Oracle Network Management System - Overview

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Electric Distribution Operations

- **Objective**: Operate the electric distribution network in a safe and reliable manner.

- Restore Outages due to
  - Storms
  - Network damage

- Avoid overloads during peak conditions

- Perform planned maintenance and track safety measures
Operational Applications

- Outage Management (OMS)
- Distribution Management (DMS)
- SCADA
- AMR/AMI
- Mobile Dispatch
Outage Lifecycle

Customer

Outage call received from customer

Updates to cust. for subsequent calls or for other cust. on same outage

Automatic info. updates to CSR

Call Agent

• Oracle CC&B
• CIS
• IVR
• Call Overflow

Outage info. automatically passed to OMS

Dispatcher/Operator

• Oracle NMS
• Outage Analysis
• List Assignment
• Outage completion

Dispatch to Field

Updates from field

Crew

• Voice dispatch
• Oracle MWM Dispatch
• Other Mobile Systems
Integrated Business Process in Action

- Lightening strikes power line causing power outage
- Customer reports outage
- Outage Cause is Determined and Reported
- Customer is informed that the utility is aware of:
  - The Outage
  - Crew Dispatch
  - Estimated Time of Restoration
- Verify outage causes, initiate repair work order
- Oracle OMS
- Oracle Storm Management
- AMI Server
- Outage Detection
- Outage Analysis
- Oracle Utilities Business Intelligence
- Outage History & KPIs
- Outage Jobs & Status
- Damage Assessment
- Dispatch Repair Crew
- Oracle MWM
- Oracle CC&B
- Outage Event Status
- Customer reports outage
- Outage Event Status
- Customer reports outage
- Outage Event Status
Outage Management without OMS

**Call Routed to Dispatch**
- Locate Call on Network
- Assess & Group Calls & Probable Faults
- Determine Probable Fault
- Locate Available Trouble Crew
- Dispatch Trouble Crew
- Crew Patrols for Damage
- Locate Fault

**Outage Prediction without AMR or OMS**
- Assess Damage
- Perform Emergency & Planned Switching
- Dispatch Switching & Repair Crew
- Perform Emergency Switching & Repair Work
- Perform Switching to Return to Normal
- Crew Reports Repair Reports
- Confirm Outage Restoration
- Produce Reports

**TIME LINE**
OMS Enabled Outage Management

Customer call & SCADA reported Off meters routed to Dispatch

- Locate & group calls and Off meters on Network
- Determine Probable Fault location
- Locate Available Trouble Crew
- Dispatch Trouble Crew
- Crew Patrols for Damage
- Locate Fault
- Assess Damage
- Perform Emergency & Planned Switching
- Dispatch Switching & Repair Crew
- Perform Emergency Switching & Repair Work
- Perform Switching to Return to Normal
- Crew Reports Repair Report
- Confirm Outage Restoration
- Produce Reports

Determining location of fault reduced to seconds

Prioritized Dispatching

More accurate dispatch

Auto-Generation of suggested restoration switching

Automatic report generation

TIME LINE
From Reactive to Proactive
Ops Objectives: Act faster, act smarter
Oracle Utilities at a Glance
A Global Business Unit of Oracle Corporation

Corporation Business Units
- Financial Services
- Health Sciences
- Communications
- Utilities
- Retail

Utilities Global Business Unit
- Software
- Consulting
  - Training
  - Support
- Sales / Partners

Utilities-specific Applications
- Network Management System
- Customer Care and Billing
- Mobile Workforce Management
- Meter Data Management
- Work and Asset Management

Oracle Technology / Applications

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Oracle Utilities NMS

- Oracle Utilities Outage Management System (OMS)
  - Call Taking
  - Analyze inputs for predicted outage locations and customers
  - Outage Status Tracking, feedback to Call Agents
  - Dispatching of crews/resources
  - Tracking of outage times, customers, work and causes

- Oracle Utilities Distribution Management System (DMS)
  - Switch Plan tracking (Emergency and Planned)
  - Powerflow analysis to assist in switching decisions
  - Suggested Switching to automatically calculate switching options for Restoration/Isolation
  - Volt/Var Optimization analysis – Loss minimization
The #1 OMS Product In The Market

Source: Gartner

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Outage Management Customer Showcase

1. Alinta (AUS)
2. Atlantic City Electric
3. Baltimore Gas & Electric
4. Bermuda Electric Light Company
5. Centerpoint Energy
6. Cincinnati Gas & Electric Company
7. Connecticut Light & Power
8. Consolidated Edison
9. CPFL (Brazil)
10. Delmarva Power & Light
11. Duke Energy
12. Electricity Supply Board (IRL)
13. Energy Australia
14. Energy United
15. Georgia Power Company
16. Gulf Power Company
17. Hawaiian Electric Company
18. Idaho Power Company
19. Interstate Power
20. Iowa Electric Service
21. Kansas City Power & Light
22. Kentucky Utilities
23. Louisville Gas & Electric
24. Mid-Carolina Electric COOP
25. Mississippi Power
26. Northern Ireland Electric (IRL)
27. Northern States Power Company
28. Nova Scotia Power
29. Potomac Electric Power Co
30. Public Service Company of CO
31. Public Service New Mexico
32. Rappahannock Electric Cooperative Inc.
33. Sam Houston Electric Co-op
34. Savannah Electric & Power Company
35. South Carolina Electric & Gas
36. Toronto Hydro
37. United Illuminating
38. Vector (NZ)
39. Western Mass Electric Company
40. Wisconsin Power & Light
Outage Management Customer Showcase
Outage Management Customer Showcase
Oracle NMS Case Study

Statistics:
- Customers Served: 1,100,000
- Network Area: 2,300 Square Miles (3,400Sq.km)
- D/T Lines: 22,000 Miles

Project Profile:
- Installed: 2003 2008
- Oracle NMS Release: 1.6.1.4 1.7.5
- Max Full Client Users: 60
- Max Exec. Dashboard Users: 100
- Max Calls/hr: 40,000
- Max dev ops/hr: 300
- Operating Environment: HP-UX, Oracle, Smallworld

"With the Oracle NMS solution we are able to pinpoint where problems are on our network, which in turn helps us more effectively prioritize work and optimally dispatch our crews. The system allows us to better serve our customers because we can provide them with accurate information about the length of time it will take to restore power, as well as providing timely feedback on the cause of the outage and the dispatch and crew assignment information."

Ken DeFontes, President & CEO
Oracle NMS Case Study

Experience with Hurricane Isabelle: “the system paid for itself during Isabelle.”

- 790,000 customers out
- over 80 people on the system at any one time
- over 23,000 individual jobs
- Restored power in 8 days to all the affected customers

BGE believes it was at least two days shorter than if they did not have Oracle NMS

<table>
<thead>
<tr>
<th></th>
<th>Isabel</th>
<th>Floyd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>8 days</td>
<td>8 days</td>
</tr>
<tr>
<td>Customers Affected</td>
<td>790,000</td>
<td>503,000</td>
</tr>
<tr>
<td>Phone Calls</td>
<td>712,000</td>
<td>290,000</td>
</tr>
<tr>
<td>Cases of Trouble</td>
<td>23,612</td>
<td>16,000</td>
</tr>
<tr>
<td>Total Personnel</td>
<td>6400</td>
<td>3300</td>
</tr>
<tr>
<td>Poles replaced</td>
<td>450</td>
<td>350</td>
</tr>
<tr>
<td>Transformers</td>
<td>306</td>
<td>210</td>
</tr>
</tbody>
</table>
BGE recently went live with Oracle Utilities NMS Release 1.7.5.

One of the major improvements was verbose switching steps as documented actions for safe and secure operations.

Switching Management module has enabled a fully paperless environment for submitting, preparing and executing Switch Sheets with the NMS for planned and unplanned outages.
Oracle NMS Case Study

Statistics:
- Customers Served: 600,000
- Network Area: 2,300 Square Miles (3,400Sq.km)
- D/T Lines: 5,000 Miles

Project Profile:
- Installed: 1999 (1.6.1.4 H), Upgraded 2008 (1.7.10)
- Network: Gas, Electric
- Number of Users: 30
- Operating Environment: IBM/AIX, Oracle

Assisted Oracle Utilities with the definition and development of automated Fault Location, Isolation and Service Restoration (FLISR). Identifies faulted sections in the field via SCADA integration.

Automatically prepares switching steps and issues actions via SCADA. Allows Alinta to avoid sustained outages by completing restoration actions within 1 minute, treating these events as momentaries.
NMS 1.8.1 - Distribution Management Footprint

DMS Standard Edition
- Model Management
- US Electric Ops Model
- US Standard Configuration
- High Availability
- GIS Adapters
  - ESRI
  - Intergraph
  - Smallworld

Operator’s Workspace
- Switching Management
- Redliner

DMS Enterprise Edition - DMS Standard Edition +
- Power Flow Extensions
- Suggested Switching
- Schematics

DMS BI
- Switching Reporting
- Feeder Load Analysis Portal
- NRT & Historical Extractors
- DMS Schema & KPI
- BI Framework

DMS SCADA
- SCADA Extensions
- SCADA Adapters
  - ICCP Blocks 1&2
  - ICCP Block 5
  - Generic SCADA

DMS Advanced Applications
- Fault Location, Isolation & Service Restoration
- Volt/Var Optimization

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Oracle NMS DMS Customers

• Customers with Switching Management Implemented

• CPFL
• ESB
• NIE (1999)
• Toronto Hydro (1997)

• Alinta
• BGE
• E.ON
• SCANA
• Pepco

Our operators run “what if” scenarios to make sure switching plans and other network actions are safe and optimized. North York Hydro (now part of Toronto Hydro) reported a 25% drop in aborted switching operations as a result of switching management.

Power Flow & Suggested Switching:
Oracle DMS Functionality

- Switching
- Suggested Switching
- Powerflow
- Overload Relief
- Volt/VAR Optimization
Product Architecture – OMS / DMS

- Single Electric Operations Model
- Persistent Data Store is the Oracle RDBMS
  - Configuration Parameters
  - Connectivity & State
  - Business Intelligence – Oracle Data Warehouse
- Common OMS/DMS System Services
  - Database Access, Object Naming Service
  - Dynamic Data, Connectivity, Outage Analysis (Jobs)
  - Power Flow Engine
- Applications subscribe for information needs
  - Pub/Sub with system services
NMS Architecture - Overview

Business Intelligence

Oracle RDBMS
Data Warehouse

ETL (Flat Files)

Web Application Server
(Servlet Container)

HTTP

ODBC

Real Time Operations

Network Management Services

NMS Web Gateway
(EJB Application Server)

RMI

JDBC

CORBA

Oracle RDBMS

Electrical Network Model Data

Control Room
Client Applications

Client Applications

Java (Swing)

Client Applications

Client Applications

HTTP

RMI

X11

Oracle RDBMS

Electrical Network Model Data

ETL (Flat Files)

Java (Swing)

Client Applications

Client Applications

HTTP

RMI

X11

Oracle RDBMS

Electrical Network Model Data

ETL (Flat Files)
Oracle NMS – Dispatcher Environment
NMS Architecture - Overview

OMS Web Client
- Web Workspace
- Web Trouble

OMS Storm
- Storm Management

OMS Call Center
- Web Call Entry
- Web Callbacks

OMS Paging
- Service Alert

OMS Web Gateway (EJB Application Server)
- RMI
- HTTP
- CORBA
- X11

Network Management Services
- Real Time Operations

Oracle RDBMS
- Electrical Network Model Data

Java (Swing)
- Client Applications

Browser Applications

Control Room
- Client Applications

Operator’s Workspace

Switching Management

Power Flow Extensions

Suggested Switching

Volt/Var Optimization

Fault Location, Isolation & Service Restoration
NMS Architecture - Overview

Business Intelligence

Java (Swing) Client Applications

Browser Applications

Control Room Client Applications

Web Application Server (Servlet Container)

Oracle RDBMS

Business Intelligence

Data Warehouse

Real Time Operations

Network Management Services

Electrical Network Model Data

ETL (Flat Files)

Oracle RDBMS

Electrical Network Model Data

Network Management Services

Real Time Operations

CORBA

JDBC

Database Connectivity

NMS Web Gateway (EJB Application Server)

HTTP

RMI

Database Connectivity

Browser Applications

Client Applications

Servlet Container

Java (Swing)

Control Room

X11

HTTP

JDBC

Database Connectivity

ETL (Flat Files)
BI consists of ETL, a Star Schema and a GUI

- Oracle Utilities Business Intelligence consist of:
  - Programs and triggers to extract data from the source system (e.g., CC&B, EAM, OMS, non-Oracle Utilities applications)
  - Rules to load the star schemas in the Oracle Utilities data warehouse with the extracted data (using Oracle Warehouse Builder)
  - Graphical Services to support querying of the data in the star schemas
Business Intelligence Visual Metaphors

Arrears (31-60, 61-90, 91+) Graph

Calendar Month Aug 2005

- 31-60 Days
- 61-90 Days
- 91+ Days

Preventive Maintenance Score Card

Calendar Month Jul 2005

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
<th>Current Value</th>
<th>% Total</th>
<th>Prior Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>Bony Creek</td>
<td>$18</td>
<td>33.33%</td>
<td>$45</td>
</tr>
<tr>
<td>100</td>
<td>Salmon Creek</td>
<td>$36</td>
<td>66.67%</td>
<td>$36</td>
</tr>
</tbody>
</table>

Total $54

Top Customers by Revenue

Calendar Month Aug 2005

<table>
<thead>
<tr>
<th>Customer Name</th>
<th>Revenue</th>
<th>% Total</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willy’s Chocolate Factory - Industrial</td>
<td>$939</td>
<td>10.36%</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Sam’s Liquor - Commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thompson Industry - Industrial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barney’s Cafe - Commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Supply Company - Commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wilkinson Metals - Industrial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Tire Company - Industrial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charles River Associates - Commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mike’s Glass Works - Industrial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems Programming Limited (PLC) - Commer</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total $9,047

Complaint Final Outcome (count by status) Graph

Calendar Month Aug 2005

- Our Fault
- Customer Confusion
- Canceled
- Open

Departmental Overview Expenditures

Calendar Month Jun 2005

Sized by Level-3 Department

- Wastewater - Level 3 - $2,181.00
- Water Works - Level 3 - $2,660.21
- Wastewater - Level 3 - $1,706.78
- Unassigned - $1,678.59
- Water Works - Level 3 - $1,620.04

Total Inventory Value Traffic Light

Calendar Month Jul 2005

<table>
<thead>
<tr>
<th>Period</th>
<th>Total Value</th>
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<tbody>
<tr>
<td>Jul 2005 Total Value</td>
<td>$30,675</td>
</tr>
<tr>
<td>Jun 2005 Total Value</td>
<td>$30,325</td>
</tr>
<tr>
<td>May 2005 Total Value</td>
<td>$29,676</td>
</tr>
<tr>
<td>Apr 2005 Total Value</td>
<td>$34,427</td>
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</tbody>
</table>

Inventory Details
Performance & Scalability

- Each Year PEPCO Certifies OUNMS to PUC
- Certifies the system as “Storm Ready”
- Simulates:
  - Major Storm Event (Hurricane Isabel) – captured calls.
  - Injects calls to NMS
  - Simulates Operations Users
    - Viewer Focuses, Map Loads/Unloads
    - Crew Dispatches
    - Device Operations (Open/Close)
- Actual Users
- Measures Wall Clock Times
Oracle NMS Customer Installation Sizes
Technology & Solution Architecture

Operations Center

Oracle Network Management System

OMS  DMS

SCADA: Supervisory Control And Data Acquisition
AMR: Automated Meter Reading
CIS: Customer Information System
IVR: Interactive Voice Response

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Pre-built Integration Adapters

- GIS
  - Standard Adapters and processes for major platforms
    - ESRI
    - Intergraph
    - Smallworld
UGBU Product Integration Adapters

- CC&B Adapter
  - Oracle Shared Table Constructs
  - Materialized Views
  - Stored Procedures
  - Call Input, Outage Status

- MWM
  - Web Services exchanging XML documents
  - Over 30 data flows
  - Outage Events to MWM
  - Either NMS or MWM can be the dispatch environment
  - Crew Management
Pre-built Integration Adapters

• CIS/IVR Generic Adapter
  • Support incoming calls
  • Outage status (customer as part of existing outage, crew dispatched, ERT)
  • Callbacks

• HVCA – Twenty First Century Communications
  • Trouble calls (Customer calls) from TFCC
  • Callback request from Oracle OMS when the outage is restored
  • Callback response from TFCC
Pre-built Integration Adapters

- **Generic MQ Adapters.** Oracle Utilities NMS offers versions of its generic integration adapters that can be used with IBM WebSphere MQ Series middleware. These include adapters for:
  - Customer Information Systems (CIS) / CIS Callbacks
  - Interactive Voice Response (IVR)
  - Mobile Workforce Management (MWM)
  - Work Management Systems (WMS)
Pre-built Integration Adapters

- SCADA
  - Support for ICCP Blocks 1, 2 (1-way) & Block 5 (2-way)
  - Generic Adapter

- NMS AVL Web Services Integration
  - Supports One-Way Data Flow
  - Location
  - Direction
  - Speed

- AMI Adapter
  - Supports Outage detection, verification, and restoration
Integrated Business Process in Action

Or Initiate Meter “Pings”

Strategic Needs Addressed
• Improve Customer Care
• Accurate Outage Statistics
• Reduce Crew Follow-Ups
• Track Partial Restorations
• Verify Service Outages
Agenda

• Fault Location Isolation & Service Restoration:
  • Why FLISR?
  • What is FLISR?
• FLISR Operational Requirements:
  • What does it do?
• FLISR Operational Scenario:
  • How does it work?
• Demonstration
Fault Location, Isolation & Service Restoration

Why FLISR?

• Mandated by the Australia Victoria Government.
• Service Reliability Targets: Per customer, of unplanned interruptions
  • Less than 1.2 sustained outages per year.
  • Less than 1.06 occurrences of supply lost for longer than 1 minute.
  • Less than 1.21 times of supply lost for less than 1 minute.
• Financial Incentives for Reliability:
  • Urban customers with more than 9 interruptions of one minute or longer in a calendar year are credited $80.
  • If the reliability of supply exceeds agreed target, the maximum allowed revenue dollars are increased.
• Developed, delivered, and in production in 2006 at Alinta Energy, Melbourne, AU
• Custom application integrated tightly with the Alinta’s Distribution Management System from Oracle.
Fault Location, Isolation & Service Restoration

What is FLISR?

- Fault Isolation and Restoration software application is integrated with distribution automation
  - Determine and execute fault isolation
  - Determine and execute best practice service restoration
  - Switch actions execute closed loop without interaction
  - Complete Alinta’s event sequence objective of 60 seconds
- Determination of actions is managed within the Oracle Distribution Management System
- Automated execution is managed by the Oracle DMS
- Execution results are detailed within the Oracle DMS
FLISR Operational Requirements

What does it do?

- Fault Isolation and Restoration software application
  - Process protection trips of SCADA switches (CBs and ACRs).
  - Accurately locate fault.
  - Determine isolation steps given a tripped breaker status and fault indication status.
  - Isolate the fault using SCADA control devices
  - Automatically generate restoration steps
    - Determine approximate KVA flow
    - Determine feeder tie capacity
    - Identify KVA overloads and feeder margins
  - Restore service to affected customers using SCADA control devices
  - Complete Alinta’s event sequence objective in 60 seconds
FLISR Operator’s Environment

• **Oracle Utilities NMS Work Agenda window**
  - Work Agenda window displays FLISR status of each outage
  - Work Agenda event number color indicates the FLISR status
    - Yellow event # color indicates FLISR executing
    - Green event # color indicates FLISR successfully identified isolation and restoration plan safely without any devices limit overloads
    - Blue event # color indicates FLISR identified isolation and restoration plan with resulting device limit overloads
FLISR Feeder Visualization

Switching Pairs
- Open Isolation Switch 17781
- Close Tie Switch 003936
- Picks Up 596 Customers

Switching Pairs
- Open Isolation Switch 990139
- Close Feeder Breaker 2213
- Picks Up 694 Customers

1100 Customers Remain Out