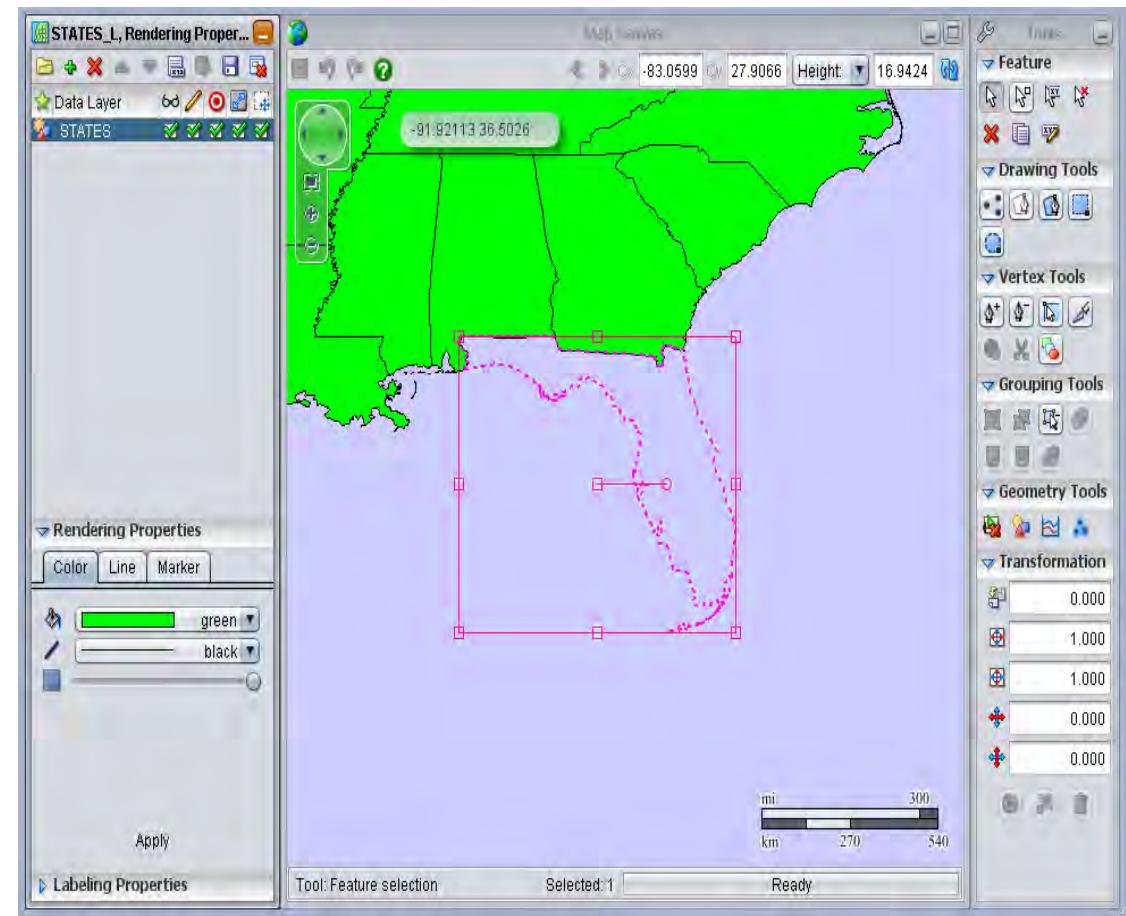
# Custom Hierarchies



# MapViewer

## Web-based Editor

- A web-based spatial data editing tool (java applet)
- Supports versioned, concurrent editing through editing sessions
- Supports Workspace Manager
- Supports geometry model
- All aspects of an editing session are saved in database



# The Spatial & Graph SIG User Group

- The SIG promotes interaction and communication that can drive the market for spatial technology and data
- Members connect and exchange knowledge via online communities and at annual conferences and events

- Meet us here at the Summit

## **Morning Reception**

**Tuesday and Wednesday**  
**7:45 to 8:30 a.m.**

**Registration Area**

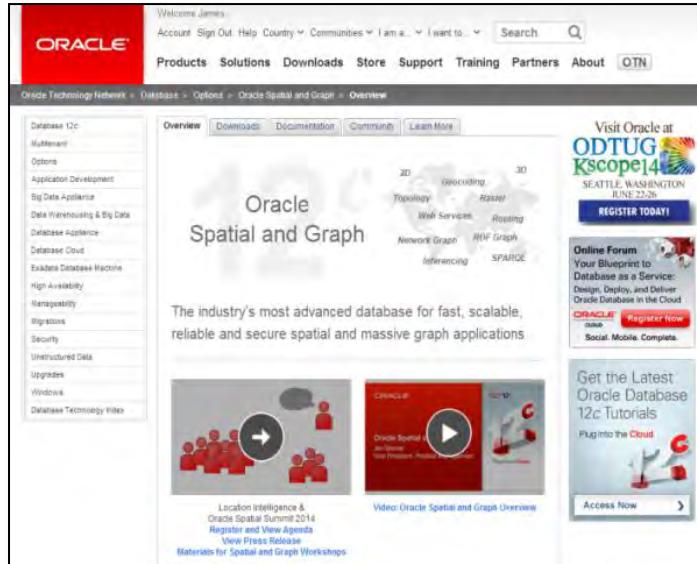
## **Social Hours**

**Tuesday and Wednesday**  
**6 to 7 p.m.**  
**Registration Area**

- Join us online

- [LinkedIn](#) (search for “LinkedIn Oracle Spatial”)
- [Google+](#) (search for “Google+ Oracle Spatial”)
- [IOUG SIG](#) (sign up for free membership through [www.ioug.org](http://www.ioug.org))
- [OTN Spatial – Communities](#) (search for “Oracle Spatial and Graph Community”)
- Contact the Board at [oraclespatialsig@gmail.com](mailto:oraclespatialsig@gmail.com)

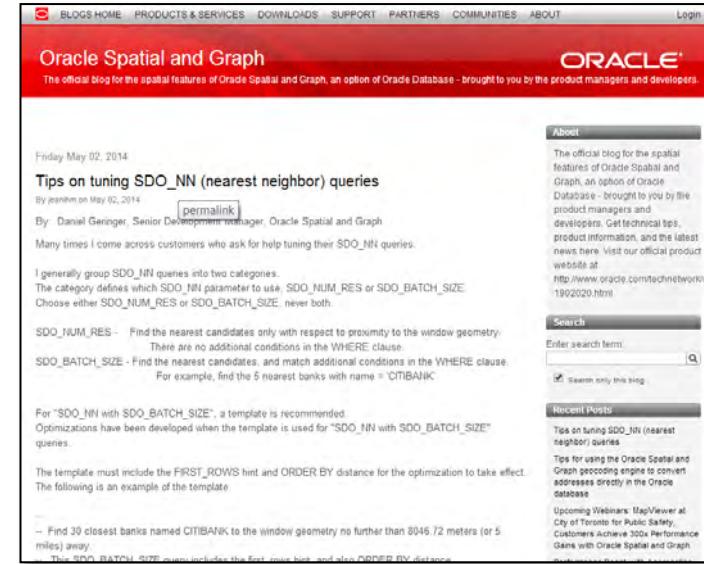
# Resources: Oracle Technology Network



This screenshot shows the Oracle Technology Network Database Options page for Oracle Spatial and Graph. The page features a sidebar with various Oracle Database options like Database 12c, Big Data Appliance, and Database Cloud. The main content area highlights Oracle Spatial and Graph as the industry's most advanced database for spatial and graph applications. It includes sections for Location Intelligence & Oracle Spatial Summit 2014, Oracle Database 12c Tutorials, and Oracle Spatial and Graph Overview. A banner for ODTUG Kscope14 is also present.



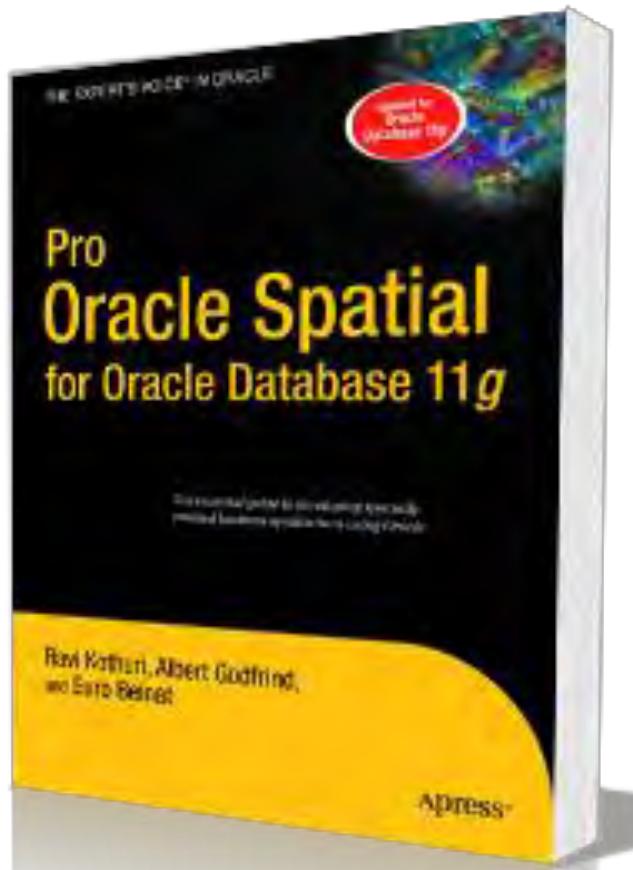
This screenshot shows the Oracle Technology Network Middleware MapViewer page. The sidebar lists various Oracle Fusion Middleware components. The main content area features a section on Oracle Fusion Middleware MapViewer, which is a toolkit for incorporating interactive maps and spatial analyses. It includes a screenshot of the MapViewer interface showing a map with data overlays and a legend. A banner for Oracle Database 12c Tutorials is also present.



This screenshot shows the Oracle Spatial and Graph blog page. The sidebar lists various Oracle products. The main content area features a blog post titled "Tips on tuning SDO\_NN (nearest neighbor) queries" by Daniel Geringer. The post discusses tuning SDO\_NN queries, mentioning SDO\_NUM\_RES and SDO\_BATCH\_SIZE parameters. It includes a screenshot of a map with a legend and a sidebar with recent posts and search functionality.

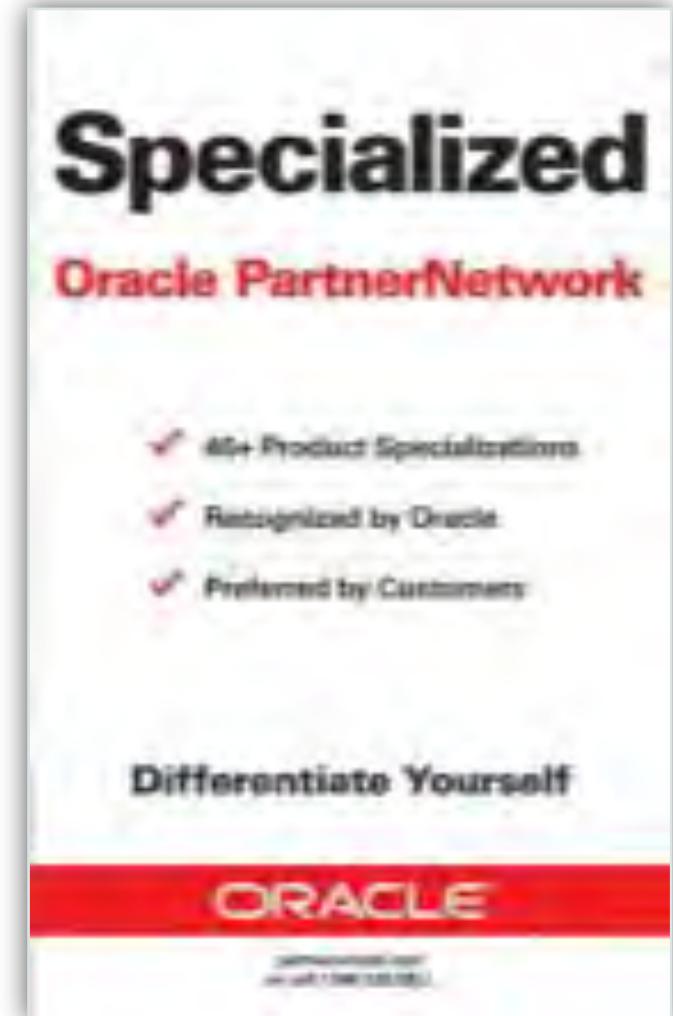
- [www.oracle.com/technetwork/database/options/spatialandgraph](http://www.oracle.com/technetwork/database/options/spatialandgraph)
- [www.oracle.com/technetwork/middleware/mapviewer](http://www.oracle.com/technetwork/middleware/mapviewer)
- [blogs.oracle.com → oraclespatial → oracle\\_maps\\_blog](http://blogs.oracle.com/oraclespatial)

# More Resources



# Certification

- **Individual Certification, Partner Specialization**
  - Credentials for individuals with Spatial implementation expertise
  - OPN Specialization – differentiates partner organizations delivering Spatial services
  - Study materials, exam information, program guidelines are available at  
[www.oracle.com/technetwork/database/options/  
spatialandgraph/learnmore/specialized-partners-423197.html](http://www.oracle.com/technetwork/database/options/spatialandgraph/learnmore/specialized-partners-423197.html)
  - Talk to Oracle team this week



# Q & A

