ORACLE

Using Location Analysis in Large Scale Operational Systems

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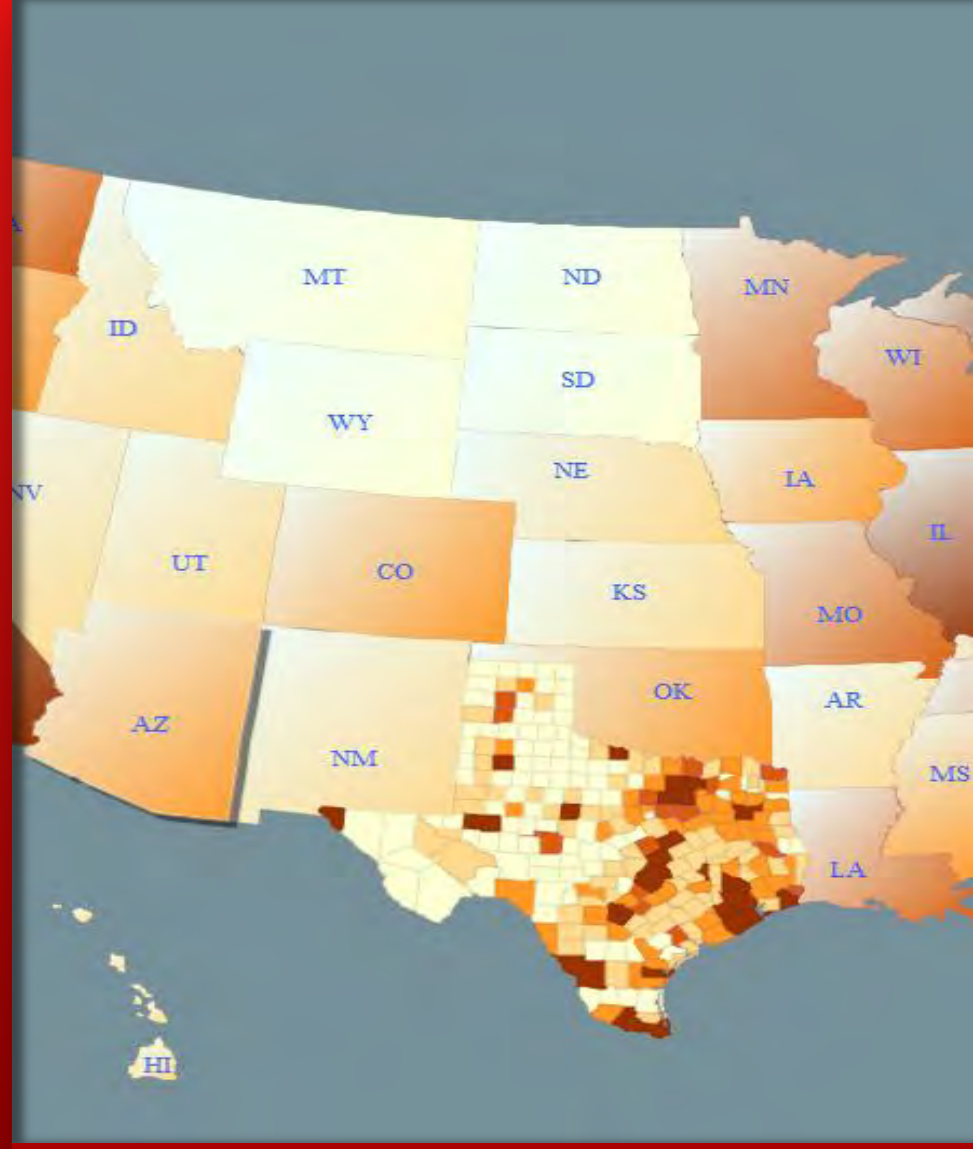
Spatial and Graph & MapViewer

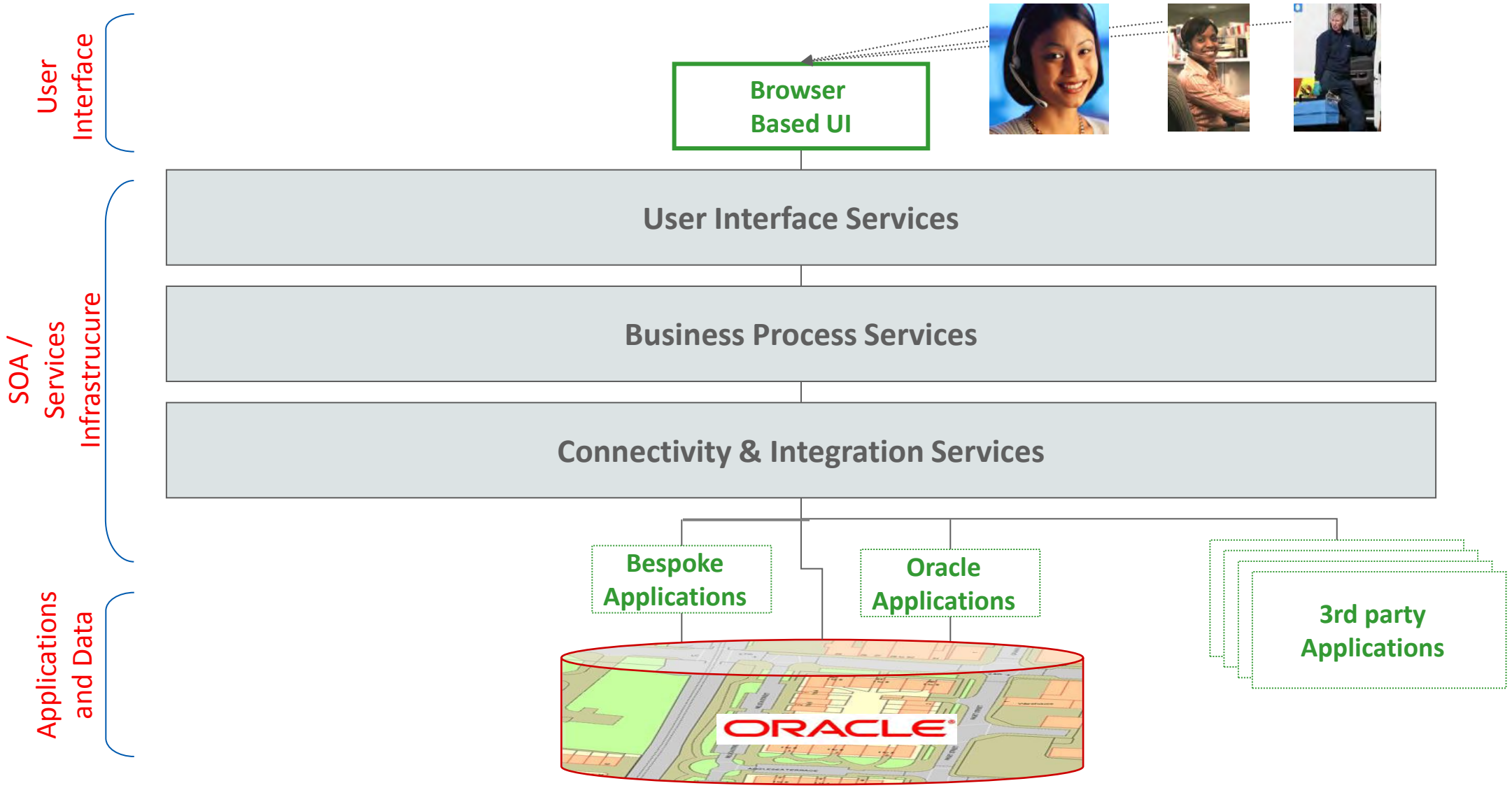
Oracle



Program Agenda

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

Conceptual Architecture

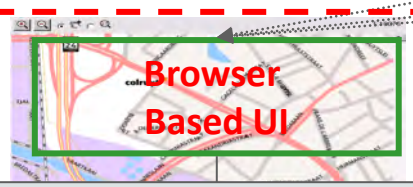


Oracle Spatial – where does it fit?

User Interface

SOA / Services Infrastrucure

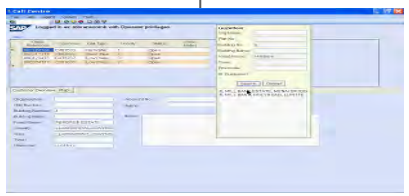
Applications and Data



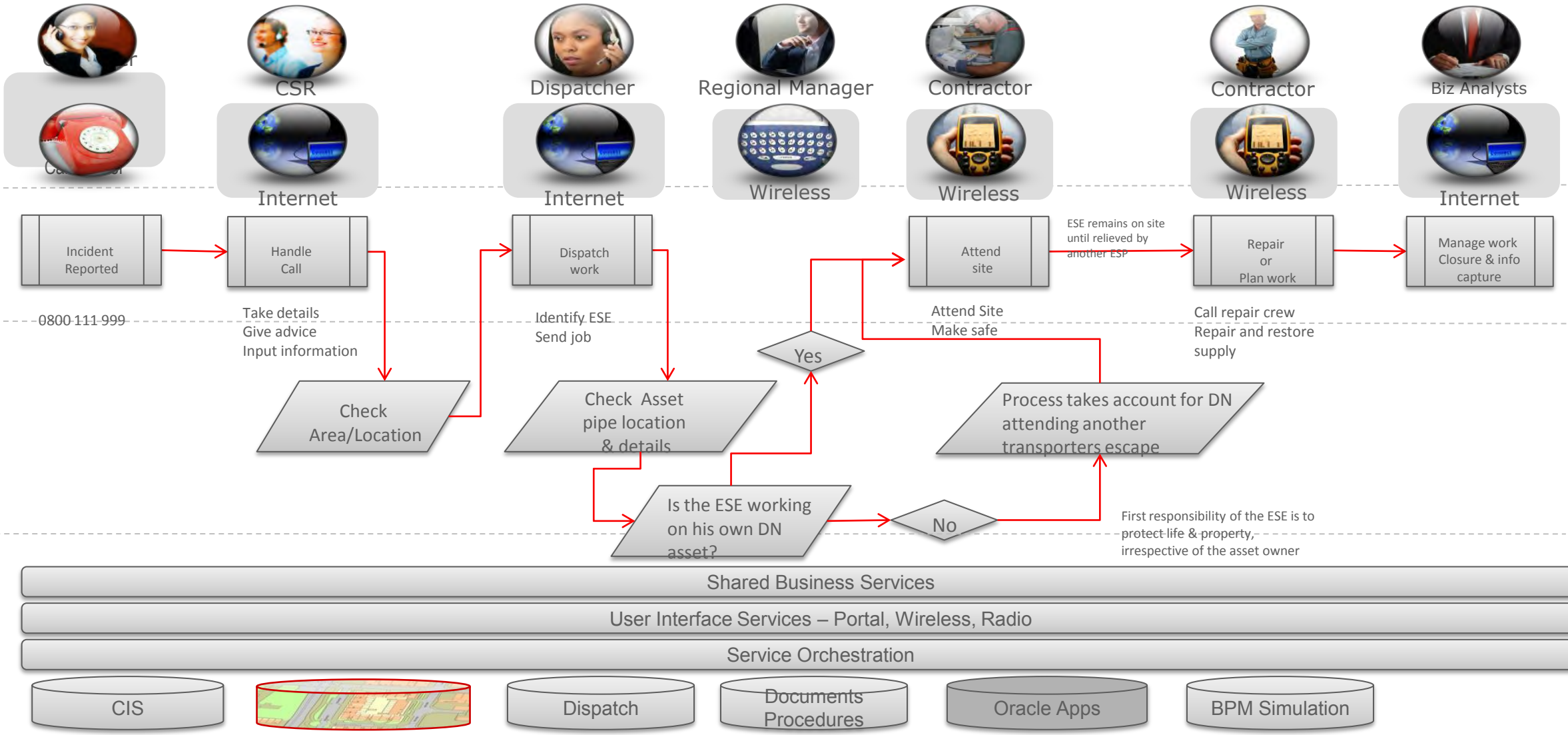
User Interface Services

Business Process Services

Connectivity & Integration Services



Example – Gas Emergency & Repair Process



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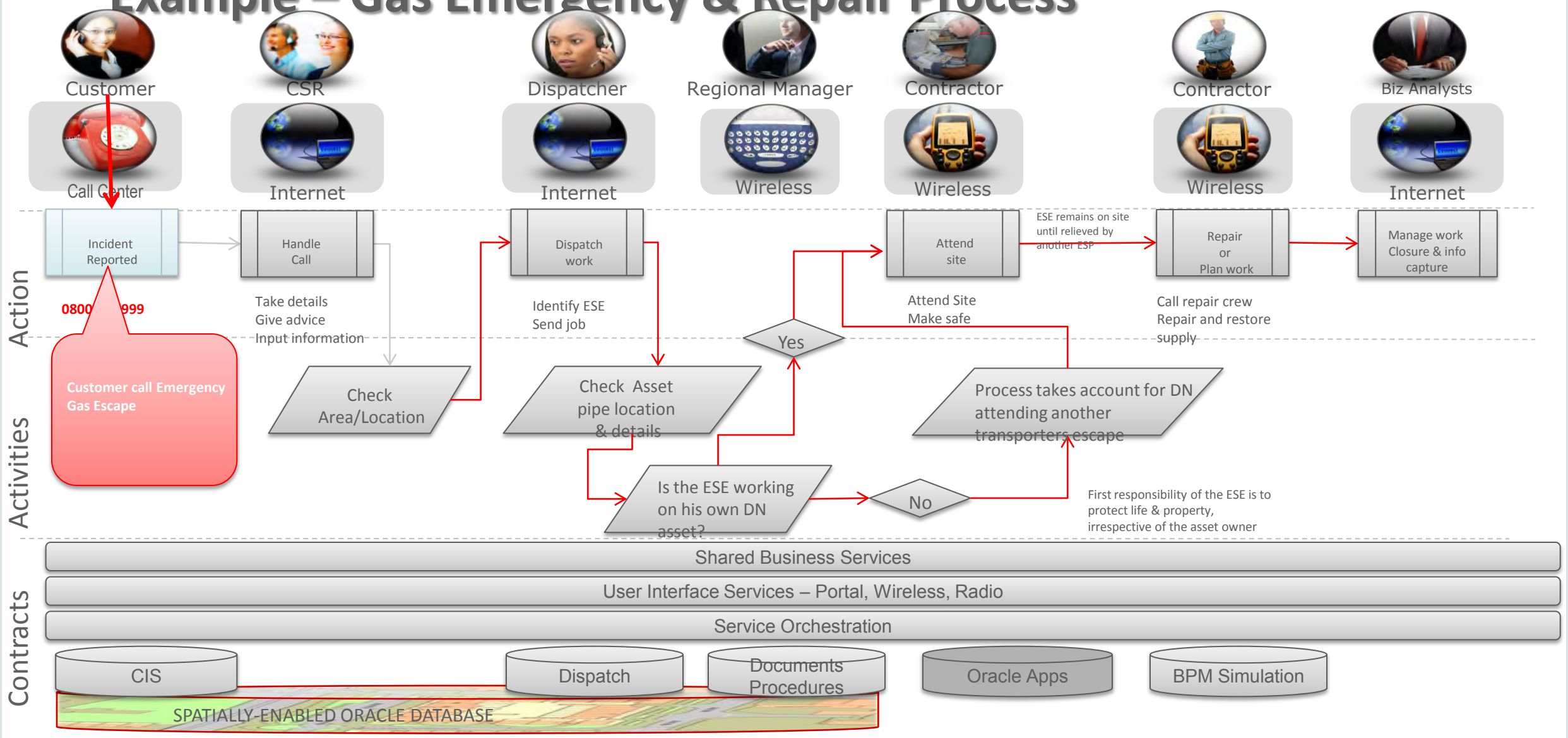

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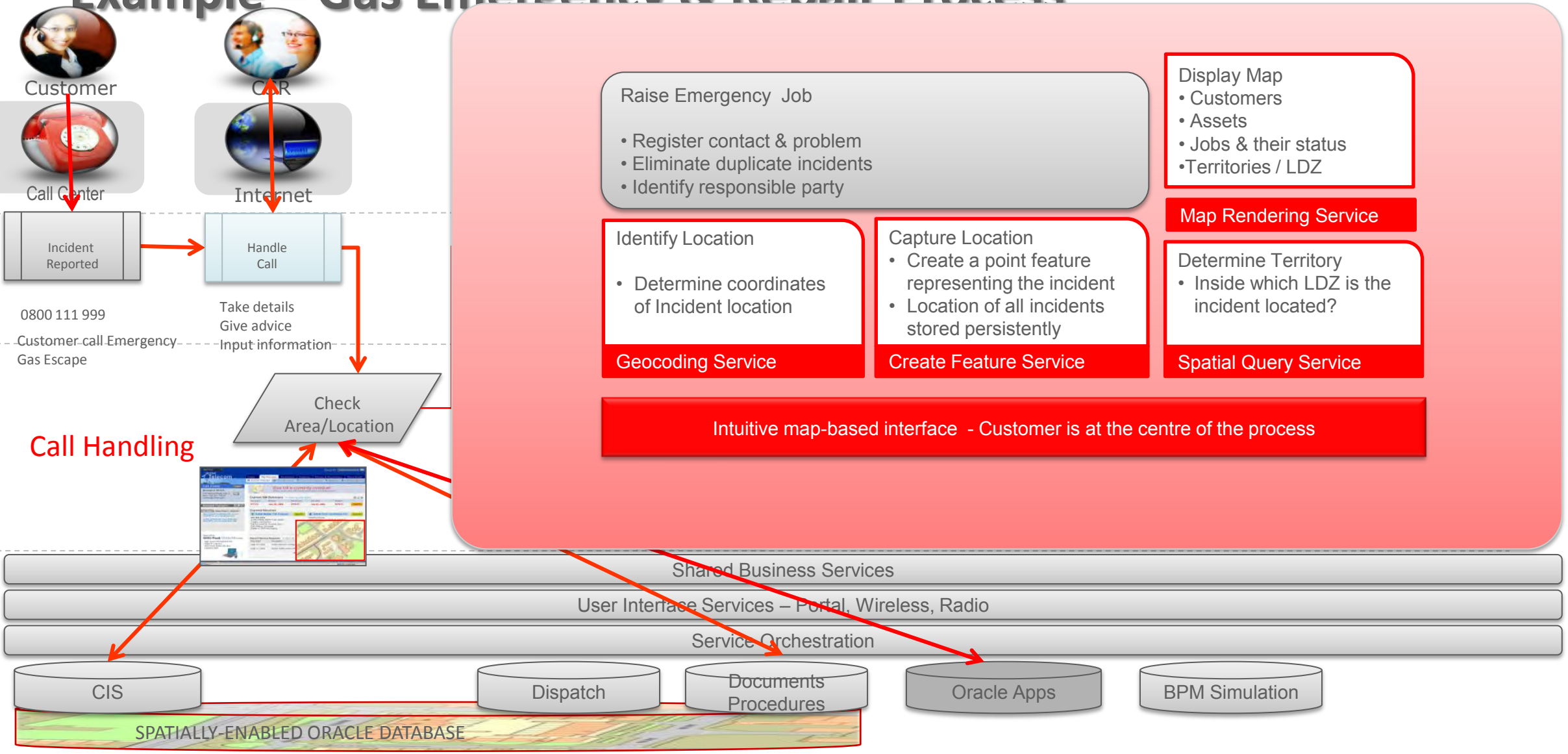

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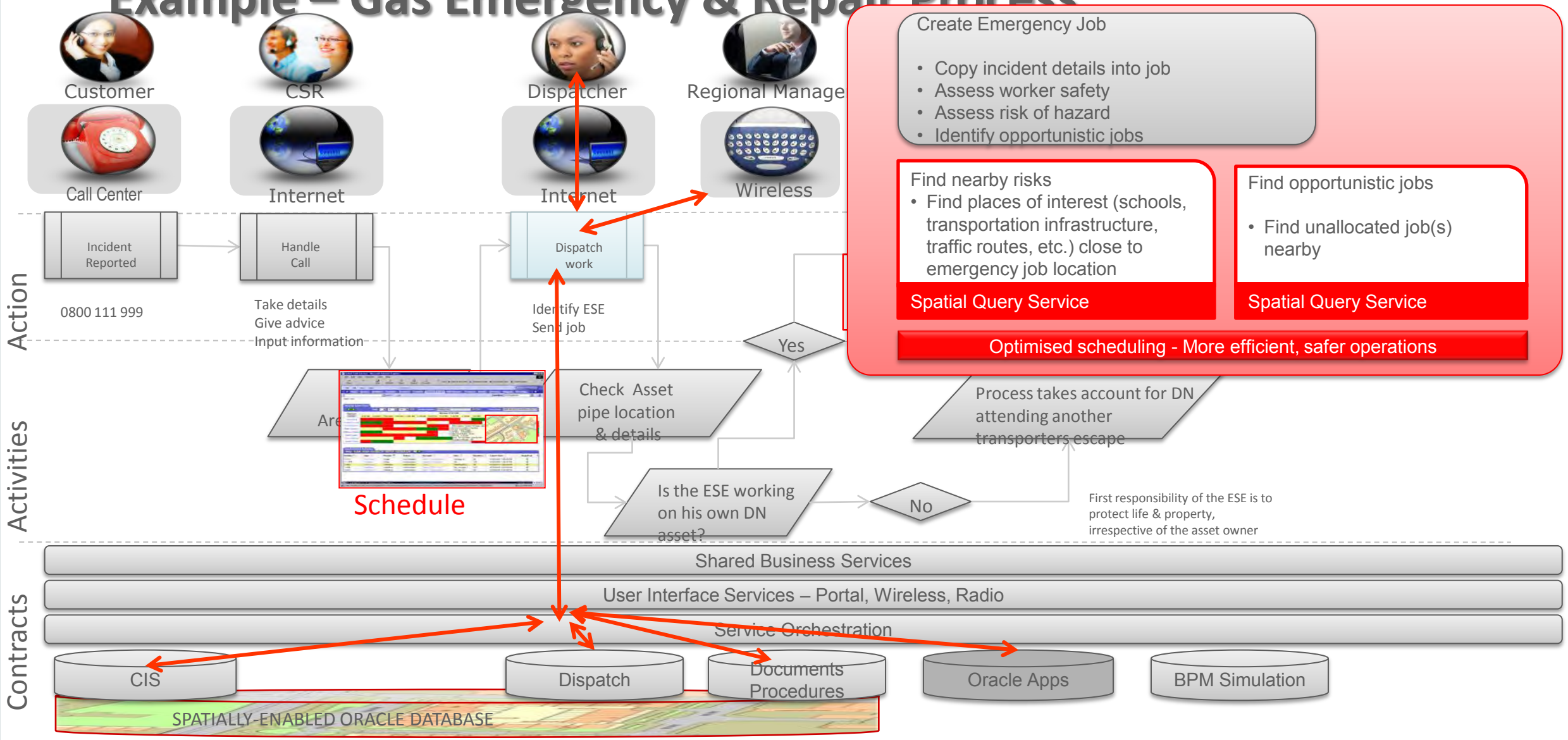

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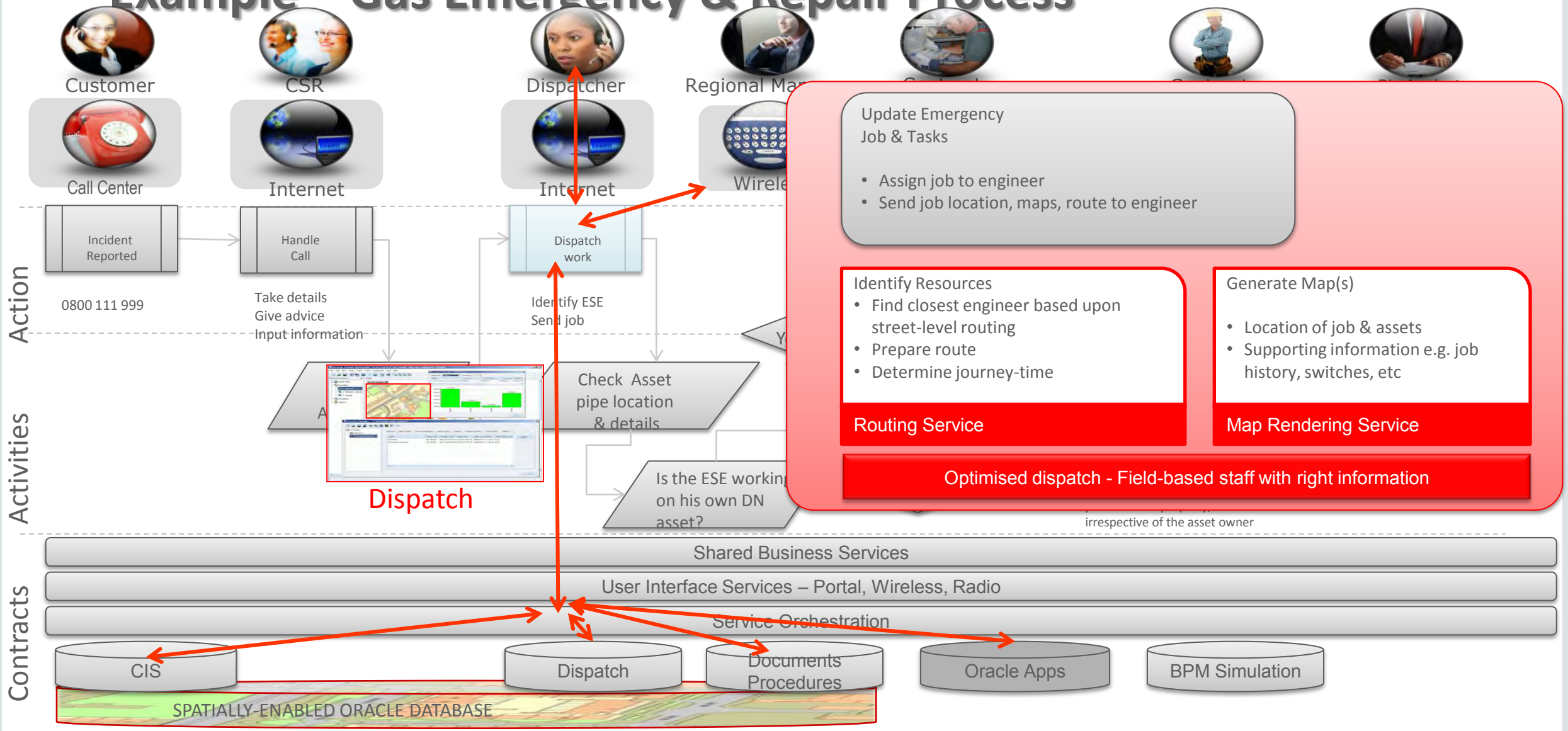

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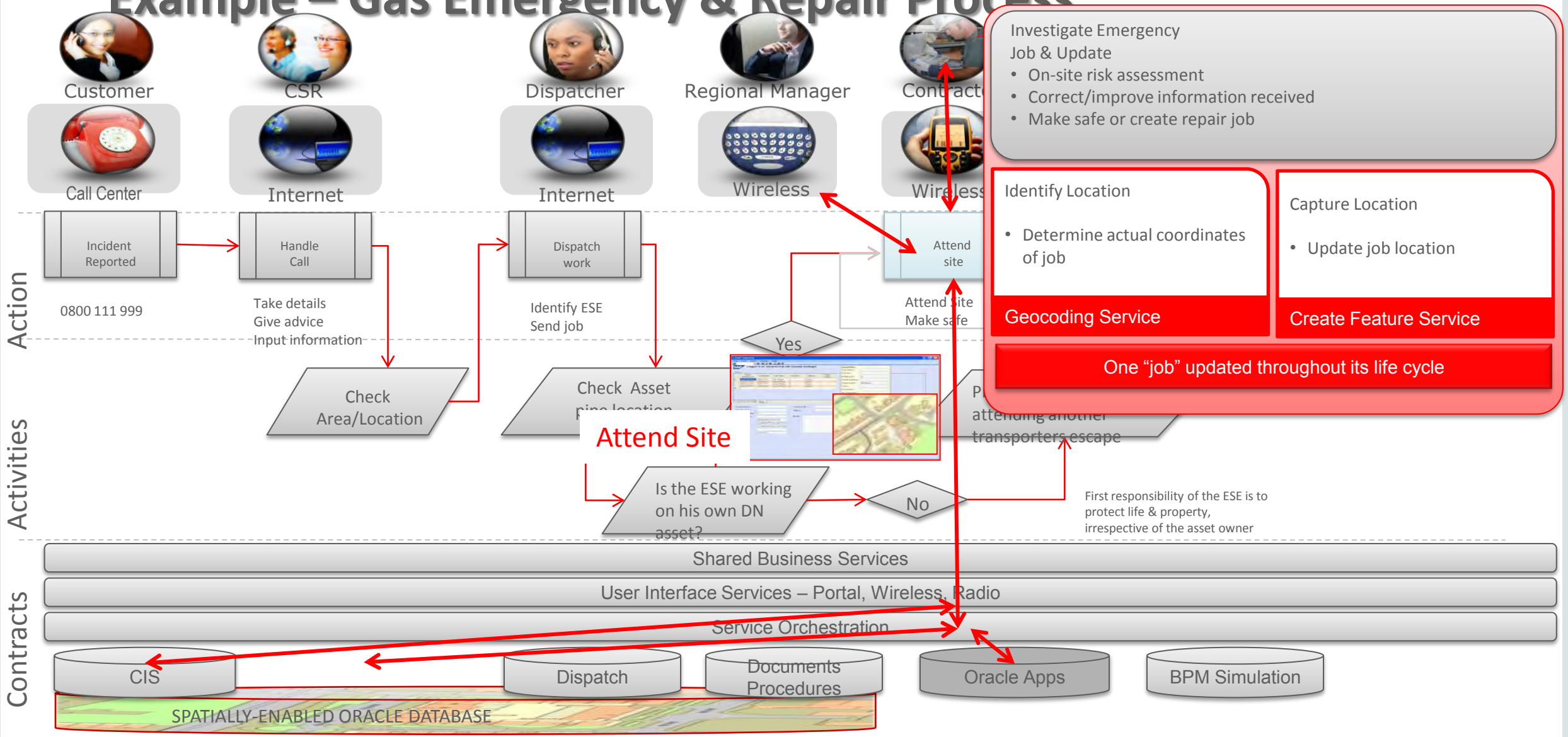

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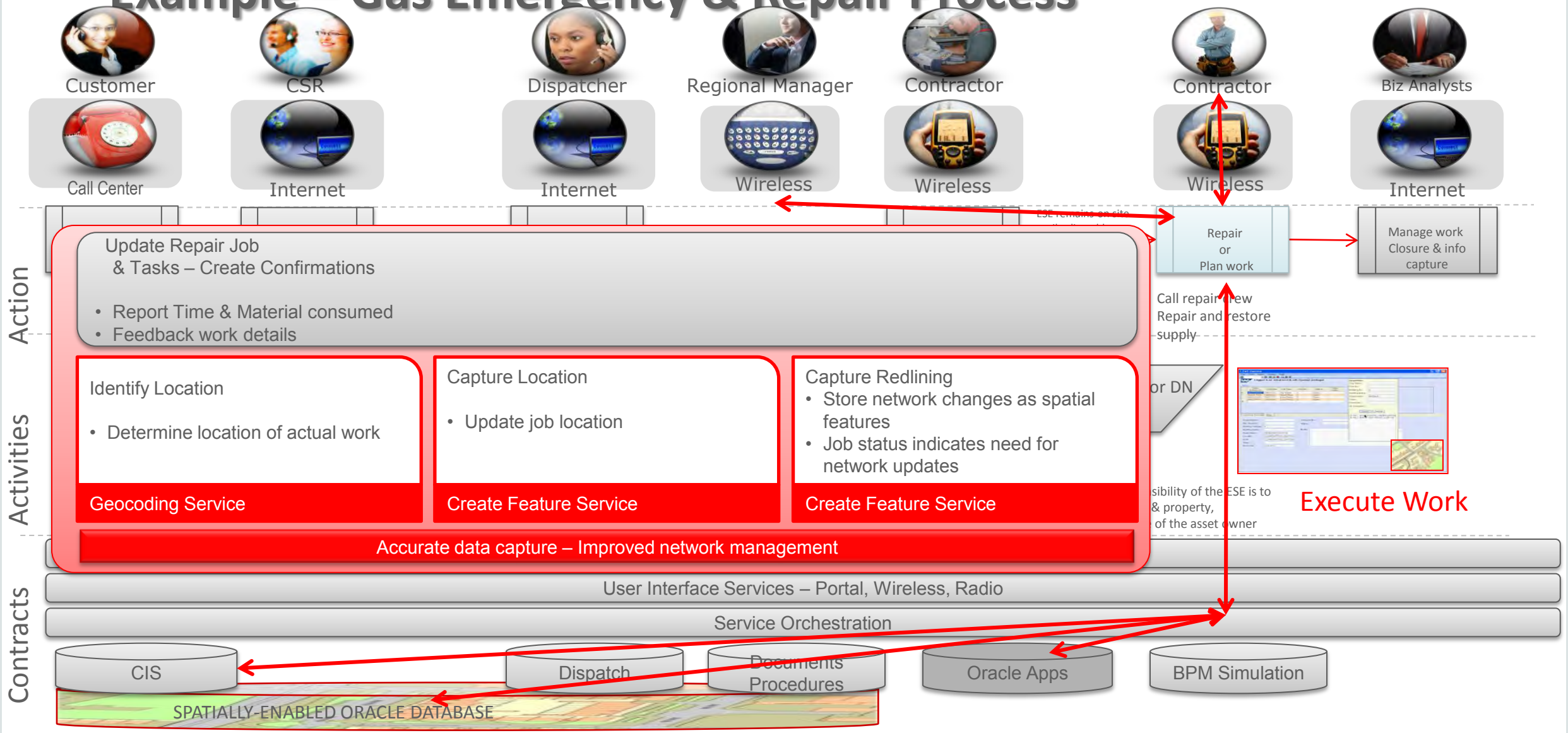

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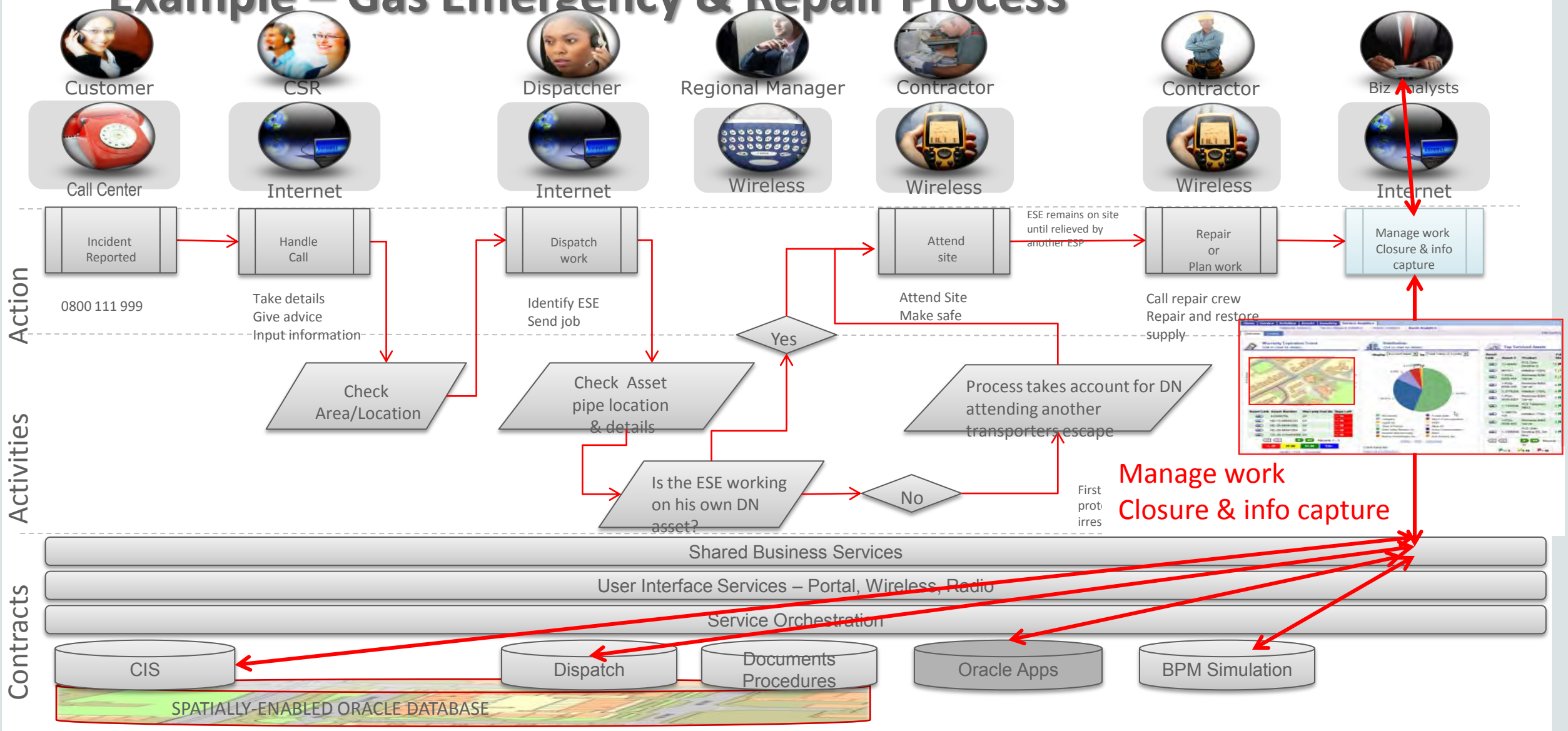
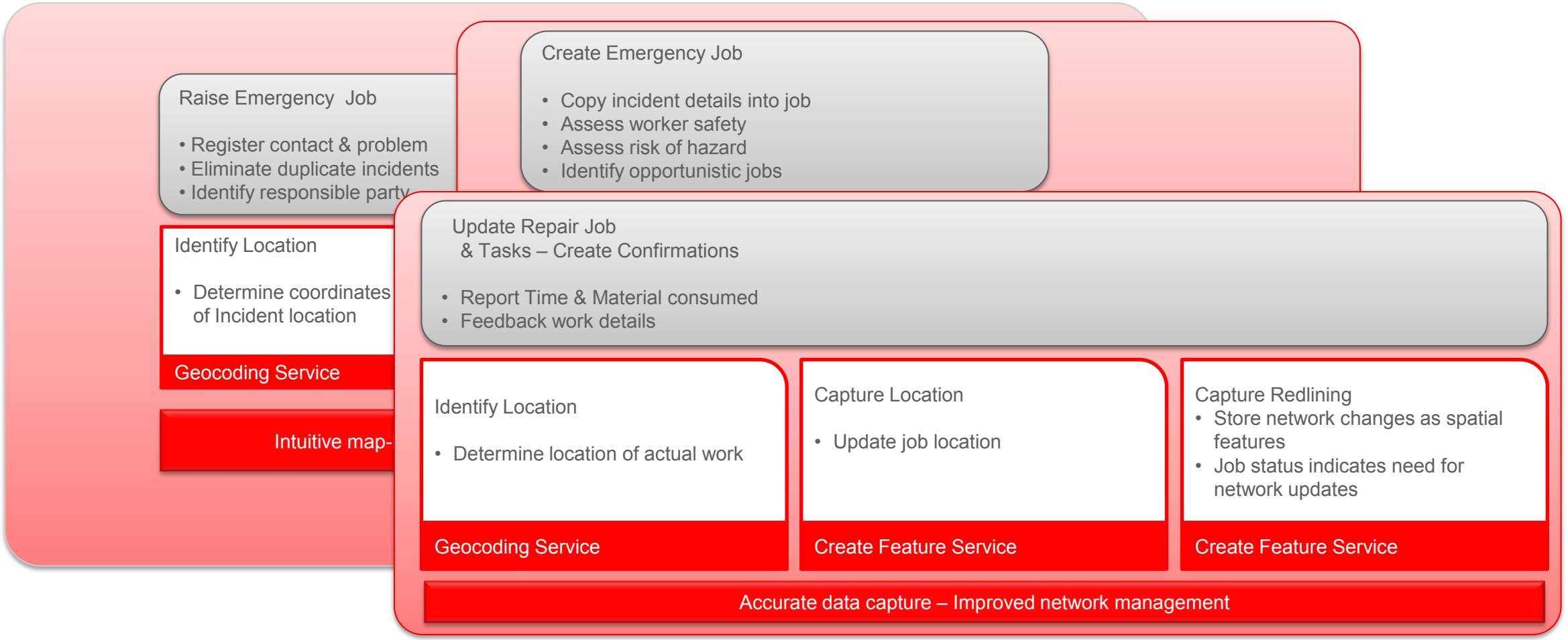


Spatial Analysis in the System



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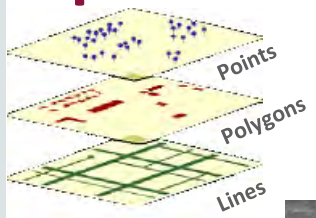
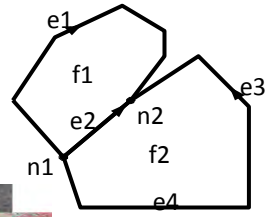
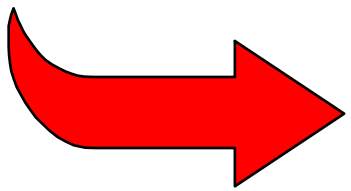
Oracle Spatial Technology in the DB

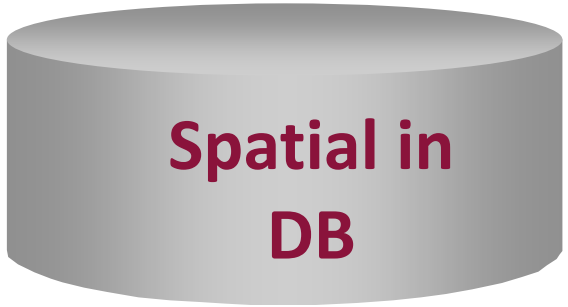
Spatial Data Types

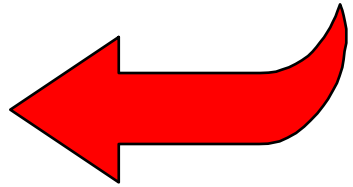




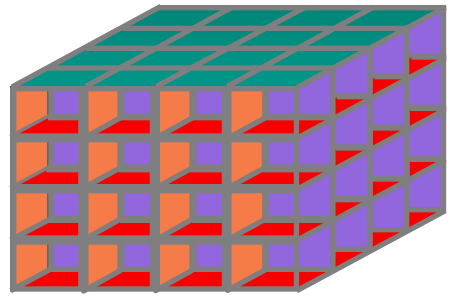
All Spatial Data
Stored in the Database







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 are 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 XMLELEMENT( … 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 a s web service
  - No code require, 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}”
  - 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 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

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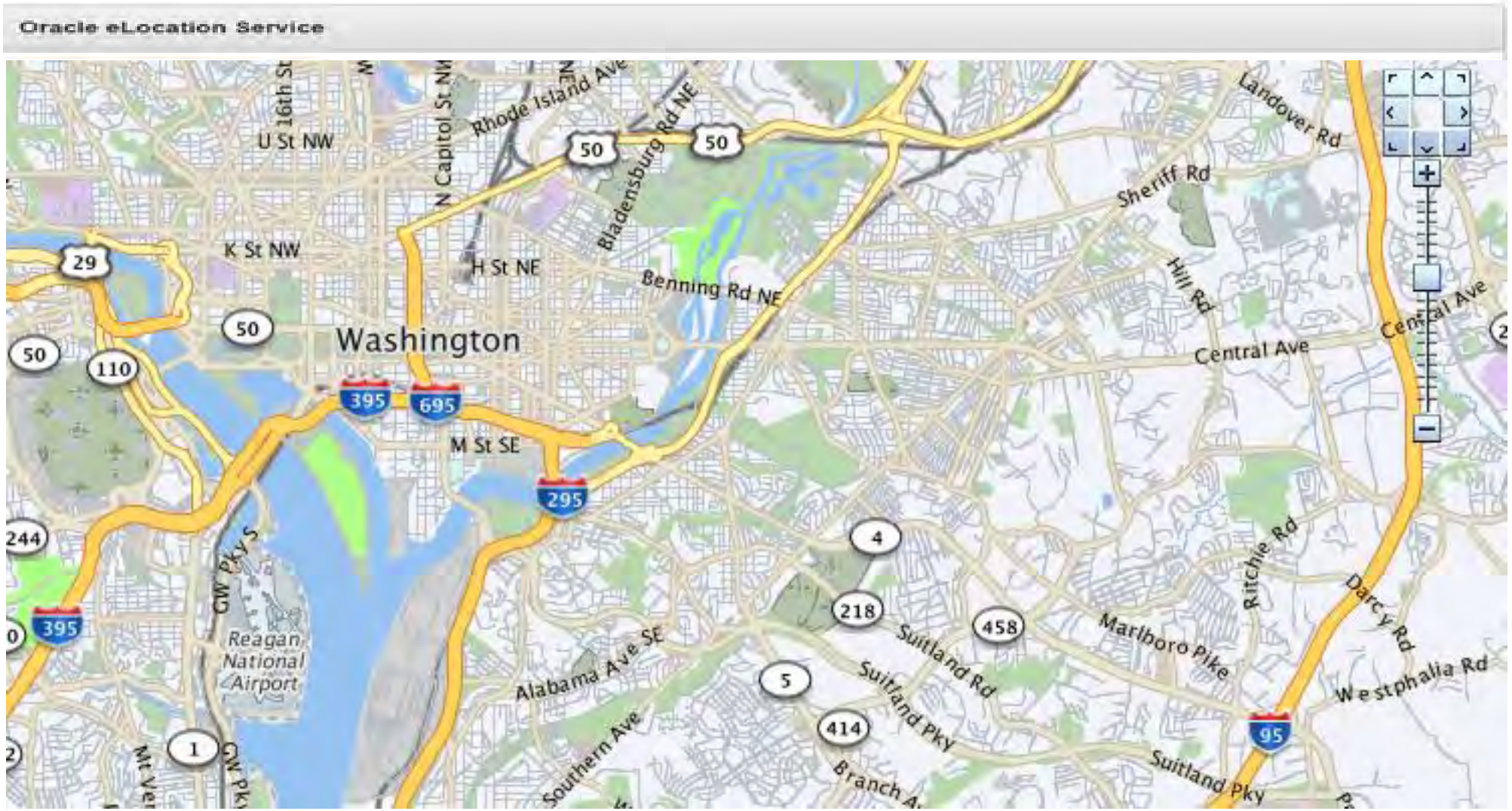
APEX Map Application

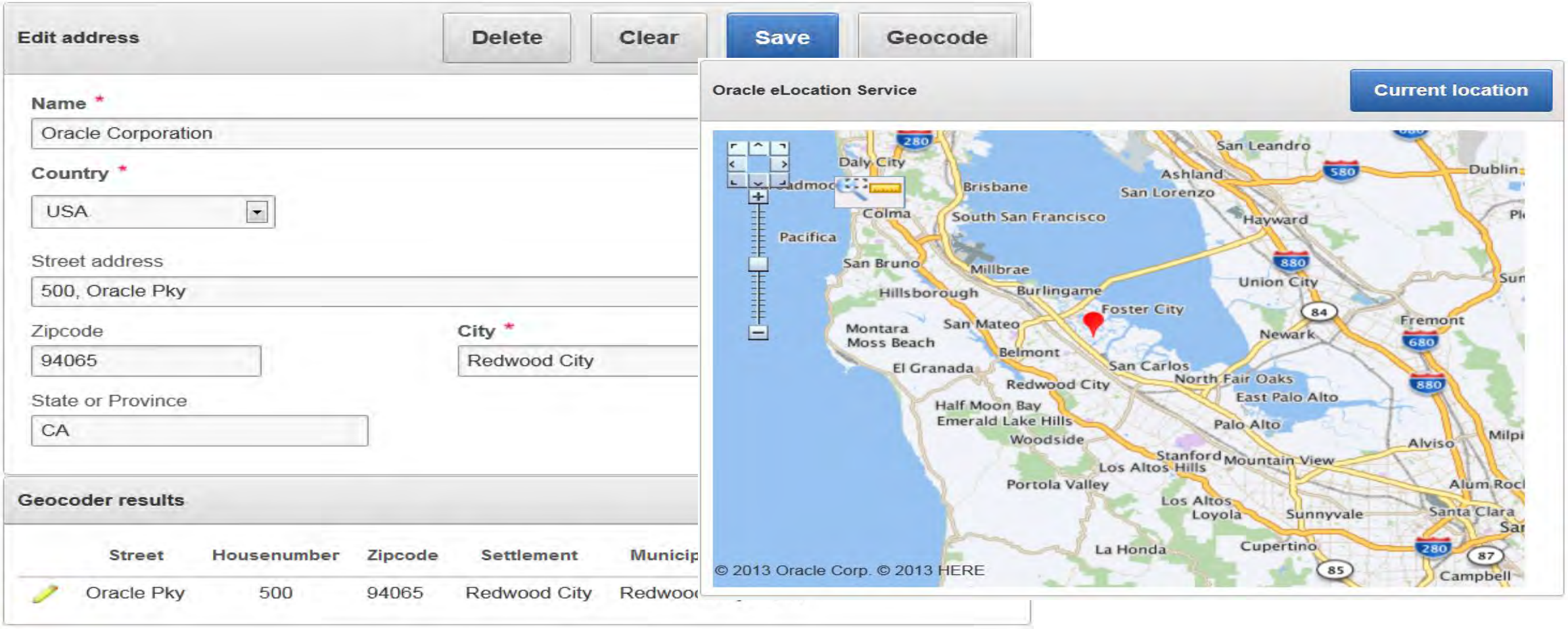
Spatial enabled Applications in APEX

- 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

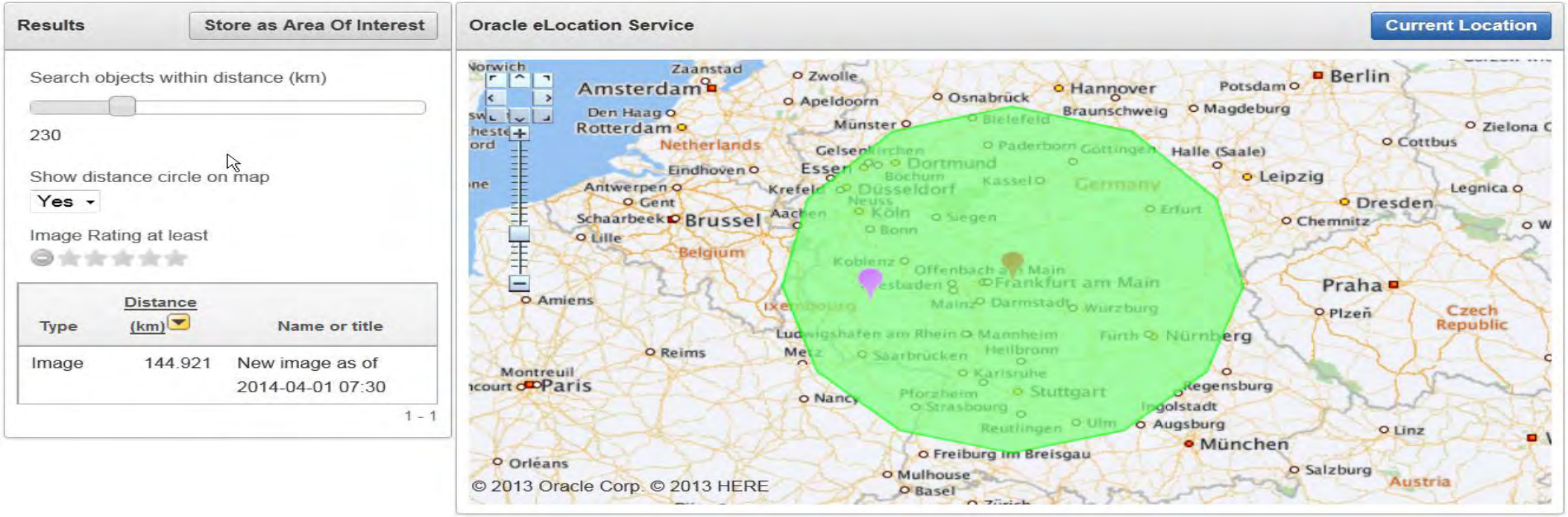
1) Map



2) Geocoder



3) Spatial Query: Within Distance



4) Spatial Query: Anyinteract

Images and Addresses

Area of Interest

Middle Germany

Show Area Of Interest on map

Yes

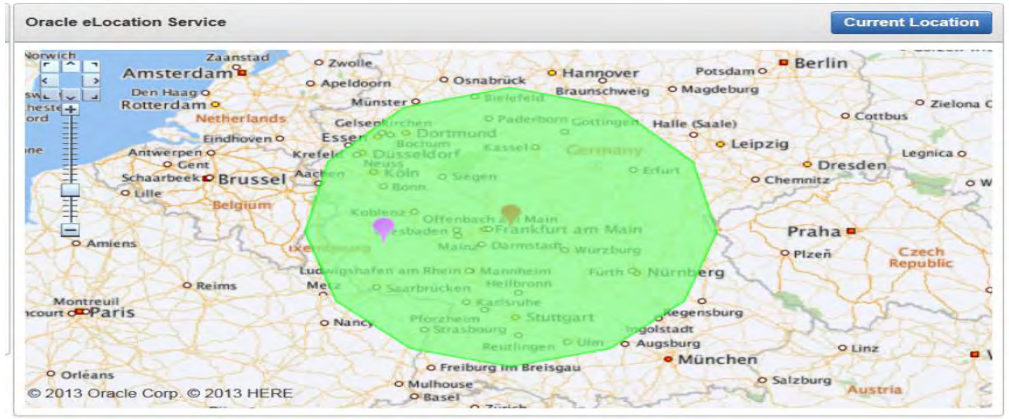
	Name	Position
Image	New image as of 2014-04-01 07:30	7°04'29" E - 49°54'56" N

1 - 1

Oracle eLocation Service

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)

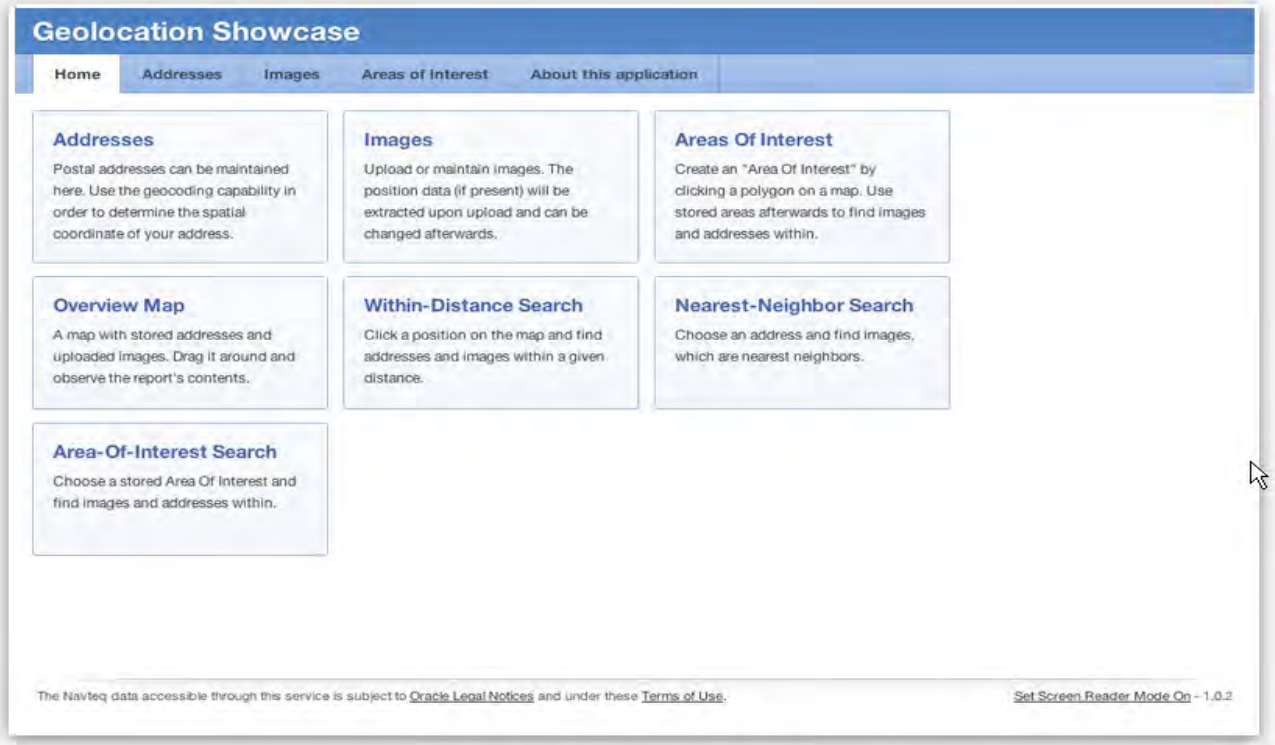
Run | Remove | Manage

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

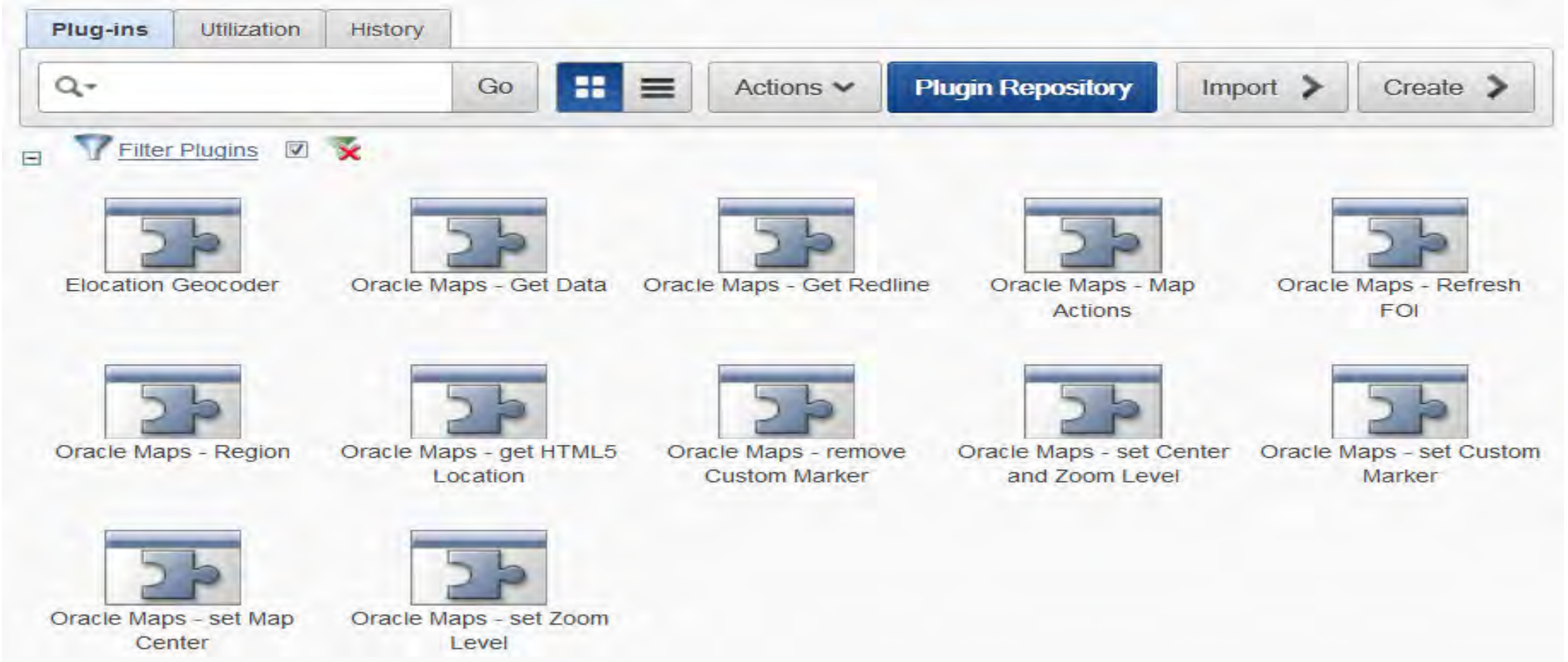
Based on this data, the application offers 3 kinds of spatial analysis

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



Sample Geolocation Showcase

Oracle Maps Utility Plugins



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

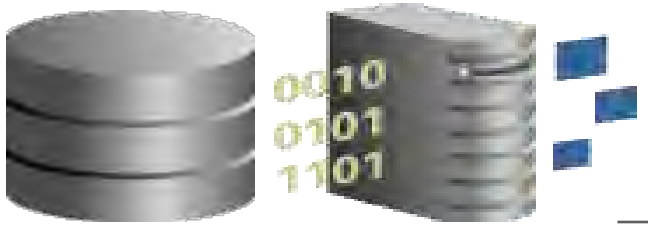
```
begin
  -- create metadata for spatial table
  -- coordinates are lon/lat – and over the whole world
  apex_spatial.insert_geom_metadata_lonlat(
    p_table_name   => 'MY_SPATIAL_IMAGES',
    p_column_name  => 'GEOMETRY'
  );
end;

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

Visualization on a map

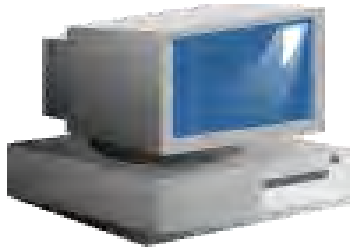
Step 2

Architecture



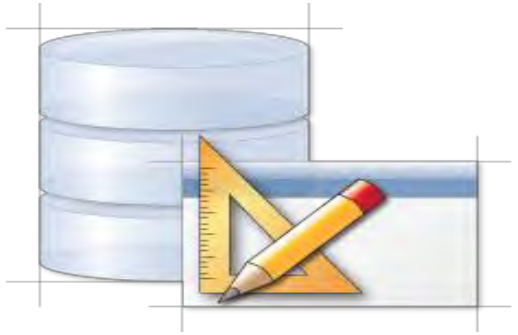
Oracle eLocation Service
with Map Database

Background Maps



Client Browser

Geocoding
Reverse Geocoding

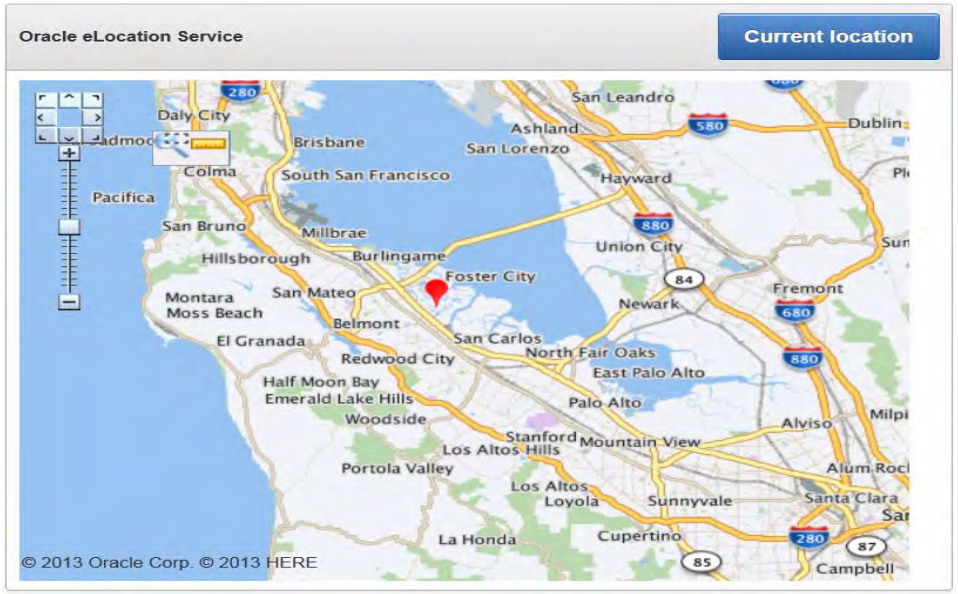


APEX database

APEX Pages and
objects to be
shown on the map

Oracle MapViewer and Oracle Maps

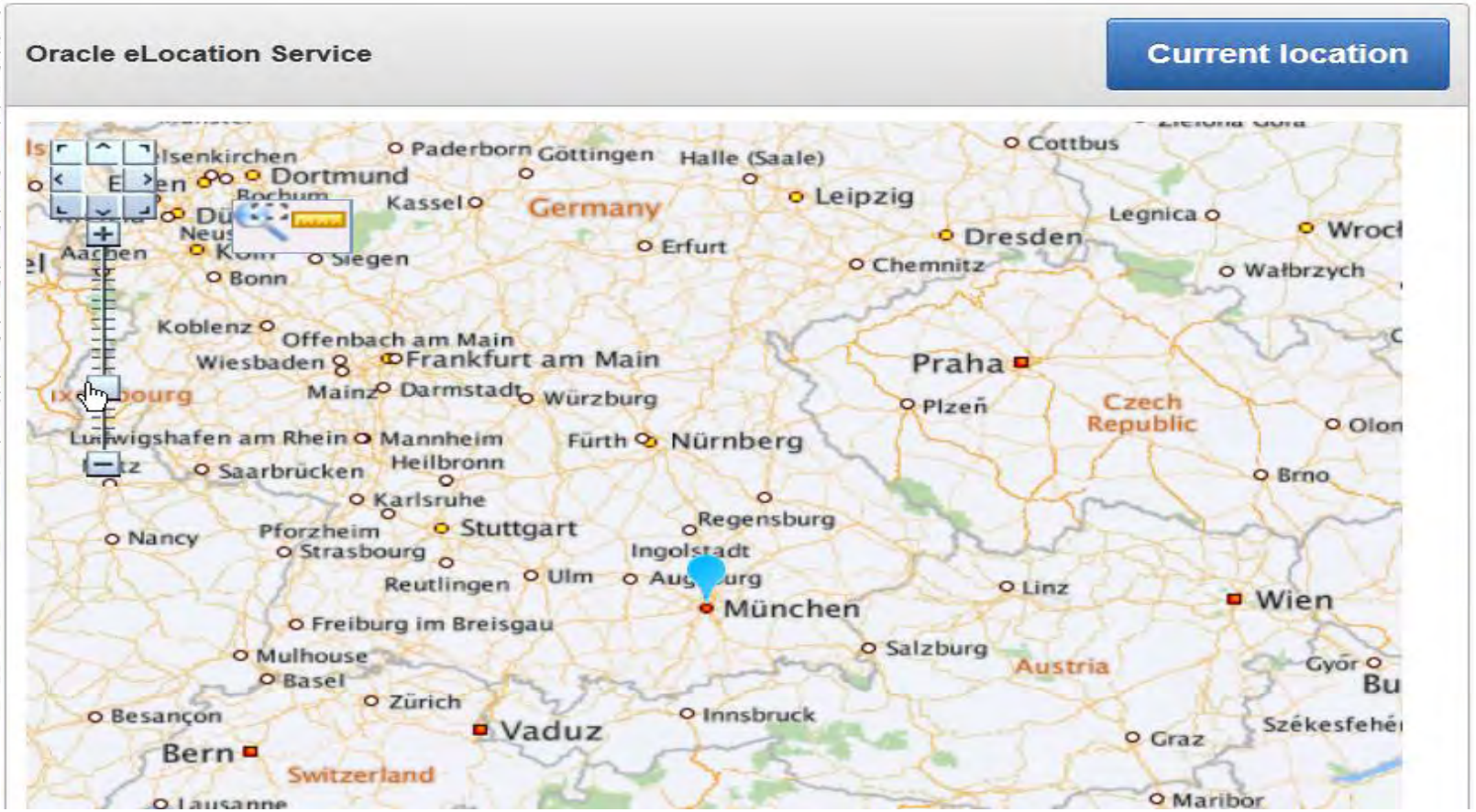
- Map Rendering based on spatial data in the database
- Alternatives in APEX
  - Own Installation of Fusion Middleware MapViewer
  - Use Oracle eLocation Service **maps.oracle.com**
- Programmers Interfaces
  - APEX Plugin
  - Oracle Maps JavaScript API



Oracle Maps APEX Plugin

Settings

* Map Server URL (Host)	https://elocation.oracle.com
* Map Server URL (Path)	
* Map Size (width, height)	
Map Size Interpretation	
* Map Tile Layers	
Feature Of Interest Layers	
Map Center (lon, lat)	
Initial Zoom Level	
Save map position in Cookie	
Navigation Bar	
Navigation Bar Options	

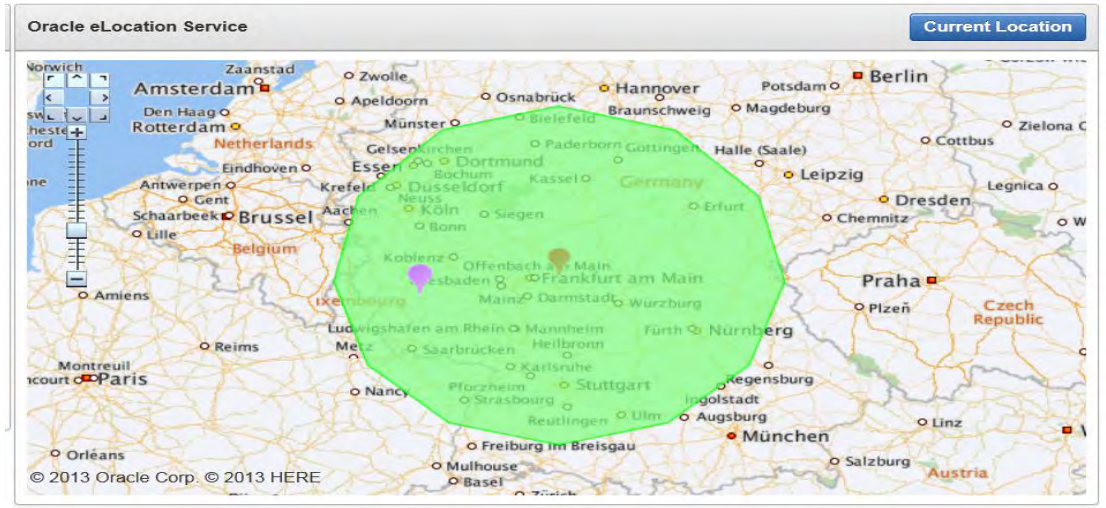


Step 3

Spatial query and analysis

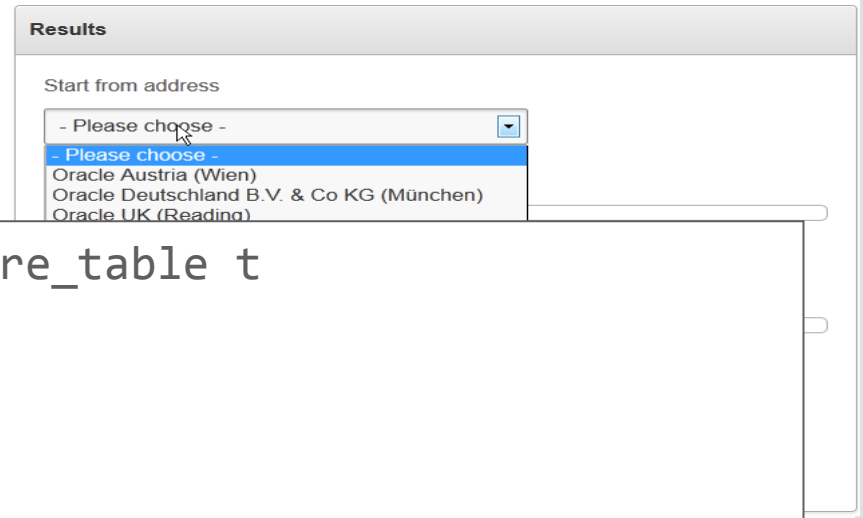
Within Distance Search

- 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

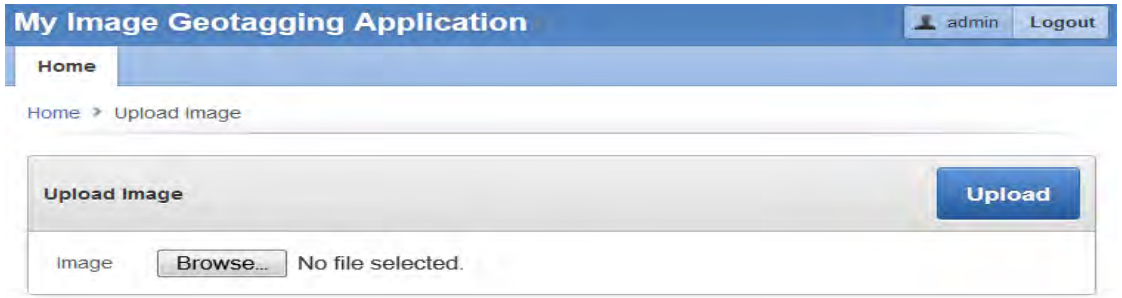
- WHERE Clause: SDO_NN
- Geometry column must be spatially indexed
- Input Parameters
  - Geometry column to search in
  - Start geometry
  - Maximum Distance
  - Max. neighbors
  - Unit to use

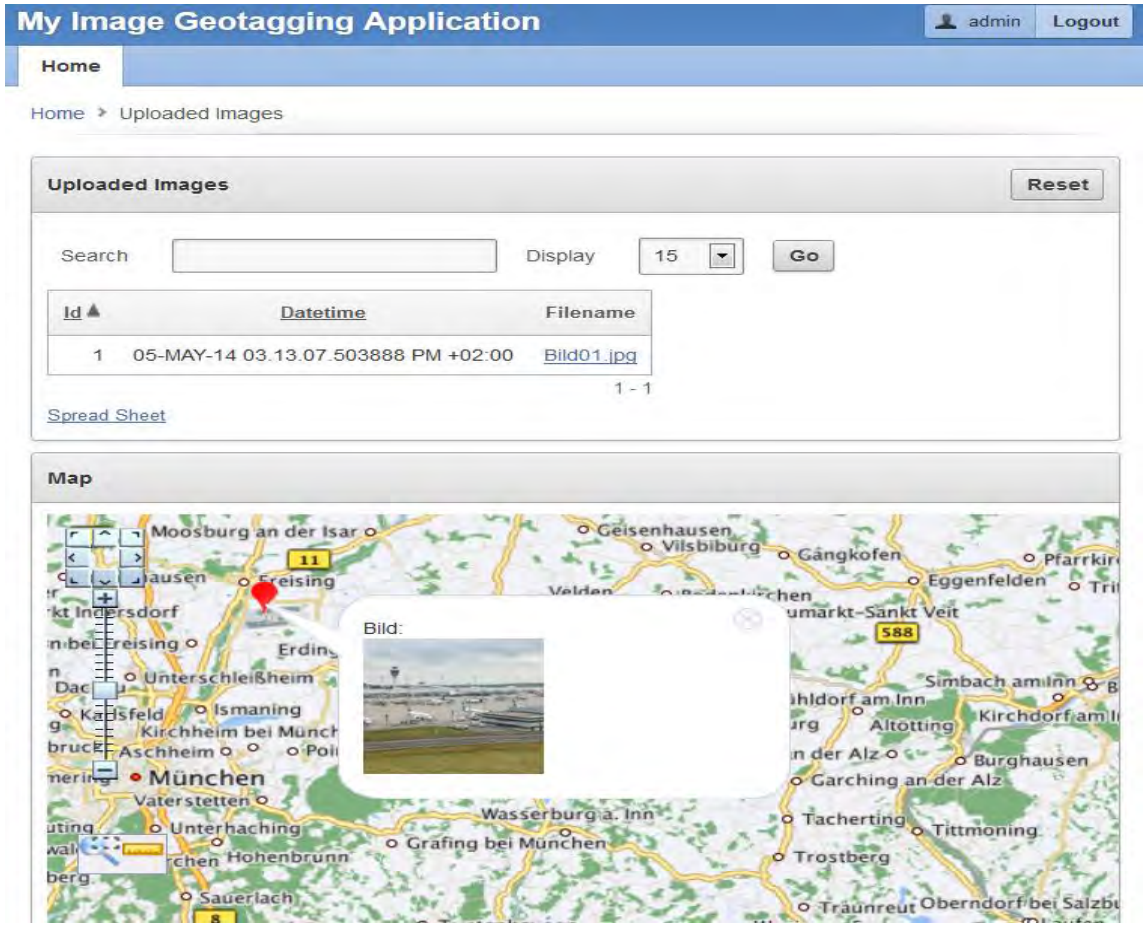



```
select * from feature_table t
where
  sdo_nn(
    t.geometry,
    start_geometry,
    'distance=XX unit=km'
  ) = 'TRUE'
```

Build your own application

Your own application …





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

Program Agenda

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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

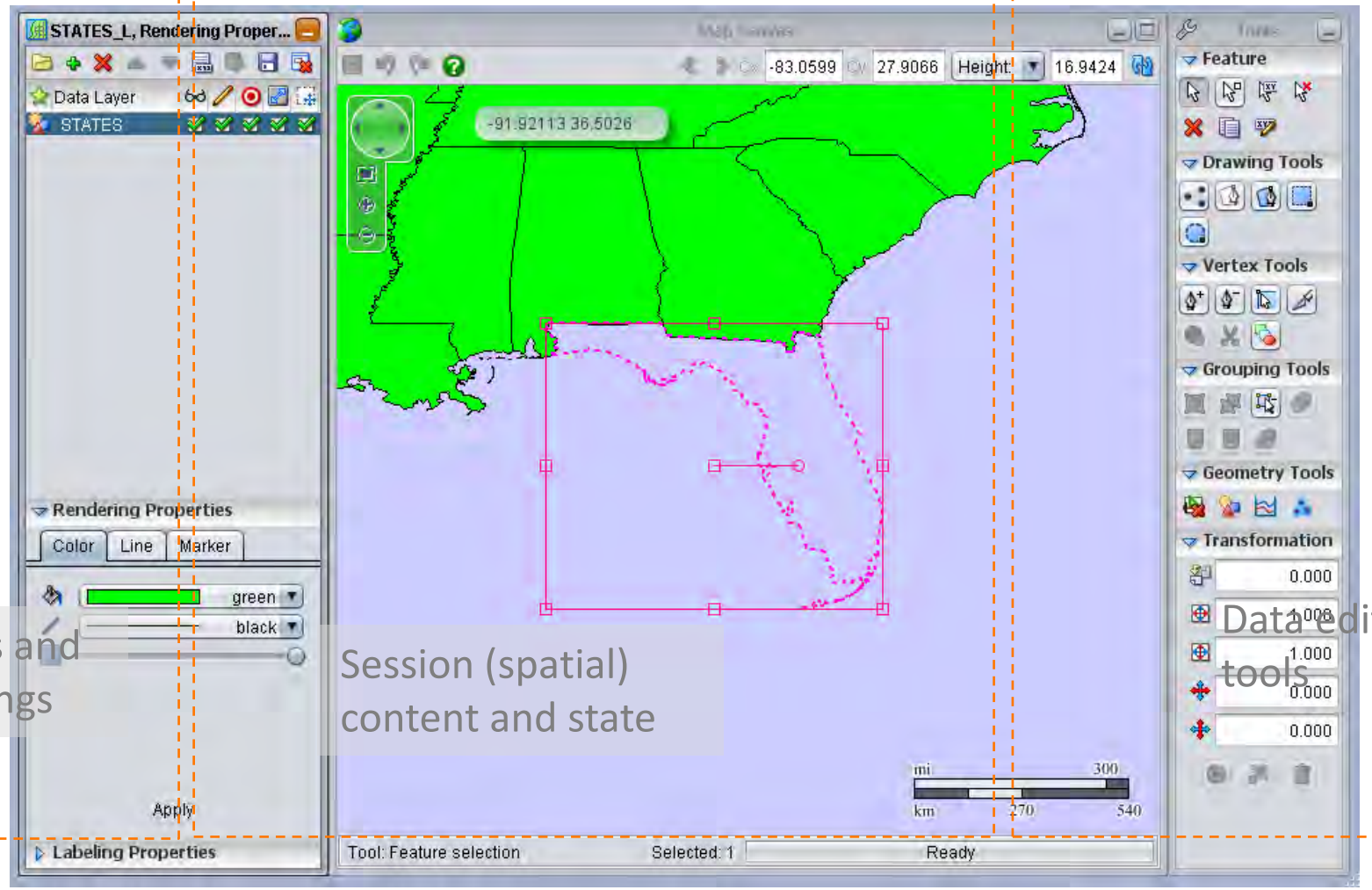
- Associate each customer with the lowest level of the hierarchy
  - In this example, lets say city is at level 4, county at level 3, etc.
  - Associate the customer records with the city level admin area
- Once this hierarch is established it is easy to calculate aggregate metrics for different customer 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



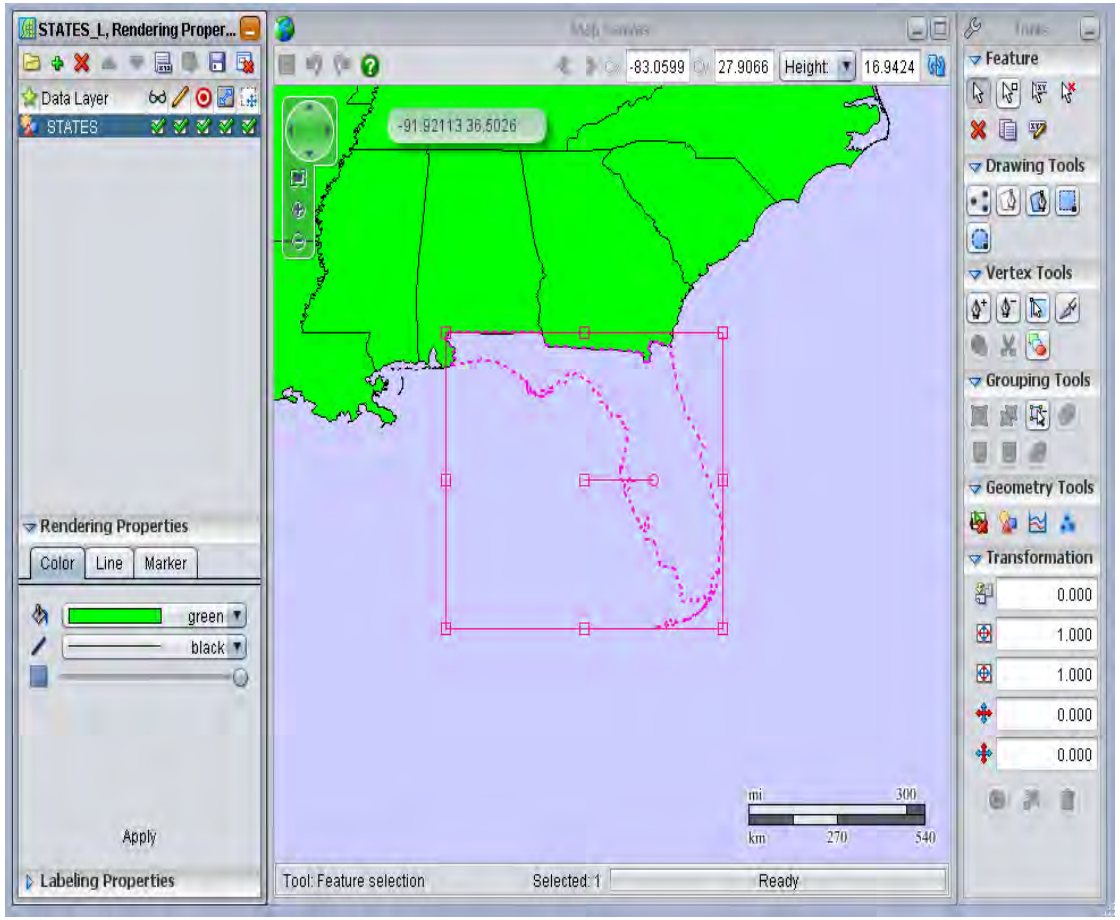
Data sources and session settings

Session (spatial) content and state

Data editing tools

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

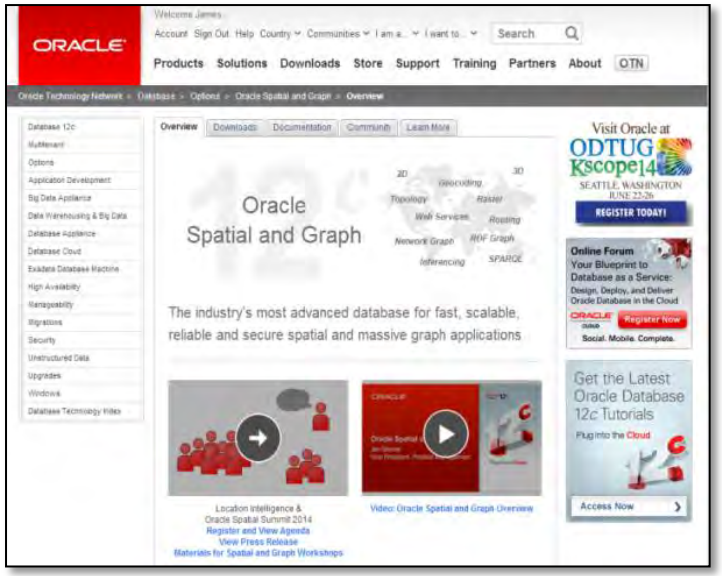
- The SIG promotes interaction and communication that can drive the market for spatial technology and data
- Members connect and exchange knowledge via online communities and at annual conferences and events

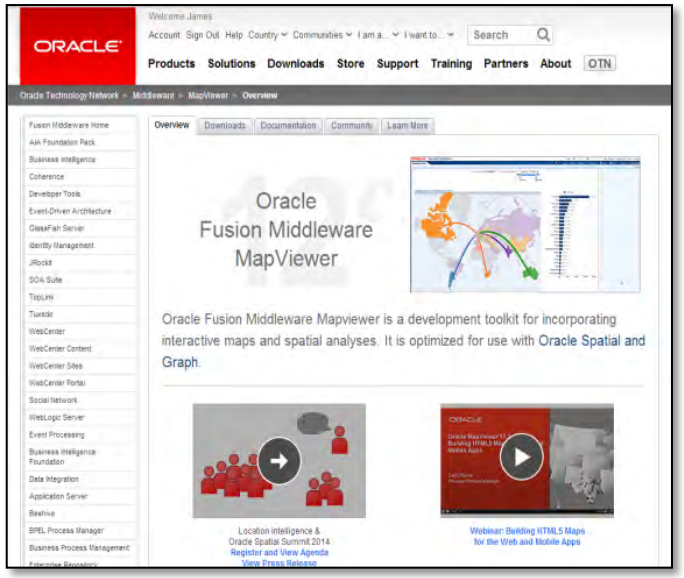
- **Meet us here at the Summit**

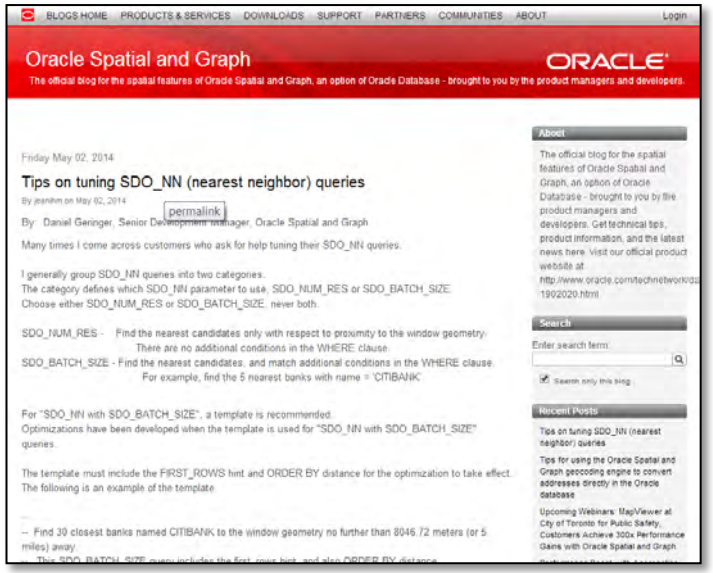
Morning Reception	Social Hours
Tuesday and Wednesday 7:45 to 8:30 a.m. Registration Area	Tuesday and Wednesday 6 to 7 p.m. Registration Area

- **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)
  - OTN Spatial – Communities (search for "Oracle Spatial and Graph Community")
- **Contact the Board at oraclespatialsig@gmail.com**

Resources: Oracle Technology Network

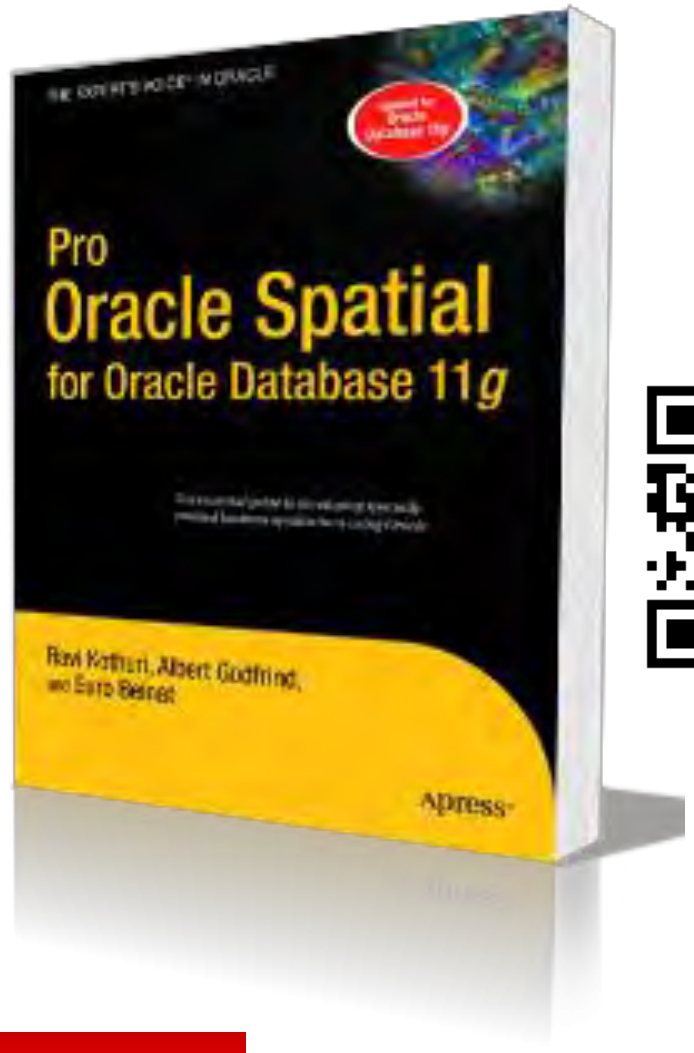


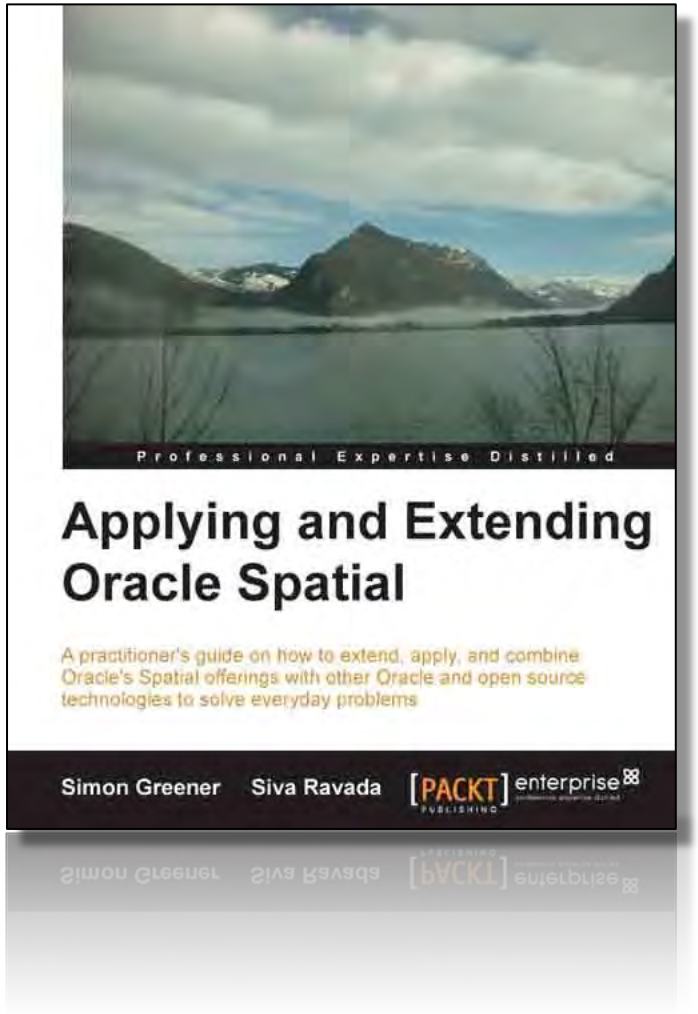




- www.oracle.com/technetwork/database/options/spatialandgraph
- www.oracle.com/technetwork/middleware/mapviewer
- blogs.oracle.com ➔ oraclespatial ➔ oracle_maps_blog

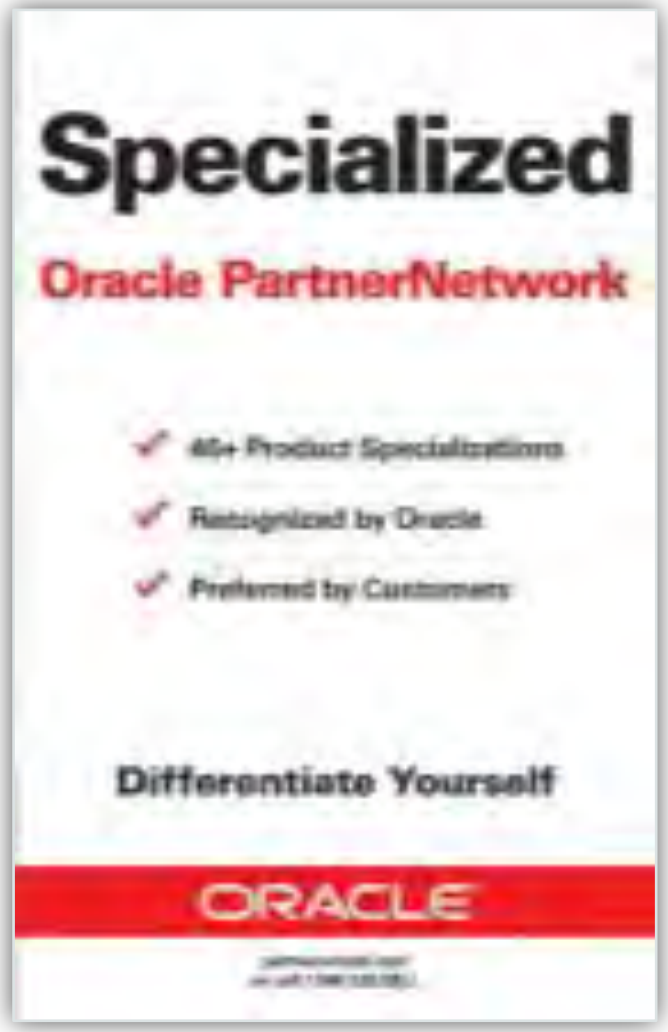
More Resources





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/spatial-partners-423197.html
  - Talk to Oracle team this week



Q & A