An Upgrade Project of Very Large and Complex Enterprise GIS

Yusuke Nishiura, OGIS-RI
Nishiura_Yusuke@ogis-ri.co.jp
Agenda

• Corporate Profile
• About the Project
• Former System overview
• Key Points of the Project
• Project Operation Summary
• Reviews
• Conclusion
Corporate profile
Corporate Profile
Our Customer

- Osaka Gas Co., Ltd.
  - Started business operations in 1905
  - Serving 6.9 million natural gas customers in the Kansai Region (25% of all gas sold in Japan)
  - Total pipeline length: 58,600km
Corporate Profile
Ourselves

- OGIS-RI Co., Ltd.
  - Started business operations in 1983
  - Subsidiary company of Osaka Gas
  - Business contents
    - IT Consulting
    - Information Strategy Drafting
    - Systems Integration
    - Systems Development
    - Network Construction
    - Support Services
    - Systems Operation/Maintenance
Osaka Gas and GIS

1983
• Start GIS Project

1986
• The first mapping system launched
• Mainframe with an Exclusive Graphic Display Terminal

1995
• Migrate to UNIX & PC

2003
• Migrate to ArcGIS
System History of the Architecture side

IBM GFIS
• 1986 - 2002

ESRI ArcGIS 8.2
• 2003 - 2005

ArcGIS9.0
• 2006 - 2007

ArcGIS9.2
• 2008 -
History of ArcGIS in Osaka Gas (2003 - 2005)

• **ArcGIS 8.2**
  - The 1st Generation
  - Since 2003 -
  - Migrate from IBM’s GFIS
  - Desktop & ArcIMS apps
  - For the Pipeline Business Unit

• **ArcGIS 9.0**
  - 1.5th Generation
  - Since 2005 -
  - Launch ArcGIS Server apps
  - Desktop, ArcIMS, and ArcGIS Server
  - Start providing for the Residential Energy Business Unit

2004 SAG Award Winner
History of ArcGIS in Osaka Gas (2008 - 2014)

• **ArcGIS 9.2**
  - 2\textsuperscript{nd} Generation
  - Since 2008 -
  - Migrate from ArcIMS to ArcGIS Server
  - Desktop, Server, Engine apps

• **ArcGIS 9.3.1 & 10.0**
  - 2.5\textsuperscript{th} Generation
  - Since 2009 -
  - Mash up with GoogleMaps API
  - Start providing for the Commercial & Industrial Energy Business Unit
  - Disaster management system has Launched
Business portfolio in Osaka Gas

- **Pipeline Business Unit**
  - Pipeline maintenance
  - Supply management

- **Commercial & Industrial Energy Business Unit**
  - Sales for Industrial Customers

- **Residential Energy Business Unit**
  - Sales for Residential Customers
Use case of GIS in Osaka Gas

Pipeline Business Unit
• Maintain Pipeline Data
• Manage Construction
• Provide Pipeline Information

Commercial & Industrial Energy Business Unit
• Analyze customers in spatial aspect

Residential Energy Business Unit
• Analyze customers in spatial aspect

Geographic Data
About the Project
Goal of this Project

• Upgrade all GIS Applications / geodatabases to ArcGIS 10.2
• Improve performance
• Reduce operation cost
• Build up the Business Continuity Environment
Critical factors

• Hardware/software support expiration
  - Hardware
    - Windows Servers
    - UNIX(AIX) Servers
  - Operating system, Software
    - Citrix CPS4.5 (Mar, 2013)
    - MS Windows Server 2003 (Jul, 2015)
    - ArcGIS 9.2 (Oct, 2012)
User Requirements

• Improve performance
  - Display maps
  - Identify features

• Support business continuity and disaster recovery management
  - Prepare for the tsunami that caused by the predicted Tokai earthquake and Tonankai earthquake
  - Utilize the Secondary Data Center at Kyoto
User Requirements (cont’d)

• Cost Reduction
  - Initial purchase cost
  - Operational cost
    - UNIX and Windows Servers
    - Data maintenance
Former System Overview
System Diagram (Overview)

Pipeline Business Unit’s systems

- **CPS Servers**
  - System Diagram (Overview)
  - Pipeline Business Unit’s systems
  - Database Server (Master); AIX
  - Pipeline User Contents Basemap
  - ArcGIS Servers
  - Web GIS App 9.2
  - Desktop Apps (ArcEditor) 9.2
  - Desktop Apps (ArcView) 9.2
  - Web GIS App 9.2
  - Peripheral Web GIS App 9.2

- **Database Server (Replica); AIX**
  - Pipeline 9.2 User Contents Basemap 9.2

- **System Owner Business Unit**
  - Pipeline
  - Residential
  - Commercial & Industrial

- **Geodatabase Replication**

- **ArcGIS/Geodatabase Version**
  - Read Only Access
  - Read Write Access
System Diagram (Overview) – cont’d
Residential Energy Business Unit and Commercial & Industrial Energy Business Unit’s systems

- Database Server (Replica)
- Linux(RHEL)
- CRM 9.2
- Pipeline
- User Contents
- Basemap
- Database Server
- ArcGIS 9.3.1
- Desktop Apps (ArcEditor)
- Peripheral Web GIS App
- CPS Servers
- DR/BCP
- Desktop Apps (ArcEditor)
- CPS Server 9.2
- Web GIS App
- ArcGIS Server 9.2

ArcGIS/Geodatabase Version
- Read Only Access
- Read Write Access

System Owner Business Unit
- Pipeline
- Residential
- Commercial & Industrial
System Diagram (Overview) – cont’d

Data Distribution

ArcGIS Servers

- Database Server (Master)
  - Pipeline
  - User Content
  - Basemap

- Database Server (Replica)
  - Pipeline
  - User Content
  - Basemap

CPS Servers

- Pipeline

Conversion & loading (daily)

Copy (daily)

ZENRIN’s Town Map Data

Conversion & loading (yearly)

ArcGIS Servers

- CRM
- Sales Transaction
- DR
- Basemap

Refresh tiled cache (daily)

Safety Force System

NOT ArcGIS Platform

System Owner Business Unit

- Pipeline
- Residential
- Commercial & Industrial

ArcGIS/Geodatabase Version
Problems to be solved

• Data duplication
  - Basemap data (ZENRIN’s Town map data)
    - Annual data conversion costs double or more.
  - Pipeline data
    - Many copies in several servers
      - For “safety force team”, for “residential sales team”...
      - Some systems GIS engine is not ArcGIS family, data must convert daily.

• No fault tolerability
  - Database server has been the single point of failure.
  - only rely on server’s fault tolerability
Problems to be solved (cont’d)

- Too many applications, Too many physical servers...

<table>
<thead>
<tr>
<th>Business Unit</th>
<th>Applications</th>
<th>Architecture Variation</th>
<th>Amount of Physical Servers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Desktop</td>
<td>Web</td>
<td>Other</td>
</tr>
<tr>
<td>Pipeline</td>
<td>7</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Residential Energy</td>
<td>5</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Commercial &amp; Industrial Energy</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>13</td>
<td>20</td>
<td>5</td>
</tr>
</tbody>
</table>
Problems to be solved (cont’d)

• Application Performance improvement
  - Displaying map
  - Stability of tiled map cache refreshing
  - Identifying features performance
  - Printing map
Key points of the project
Key Points of upgrading

• Reduce running cost
  - Aggregate the duplicated geodatabases
  - Reduce the amount of physical servers

• Define our BCP policy
  - Decide the necessary and sufficient apps and database
  - Build up fault tolerant server & storage system

• Reduce rebuilding cost
  - Classify application’s rebuild plan
    - Full rebuilding, Minimum migration, Recompilation only

• Performance improvement
  - Hybrid Map Cache Service
  - Load Balancing of Map services
  - Change user action for “Identify Feature” Command
Aggregation of the databases & servers

- Aggregate databases that referenced by multiple business units
  - Pipeline database
  - Basemap database
- Introduce the hardware virtualization technology
  - Microsoft Hyper-V technology
Business Continuity Plan

• BCP Policy
  - **Prepare for the tsunami** caused by the predicted Tokai earthquake and Tonankai earthquake.
  - Choose target database and applications efficiently.
  - Utilize Kyoto Backup Center

• Fault Tolerability
  - Active/Cold stand-by Server
  - Data transportation by Storage level replication (IBM’s DS8000 functionality)
Classify rebuild plan of applications
Desktop apps & batch apps

• Former apps
  - Visual BASIC 6.0 or .NET framework 2.0
    - Visual studio 2005 or 2008
  - VBA customization style
  - ArcObjects batch program

• Complete rebuild of applications
• But with specifications unchanged basically
  ✓ functionality
  ✓ Usability

• 10.2 apps
  - .NET Framework 3.5 SP1 or higher
    - Visual Studio 2010(C#)
  - “Add-in” customization style
  - Python batch scripting
Classify rebuild plan of applications (cont’d)

Web GIS apps

- Former apps
  - Use custom JavaScript libraries
  - Use application-specified tiled cache files

- 10.2 apps.
  - Using ArcGIS API for JavaScript
  - Share tiled cache files

Application’s specifications have not changed basically
✓ functionality
✓ Usability

Only performance issues are fixed.
APIs of the SOAP web services have not changed.

- Signature
- Arguments
- Return value

Minimize modification of service subscriber side.
Performance Improvement

- **Hybrid Cache Service**
  - Making Custom ArcGIS Map Service
    - Tiled-Cache service in smaller scale range (<=1:500)
    - Dynamic Map Service in bigger scale range (>1:500)

- **Introduce NLB appliance**
  - Check the appropriate amount of servers
    - GIS Server/Service
    - Print Server/Service
  - Load balancing ArcGIS REST Services with Network Load Balancer

- **Change user action for “identify feature”**
  - Former: Command “identify...” -> pick -> Search all layers
  - Now: Command “identify...” -> Choose “Target Layer” -> pick -> Search single layer
Project Operation Summary
Schedule Overview

**Apr. 2013**
Start Project

**Mar. 2014**
Partial Service-In
* Residential Energy Business Unit
* Commercial & Industrial Energy Business Unit

**Jul. 2014**
Finish project
* Pipeline Business Unit
* Fault tolerant & full-aggregated Databases
Current System Diagram
Application Deployment View

- **Database Server (Linux)**
- **Common Database Servers (Fault Tolerant)**
- **Pipeline User Contents**
- **Pipeline Database Server (Linux)**
- **Unload & Load (Daily)**

**Application Deployment View**

- **Physical Server**
  - **Xen App Servers (Virtual Server)**
  - **ArcGIS Servers (Virtual Server)**

- **Desktop Apps**
  - **Desktop Apps (Standard)**
  - **Desktop Apps (Basic)**

- **Web GIS App**

- **Peripheral Web GIS App**

- **Web GIS App + Peripheral Web GIS App**

- **Xen App Servers**
  - **(Virtual Server)**
  - **ArcGIS Servers**
    - **(Virtual Server)**

- **Database Server (Linux)**
- **Pipeline Database Server (Linux)**
- **Common Database Servers (Fault Tolerant) (Linux)**
- **Unload & Load (Daily)**

**Physical Server**

- **Xen App Server (Virtual Server)**
- **ArcGIS Server (Virtual Server)**

**Peripheral**

- **Web GIS App**
  - **Peripheral Web GIS App**

**Desktop Apps**

- **Desktop Apps (Standard)**
- **Desktop Apps (Basic)**

**Web GIS App**

- **Web GIS App**

**Diagram Elements**

- **Basemap**
- **Pipeline**
- **CRM**
- **Sales Transaction**

**Legend**

- **Unload & Load (Daily)**
Current System Diagram (cont’d)
Hardware Fault Tolerability & Disaster Tolerability View

Operation Center (Osaka)
- Xen App Servers (Virtual Server)
- Fault-Tolerant Software
- Common Database Servers (Active)
- Common Database Servers (Stand-by)
- Storage Unit (IBM DS8000)
  - Pipeline
  - Basemap
  - DR
  - Heart Beat

Backup Center (Kyoto)
- Xen App Servers (Virtual Server)
- Common Database Servers (Stand-by)
- Storage Unit (IBM DS8000)
  - Pipeline
  - Basemap
  - DR

Storage-level synchronization
Inactive normally
reviews
Cost

• Initial cost
  - Suppress amount of physical servers. (27 -> 13)
  - Adopt hardware virtualization technology.
    - Microsoft Hyper-V technology
  - Suppress rebuilding cost
    - Minimize amount of complete-rebuilt systems

• Operation cost
  - Reduce operating cost by migrating operating system from IBM’s AIX to Linux (RHEL).
Data management

• Aggregation of databases over the business Units
• Satisfy the fault tolerability.
  - 24/7 available databases (pipeline database, basemap database)
  - Distributed database safekeeping between Osaka and Kyoto
Conclusion

- **Success** for the making of the business continuity environment by realization of the distributed safekeeping of databases.
- **Suppress** the operating cost by the aggregation of GIS data and migration of the OS.
- **Improve** performance of the WebGIS apps in the point of responsiveness and stability.
Questions & Answers