Multi-modal routing with Oracle Network Data Model & Oracle Mapviewer

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Southbank headquartered company Est. 1994, 70 staff, Brisbane office.

Leader in the provision of spatially based business solutions to government, road, rail & power utilities:

- Field based asset mapping and inspections,
- Spatial data distribution and value added reselling,
- Digital aerial imagery and terrain models,
- Enterprise GIS solutions including web & mobile technology,
- Development, implementation and support of hosted and Application Service Provider (ASP) based solutions.
Directions Plus™ at the 2006 Melbourne Commonwealth Games

Emergency crews take to PDA guide

Volunteers have hi-tech help for tourists all in hand
Directions Plus™ Television Coverage – March 2006
Directions Plus™ Project

**Business Objectives**
- To showcase Victorian ICT
- To design, build, test, deploy a mobile mapping solution before 2006 Melbourne Commonwealth Games

**Technical Objectives**
- To acquire and build a routable public transport dataset
- To provide shortest route from selected locations using Melbourne’s public transport network
- To generate meaningful travel directions and maps
- To build a mobile application to incorporate spatial web services and deliver answers via screen, print and digital messaging
- To ensure that data and application security was a high priority
1. Volunteer assisting patron in determining route between locations using Pocket-PC based solution
2. Routing request made via the device to backend servers
3. Web services consumed and served to perform routing request
4. Application servers produce and return appropriate routing information
5. Directions and map printed on belt mounted thermal printer
6. Route information and Directions delivered to mobile via SMS & MMS

Realtime technical support and data enhancements

Web-based administration of data and security. Analysis, logging and reporting.
Technologies

Oracle10g R2 and Oracle 10g AS Java Edition

Oracle Network Data Model
• Java API
• Network Data Editor tool

Oracle MapViewer
• MapBuilder

Microsoft .NET
Transport data in Victoria

Vicmap Transport
- Roads (node/links)
- Rail (Trams, Trains)

Metlink/ Dept of Infrastructure
- Tram – 29 routes,
- Bus – 289 routes, over 23,000 stops

Custom built during project
- Node/links
- Route metadata
Oracle NDM Concepts

A Simple Network

- Node
- Link
- Path
Building the routable data

- Train
  - VicMap
- Tram
  - DOI Stops
  - Metlink Stops
  - Metlink Routes
- Bus
  - Metlink Stops
  - Metlink Routes
- Property
  - VicMap

Network Data Model
- Nodes
- Links
- Paths
- Geometry
- Route Metadata
Building the routable data

Network Data Model
- Nodes
- Links
- Paths
- Geometry

Route Metadata

Train
- VicMap

Tram
- DOI Stops
- Metlink Stops
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Bus
- Metlink Stops
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Road
- VicMap
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Network Data Model
- Nodes
- Links
- Paths
  - Geometry
- Route Metadata

Geometry Creation
Sample Output

From: Melbourne Observation Deck
To: Novotel Hotel, St Kilda

WALK to Stop 2 King St/Collins St (Melbourne City) (0.1km)

TRAM No. 109 Port Melbourne from Stop 2 King St/Collins St (Melbourne City) to Stop 125 Port Junction/79 Whiteman St (Southbank)

TRAM No. 96 St Kilda Beach from Stop 125 Port Junction/79 Whiteman St (Southbank) to Stop 137 Alfred Pl/The Esplanade (St Kilda)

WALK to Novotel St Kilda (16 The Esplanade St Kilda) (0.3km)
Building the network data

Data Cleansing
- Reconciliation of stops with map base
- Sequencing of stops
- Duplicate removal within routes
- Duplicate nodes between routes

Geometry
- Union of road network for route
- Splitting road segments based on stop positions
- Fixing directions of both links and geometry
Transport Network - Logical
Transport Network - Physical
Putting all the pieces together

Connections between modes
- Foot links

Determining the ‘least cost’
- Multiple costs on links
- Travel time
- Distance

Network Management with SQL and Oracle Network Data Editor

Directions to include:
- Route Name, Destination, Stop Name, Walking distance (in kms)
The multi-modal network

- Train
- Tram
- Bus
- Foot
- Shuttle bus
Routing with Mapviewer

JDBC Themes for non-base data
- Route Start/End
- Route geometry

PNG output
Web service builds directions and map into single response
Map authoring with Oracle MapBuilder
Oracle MapBuilder
Solution Architecture

- XML Request (Open LS)
- Map and Directions
- getRoute
- getInstruction
- Map Base
- Oracle MapViewer
- getCoords
- NDM
- Features
public DetermineRouteResponse requestRoute(double[] startPoint, double[] endPoint) throws Exception {
    ...

    Path path = shortestPath(getNearestNodeIDs(startPoint, 5), getNearestNodeIDs(endPoint, 5));

    // if a path is not found between the given start and end points
    RouteGeometry routeGeometry;
    if (path != null) {
        // OUR METHOD to compute Geom
        path.setGeometry(computeGeometry(path));
        // Generalise route for presentation
        routeGeometry = createRouteGeometry(path.getGeometry());
    }

    // create the route geometry
    if (routeGeometry != null) {
        response.setRouteGeometry(routeGeometry);
        this.setLineString(routeGeometry.getLineString());
    }

    // create the route instructions. method call()
    RouteInstructionsList instructionsList = createNetworkInstructions(path);
    response.setRouteInstructionsList(instructionsList);

    return response;
}
public RouteMap buildMap(String format, int width, int height) 
    throws Exception 
{
    ...

    MapViewer mv = new MapViewer(mvProdURL);
    mv.setImageFormat(MapViewer.FORMAT_RAW_COMPRESSED);
    mv.setMapTitle(mapTitle);
    int mapW = width, mapH = height;
    mv.setDeviceSize(new Dimension(mapW, mapH));
    double MapSize = Double.parseDouble(mapSizeString);
    mv.setDataSourceName(dataSourceString);
    mv.setBaseMapName(baseMapString);
    mv.setSize(MapSize);

    ...

    mv.setBoundingThemes(boundingThemes, 0.20, true);
    mv.addJDBCTheme(dataSourceString, "themeroute", lineStringSQL, "shape", "8311", mapRouteStyle, ",", ",", true);
    mv.addJDBCTheme(dataSourceString, "startpt", startPntSQL, "shape", "8311", mapStartPointStyle, ",", ",", true);
    mv.addJDBCTheme(dataSourceString, "endpt", endPntSQL, "shape", "8311", mapEndPointStyle, ",", ",", true);

    this.setMapViewerRequest(mv);

    MapViewer prodmv = this.getMapViewerRequest();
    prodmv.run();
    Image img = prodmv.getGeneratedMapImage();
    byte[] b = baos.toByteArray();
    String base64string = Base64.encode(b);
Microsoft, Geomatic Technologies, Readify and Govt of Victoria.

Version: 1.0.2.0
Conclusions

• Oracle Network Data Model can deliver multi-modal routing
• Oracle route server works for road networks only
• NDM must be extended with metadata for direction generation
• NDM API provides for route analysis
• Mapviewer is well suited to delivery of light-weight images via web services
Questions?