Building and Deploying Enterprise ArcGIS Server Solutions (Best Practices)

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Presentation Goals

- See real world, Enterprise implementations of ArcGIS Server presented in a case study fashion
- Learn from the experience of ESRI Professional Services staff
- Take away some lessons learned that can be applied to your project(s)
Presentation outline

• Introduction

• Project Case Studies
  – Background
  – Technology Stack
  – Unique Challenges
  – Design and Architecture
  – Lessons Learned

• Summarize Project Experience

• Q & A
What is Enterprise (practically)?

- Integration with third-party services and applications
- Large volumes of data
- High availability
- High throughput
- Cross platform environment
Common Enterprise GIS Implementations

- High volume editing and dissemination
- Advanced spatial analysis supporting range of clients
- Spatial Data Infrastructure (SDI)
- Map production systems
Case Studies
FedEx Express – Background

• Company
  – 2+ million stops per day
  – 60,000+ employees
  – 2,000 Java developers

• Business Problem
  – Implement a scalable work area design system that can also assist with and prescribe an on-the-road plan for efficient delivery and pickup operations
  – Provide users with a highly capable and flexible interface for reporting on their execution of the on-the-road plan
FedEx Express – Background

• J2EE as the standard server development platform
  – Deployed to WebLogic Application Server
  – Secured by Oblix single-sign on

• Cross platform environment
  – Web / Application Servers: Redhat Linux
  – ArcGIS Servers (operation): Redhat Linux
  – ArcGIS Servers (caching): Windows 2003 Server
  – Database Servers: HP-UX
  – Citrix Servers: Windows 2003 Server
FedEx Express – Technology Stack

• **ESRI Technologies**
  - ArcGIS Server Java 9.2
  - ArcGIS Desktop 9.2
  - ArcSDE 9.2

• **Other Technologies**
  - Apache HTTP Server
  - WebLogic Server 9.2
  - Oracle 10gR2 RDBMS
  - Oracle Identity Management (Oblix)
  - Third-party Geocoder
  - Appistry Enterprise Application Fabric
FedEx Express – Challenges

- Very complicated business process for desktop editing
- Very loose requirements for web application
- Spatially analyzing and displaying 1+ billion points
- Integration with other non-spatially aware applications
- Deployment to high-availability, clustered WebLogic Environment
FedEx Express – Server Architecture

Apache

WebLogic

RJP
Planet Station
T2 R&M
ROADS Portal
T2 Web Services

HTTP

Oblix (WSSO)

Appistry Fabric

Network Attached Storage

Apache

HTTP

Write

Local (DCOM+MIME)

ArcGIS Server (SOM)

Base
T2
Empty

ArcGIS Server (SOM)

Base
T2
Empty

ArcGIS Server (SOC)

ArcGIS Server (SOC)

Oracle GDB

Oracle GDB

Geocoder

Hibernate (JDBC)

Streets & Basemap

Route Structure Elements

Streets Index

Developer Summit 2007
FedEx Express – Lessons Learned

• Know the IT Standards
  – Rules regarding shared file systems caused significant problems
    • Resulted in complex caching workflow
    • Resulted in complex output storage mechanism
  – Clustered Web / Application Server environment introduced challenges
    • Apache timeout of 5 minutes prevented map books from being created
    • Serialization of web session could not be supported
FedEx Express – Lessons Learned

• **Thoroughly document requirements and use cases**
  – Without solid requirements and use cases, even a moderately sized development project can go astray
    • Use cases explain how the users expect to interact with the application
    • Requirements provide additional detail on parameters and behavior not obvious to the end users
  – FedEx map viewer requirements were lose
    • Lead to misinterpretation of behavior
    • Significant changes were required late in the project lifecycle just to satisfy the user community
  – Use a process and a tool to capture this information
FedEx Express – Lessons Learned

• Development → Production takes A LOT of time
  – Many levels of testing are required to certify a business critical set of applications for production
  – FedEx has 5 separate levels:
    • Level 1: Developer Testing
    • Level 2: User Testing, Round 1 (UAT)
    • Level 3: User Testing, Round 2 (UAT)
    • Level 4: Load Testing
    • Level 5: Production Look-alike, Final Testing
  – Other IT organizations have “Integration Level” or “High Availability Level”
FedEx Express – Lessons Learned

- ArcGIS Server on Linux works, and it works well
  - 9.2 release had many improvements over 9.1
  - No longer reliant on a Windows machine for authentication
  - Some challenges with rollout
    - Silent install made it difficult for system teams to deploy to large number of instances
    - Look for improvements at 9.3
FedEx Express – Lessons Learned

- Dynamic data with cached basemap can be tricky
  - Three specific requirements were difficult to meet:
    - Sub-second performance
    - Ability to zoom to any scale (not at fixed levels)
    - Ability to export the entire map view with layout in PDF format
  - Developed hybrid solution:
    - 2 resources, one cached and one dynamic
    - Cached resource had basemap content in as map cache
    - Dynamic resource had business data, along with the basemap data turned off
    - Clever manipulation of resources was required, but all three requirements were met
FedEx Express – Lessons Learned

• Map Printing != Map Production
  – Most applications have a requirement for printing
  – Printing normally comes in two flavors:
    • Export current map to a chart / layout (HTML/PDF)
    • Export a predefined product using some of the current map settings such as center point or scale
  – Exporting products can have a significant impact on the system
    • Large exporting times
    • Fine-grained manipulation of the page layout
    • Complex rules for map surrounds

NOTE: Exporting to PDF with ArcGIS Server requires access to ArcObject proxies (Local Connection)
BHP Billiton SDI – Background

• Company
  – World’s largest diversified natural resources company
  – 38,000 employees working in more than 100 operations in approximately 25 countries
  – 2006 profits exceeded $10 billion

• Business Problem
  – Improve productivity through more efficient management and sharing of spatial information.
  – Provide a single enterprise-wide location to search for and retrieve spatial information.
  – Create a simple, streamlined process for publishing GIS content
BHP Billiton SDI – Background

- SAP Enterprise Portal as the corporate portal standard
  - Deployed to 4 nodes around the world for efficiency
  - Integrated with Active Directory for single-sign on
  - Java-based development of “iViews” (ie. Portlets or WebParts)

- Both .NET and Java are used throughout the company
  - Business-units within BHP Billiton have their own standards
  - Few corporate IT standards

- All systems managed by CSC
  - Windows 2003 Server throughout
BHP Billiton SDI – Technology Stack

• ESRI Technologies
  – ArcGIS Server 9.1
  – ArcIMS 9.1
  – ArcSDE 9.1
  – ArcGIS Desktop 9.1
  – GIS Portal Toolkit 2.0

• Other Technologies
  – SAP Enterprise Portal
  – Microsoft IIS w/ Active Directory Integration
  – Apache Tomcat
  – Oracle 9i RDBMS
BHP Billiton SDI – Challenges

- SDI infrastructure to be used by several applications and services throughout the company on independent development cycles
- Fast searching of metadata from anywhere in the world
- Complex security requirements
  - Fine-grained restriction of map services
  - Single-sign on for all web applications using Active Directory
- Support offline access to federated content
- Support for AXL-based map services
BHP Billiton SDI – Portal Concept

GIS Catalog Portal
- Metadata Service
- Metadata Catalog Management
- Spatial and Text Searches
- Internet Map Viewing

GIS Network
- Constellation of GIS Websites
- Content Standards
- Published GIS Data Holdings

1. Publish GIS Data and Services, Document in Catalog
2. Search Catalog and Find
3. Connect and Use, Download and Use

World Wide Web

GIS Users
BHP Billiton SDI – Node Distribution

- London
- Houston
- Santiago
- Johannesburg
- Perth
- Brisbane
BHP Billiton SDI – Architecture Overview

- **Siemens LDAP Server**
  - LDAP
  - SAP Portal
  - Map Viewer

- **LDAP Server**
  - SAP Portal
  - Map Viewer

- **Microsoft Active Directory**
  - LDAP
  - Microsoft IIS
  - HTTP
  - Tomcat
  - Metadata Services
  - ArcIMS Connector
  - Map Viewer
  - Publishing Services
  - Extract Services

- **IIS**
  - Tomcat
  - Metadata Services
  - ArcIMS Connector
  - Map Viewer
  - Publishing Services
  - Extract Services

- **ArcIMS**
  - Map Service
  - Metadata Server

- **ArcGIS Server**
  - Extract Service

- **Oracle Replication**
  - Metadata Repository
  - Business Data

- **Developer Summit 2007**
  - 25
BHP Billiton – Lessons Learned

- Metadata is very important
  - Can be involved than one would think
  - Enforce a corporate standard developed by the community
  - Good metadata is very good, bad metadata is very bad
  - Consider the type of metadata being published and how clients that discover it can interact with the content
    - Map service
    - Map layer
    - Featureclass
    - Globes
    - Geoprocessing Models and Scripts
BHP Billiton SDI – Lessons Learned

- Federation == Complication
  - Creating a Federated SDI requires a number of web services
    - Web services calling web services calling web services (globally)
    - Single-sign on adds another dimension of complexity
  - A fast, federated search may require metadata replication
Version upgrades are non-trivial

- Server software has a number of dependencies
  - Desktop applications depend on GIS Servers
  - Desktop applications depend on database
  - Web applications depend on GIS Servers
  - GIS Servers depend on database
- Carefully think through a rollout plan before moving forward with any version upgrade
  - Research all version compatibility issues
  - Realize that this applies to all software, not just ESRI components

NOTE: Always perform the upgrade in a test environment first
NGA ePODS – Background

• Organization
  – US Government agency providing timely, relevant, and accurate geospatial intelligence in support of national security objectives
  – Support global safety of navigation (Nautical & Aeronautical)

• Business Problem
  – Safety of navigation charts are very out of date and expensive to update
  – These products must be made available to a larger audience “on demand”, and must contain the “best available” NGA data
    • Manual replacement not an option
    • Desktop / Thick client solution not an option
NGA ePODS – Background

• J2EE as the standard server development platform
  – Web applications and services deployed to WebLogic
  – Support .NET server applications if justifiable

• High availability a must
  – Web application used around the world, 24 hours a day

• Cross platform environment
  – Web / Application Servers: Windows 2003 Server
  – ArcIMS Servers: Windows 2003 Server
  – ArcGIS Servers: Windows 2003 Server
  – Database Servers: Solaris
NGA ePODS – Technology Stack

• ESRI Technologies
  – ArcGIS Server .NET 9.2
  – ArcIMS 9.2
  – ArcSDE 9.1 / 9.2
  – ArcGIS Desktop 9.2 w/ PLTS Extension

• Other Technologies
  – Apache HTTP Server
  – WebLogic Server 9.2
  – Oracle 9i / 10g RDBMS
NGA ePODS – Challenges

- Very complex rules for cartographic output
  - Dynamic map surrounds
  - Large sizes (up to E-size)
  - Support cartographic “refinement” post-export
- All advanced product options to be exposed through web service interfaces
- Support asynchronous processing of web service requests
NGA ePODS - Architecture

### Data
- **GDB / SDE**
- **File based data**

### Server(s)
- **ArcGIS Server**
  - Map Type 1
  - Map Type 2

### Applications
- **ArcIMS**
  - User Queries, Interface, Rules

### Users
- **Chart Selection & Configuration Interface**
- **Results – Charts & Data**
  - PDF, JPG, TIFF, CADRG
  - Geodatabase
  - Shapefiles

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Subset of data used by ArcIMS in map selection

Data accesses by ArcGIS Server for map generation

ArcMap sessions with cartographic rules generate requested maps
NGA ePODS – Lessons Learned

• True map production is very involved
  – Often the cartographic requirements for map production are very rigid
    • Typically based on specifications
    • Complex map surrounds that update dynamically as the map changes
    • Translates to heavy load on the server
  – Consider PLTS w/ Server extension
  – Look for POD framework solution from ESRI Professional Services
NGA ePODS – Lessons Learned

- Cartographers will always want to fine tune
  - Even with the best server-based solution, often it's still not possible to meet all aspects of the specification
  - Consider providing the capability to export “finishing product”
    - Downloads the pertinent data in file format (clip and ship)
    - Downloads an MXD configured to read downloaded data
  - Allows the cartographer to fine tune the MXD with desktop tools, then export to PDF directly from their workstation
Summary
Project Experiences

• Enterprise systems are complicated, and need to be well defined and designed

• Enterprise GIS adds another dimension to enterprise systems, but they are still enterprise

• Look for other case studies and learn from the experiences of others

*Don’t reinvent the wheel!*
Further questions?

• TECH-TALK AREAS
  – **What:** Further opportunity to discuss questions and concerns with presenters and subject matter experts
  – **Where:** Tech Talk Area 3
  – **When:** during the next 30 minutes

• ESRI Showcase

• Meet the teams

• ESRI Developers Network (EDN) website
Q & A