ABSTRACT
This paper discusses the implementation of SAS Enterprise BI Server at BlueCross BlueShield of Minnesota (BCBSM). It provides an overview of the hardware and software architecture and the deployment of SAS Enterprise BI Server within a mature enterprise-wide and external web-facing infrastructure in a multi-tier UNIX environment. This paper also provides highlights of the installation and configuration process as well as lessons learned from the overall installation and configuration experience from both the SAS and customer point of views.

INTRODUCTION
BlueCross BlueShield of Minnesota (BCBSM) has committed to SAS Enterprise BI Server (EBI) as its strategic enterprise analytic tool.

The corporation’s license for its internal SAS reporting environments (three separate Solaris servers) using SAS8 & SAS9 Foundation Software expired at the end of February, 2006. BCBSM decided to migrate all SAS users and SAS applications from current Solaris UNIX servers to new IBM AIX servers using SAS EBI. Initially, 100 ad-hoc users migrated from the current SAS environment on Solaris. By the end of 2006, there were nearly 200 users ranging from ad-hoc analysts with SAS® Enterprise Guide® to web users using guided queries via SAS EBI software. Current usage is running between 20-30 concurrent sessions (batch and SAS Enterprise Guide) running queries and/or reports.

SAS EBI software is configured as an external, web-facing infrastructure. External Blue Cross customers are granted access to the application through the SAS® Information Delivery Portal to launch reporting content based on their user login id. SAS9 security provides the fine-grain authorization as to what data and reports an individual can access.

Hardware requirements were based on the following with the anticipated usage from the external customers:
- Up to 900 external customer accounts provided access
- Up to 5 defined users for each customer account
- Up to total end-user access of 4,500 users with as many as 50 users accessing the system at any one given time

Considering the user access volumes, SAS was engaged to assist with sizing the hardware architecture.

HARDWARE ARCHITECTURE
The hardware architecture is segmented into internal and external access. Internal users consist of BCBSM employees. External users are the customer accounts granted access to the SAS EBI reporting tools.

Our configuration management strategy was to set up multiple EBI environments for internal and external access.

The server hardware consisted of two IBM P570 servers, allowing the physical server to be divided into logical server partitions (LPARS) for each environment:

TEST
The test environment is used for development of all EBI content for internal and external users. Access to this environment is granted to the business report developers and the SAS Administrators who manage this environment.
INTEGRATION
This environment is used by the developers to conduct integration testing before the reports are locked down and promoted to the Quality Assurance (QA) environment. New or enhanced reports are validated that they work properly within the entire framework.

QA
The QA environment is on a separate server housed at a remote disaster recovery site. This environment is used by the testing group to ensure the expected results are received when the reports are run. Acceptance and regression testing is performed in this environment before final promotion to Production, as well as performance and load testing.

PRODUCTION
The production environment is currently used primarily by BCBSM’s external accounts, as well as the internal account managers, who demo the application and train new accounts as they are granted access. We are in the process of building out the infrastructure for the internal users as well.

Each of these environments (Test, Integration, and Production) is installed and configured using logical server partitions split out from a P570 with 12 CPUs running AIX 5.3 with 72 GB of shared memory. A micro-partitioning strategy is used such that the production servers will utilize 6 CPUs and 36GB of memory and the test and integration environments will share the other 6 CPU/36 GB of memory. The production LPARS are configured to dynamically pull resources from the test and integration logical server partitions as needed. Figure 1 illustrates how these logical partitions were setup for each environment.

Figure 1: Logical Server Configuration

Firewalls are very important to consider when implementing SAS EBI in a multi-tier architecture. If at all possible, it is highly recommended to get all your servers, including the server running the mid-tier applications, in the same subnet. Firewalls may require one or more ports to be opened when SAS EBI is implemented in a multi-tier architecture. We faced setbacks during the installation and configuration of EBI when we were unable to connect from one server to another because of a firewall between each server. Firewall placement within the hardware architecture can also affect the deployment of client tools, such as SAS® Management Console, SAS Enterprise Guide and SAS® Information Map Studio. Each of these requires connectivity to the Metadata and/or Application servers over the prescribed ports. It is important to include the desktop subnets in any requests made for connectivity through.
SOFTWARE ARCHITECTURE

The SAS EBI software architecture at BCBSM consists of the following tiers:

DATA TIER

Data sources for SAS reporting include Oracle and DB2 (distributed and mainframe). SAS/Access software is used to access data in these DBMSs to be surfaced in reporting content, in conjunction with the DB2 run-time and Oracle client software (installed on each LPAR prior to SAS software being installed).

SAS SERVER TIER

SAS servers perform the SAS processing on the data. Several types of SAS servers are available to handle different workload types and processing intensities.

The SAS® Metadata Server controls access to a central repository of metadata that is shared by all of the applications in the system. The SAS Metadata Server enables centralized control so that all users access consistent and accurate data. In the BCBSM hardware architecture, which is separated into external and internal environments, the physical server running the metadata server processes is divided into two separate metadata repository installations, running through two different ports.

The SAS® Stored Process Server executes and delivers results from SAS stored processes in a multi-client environment. A SAS stored process is a SAS program that is stored centrally and that can be executed by users and client programs on demand. The BCBSM Business Report Developers used SAS Stored Processes for the first phase of this project. All programs and report content were developed using SAS Enterprise Guide.

The SAS Workspace Server enables client applications to submit SAS code to a SAS session. SAS® Web Report Studio would use this type of SAS Server if the data sources were processed against relational data sources. BCBSM plans to leverage this in a later deployment.

The SAS® OLAP Server is a multidimensional data server that delivers pre-summarized cubes of data to business intelligence applications. The data is queried using the MDX (multidimensional expression) language. Internally, we will be prototyping this functionality in second quarter of 2007, with and plan to begin rollout in the third quarter, as we convert reports currently written in Cognos to SAS. There is also a possibility that we will be creating OLAP cubes for external use in early 2008.

In summary, the SAS server tier is deployed in the hardware architecture as follows:

- Two logical partitions serve as SAS compute servers with SAS9 Foundation software installed and configured with the SAS Workspace, SAS Stored Process, and SAS OLAP Servers.
- Each compute server is dedicated to either the internal or external user access via the SAS Information Delivery Portal (IDP).
- Two metadata servers are installed and configured on one logical server partition to support the internal or external environments.
- One stand-alone LPAR is configured for running EBI (app/meta) for ad-hoc querying and reporting.

MIDDLE TIER

The middle tier enables users to access intelligence data and functionality via a Web browser. This tier provides Web-based interfaces like the SAS Information Delivery Portal and SAS® Web Report Studio for report creation and information distribution, while passing analysis and processing requests to the SAS server tier. The BCBSM application server standard is currently BEA WebLogic. The middle tier for each environment is installed on its own BEA WebLogic instance on separate physical Solaris servers.

CLIENTS

The client tier provides users with desktop access to intelligence data and functionality through easy-to-use interfaces. For many information consumers, reporting and analysis tasks can be performed using a Web browser. For more advanced design and analysis tasks, SAS Enterprise Guide client software is installed on users’ desktops.
Figure 2 illustrates the installation and configuration of the software architecture.

**EBI INSTALLATION AND CONFIGURATION AT BCBSM**

**DEPLOYMENT OVERVIEW**
Once the physical server was configured, the LPARS defined and system access was granted, the following were the main steps in deploying SAS EBI in the distributed server environment at BCBSM:

- Worked with SAS to develop a SAS Plan file
- Created the SAS Software Depot
- Acquired SAS Installation Data (SID) license file(s) and deployment plan files
- Created operating system IDs and groups (roles) used to install and configure the environment
- Installed and configured SAS software using the SAS Software Navigator and the SAS Configuration Wizard
- Installed and configured the web tier such as the J2EE application server and WebDAV software

Prior to the deployment, SAS and BCBSM conducted a series of hardware and software architecture meetings. These meetings helped assess any gaps in either hardware or software (SAS or third-party) that may have been required for use with SAS EBI. Outcomes of these meetings provided a set of pre-installation and configuration tasks for SAS and
One result of these meetings was the development of the SAS Plan file.

The SAS Plan file is a pre-selection of the software that will be installed and configured by the SAS Software Navigator. The plan file contains a description of what the plan deploys, identifies the target machines, and lists the software to be installed and configured. Sample plan files are provided with the software but a custom plan file was created by SAS due to the hardware architecture.

**SAS EBI INSTALLATION PHASE**

BCBSM created one SAS software depot of the SAS installation files for installation on all LPARS in their hardware architecture. The depot stores a copy of all of the SAS EBI media on CD on a shared file system used during the installation and configuration of the software. Depending on your network speed, allocate extra time for the creation of the depot. This depot, created on a Network Addressable Storage (NAS) appliance at BCBSM, was remotely mounted to each server, allowing the appropriate software to be installed and configured for each SAS tier in the architecture. This central location was also used to store files needed as part of the installation process like the SAS SID and Plan files.

The BCBSM Security Administrators were responsible for creating all the user and group accounts on all the systems. The SAS Administrator worked closely with them to set up the accounts and create strong, secure passwords ensuring that they are different across each environment. It was important that the service accounts were set up as non-expiring, application ID accounts. If we set them up as regular user login accounts, the system will stop functioning when the passwords expire, and password updates would need to be applied for proper operation. Ensure that Security Administration understands that the SAS Administrator needs to have access to these passwords to properly configure the environment. The SAS Administrator will want to make certain that the SAS user id (recommended to use for the installs) is able to physically log into the server. This prevented access and file ownership issues later on during the install and configuration.

The SAS Software Navigator is used to create the SAS Software Depot and to install the appropriate SAS software components on each server that made up the SAS EBI architecture.

**SAS EBI CONFIGURATION PHASE**

The SAS Configuration Wizard starts after all software is installed on the server and typically the last step of the SAS System Navigator installation tasks. The SAS Configuration Wizard can be broken down into four phases:

1. The wizard prompts for preliminary information, such as the language preference for messages and prompts.
2. The wizard prompts for information needed to configure the current machine like user accounts and the location of the SAS Metadata Server.
3. The wizard displays a section to edit advanced properties in a text file.
4. The wizard produces a HTML document called *instructions.html* that provides you with instructions for performing any additional required configuration.

The key to successful configuration on each server was modification of the advanced properties used as part of the configuration process. Editing of the advanced properties was due to the multiple EBI environments installed on the same or separate system. As an example, a port assignment standard was implemented for all server types used for each EBI instance as follows:

The internal LPAR infrastructure uses an alternate numbering scheme for the servers and the communication ports than the external LPARS. This is due to our installing 2 separate metadata repositories on a single LPAR. This approach required us to come up with new port numbers. The default port scheme that SAS uses is 8561 for the Metadata server and 5099 for the remote services. It's important to keep the ports you use consistent, especially if you are creating multiple environments. Choose something that is easy to remember, such as keeping 8561 for the internal metadata and using 8661 for the external metadata. You can then use the same scheme for the remote services ports – 5099 for internal remote services and 5199 for external remote services.

**THIRD PARTY SOFTWARE REQUIREMENTS**

Several third party components are configured as part of the solution per IT requirements from BCBSM.
**WebDAV**
The WebDAV server is an HTTP server that supports the collaborative authoring of documents that are located on the server. WebDAV enables users to manage files located on the Web server from the client desktop. The WebDAV server supports the locking of documents, so that multiple authors cannot make changes to a document at the same time. It also associates metadata with documents in order to facilitate searching. The WebDAV server acts as a network-accessible file system. It stores content that users might want to access through SAS Web Report Studio or SAS Information Delivery Portal, such as documents, report definitions, and images. BCBSM installed and configured Xythos WFS for use with Oracle 9.1.x.

Each Xythos installation is set up under its own separate WebLogic managed server instance, linked back to the main SAS WebLogic instance via the properties file. This is linked to the Oracle database during the Xythos install phase.

**J2EE Application Server**
BEA WebLogic is currently the standard application server at BCBSM. A base image of BEA WebLogic was created for each environment. Two managed servers were created to support EBI: A managed server to deploy all EBI web applications as well as a separate managed server to deploy the Xythos and WebDAV console.

The initial EBI environments were configured by default, for host authentication. BCBSM and SAS ran test cases through this environment to ensure the EBI software was functioning properly. At this point the environment was reconfigured to accept single sign-on for the SAS Information Delivery Portal and SAS Web Report Studio. BCBSM uses an LDAP-compliant software application for perimeter authentication, which passes the user id in the request header to the application server (WebLogic). The SAS Weblogic instance needs to be reconfigured for container managed security with an authentication method of CLIENT-CERT. A dummy role is configured to provide secure access to all pages/servlets. We made these changes to the web.xml and weblogic.xml files within the SAS Information Delivery Portal and SAS Stored Process exploded war files directory. Once they were redeployed, access to the SAS Information Delivery Portal was only allowed through single sign-on.

**SUMMARY OF INSTALLATION/CONFIGURATION EXPERIENCE**
There were eight SAS EBI environments to get up and running for use at BCBSM in this order: Test, Integration, QA, and Production. We first segmented the installations into the following environments and then within each environment configured the SAS tiers in this order: metadata, application server and mid-tier.

Test External
Test Internal

Integration External
Integration Internal

QA External
QA Internal

Production External
Production Internal

The initial environment instance required over a week to get the software installed, configured, and operational. It was important to stress that the Security and Network teams need to be engaged to help define possible roadblocks with connectivity issues between the servers and the desktop. Each environment had different challenges, but we eventually perfected the process so we could install and configure an entire EBI environment (Metadata, Application, and Mid-tier servers) in two days.

**ON-GOING ENVIRONMENT SUPPORT**
Once the EBI environments became operational, the following roles provide a summary of ongoing support activities.

**SAS ADMINISTRATORS**
This role administrates all metadata content and administrates the hardware and software portions of the EBI environment. All client products were installed to not only administrate metadata but also perform testing with tools to
ensure components are up and running for user community. BCBSM currently has two individuals responsible for this role at this time.

SAS Administrator activities include:
- Creating and scheduling scripts that monitor and clean up the work and sort space on each server.
- Monitoring SAS sessions for orphaned processes and canceling them as needed to free up resources.
- Copying logs to a central location and parsing them to gather statistics on average run-time, etc.
- Managing the Metadata Server, ObjectSpawner, and WebLogic server instances periodically to refresh the environment and server logs as necessary (this saves space, as the logs can grow large).
- Promoting reporting content from the test to production environments
- Administering security for all users who access the reporting content
- Applying SAS Service Pack applications
- Applying EBI Software Upgrades

REPORT DEVELOPERS
Report developers create reporting content in the test environment that will be promoted through to production SAS Enterprise Guide is being used by individuals responsible for creating reporting content for internal and external users. SAS Enterprise Guide is configured to use the SAS metadata servers and SAS compute servers in the internal environment. Currently, BCBSM has 10 report developers in this role.

AD-HOC PROGRAMMERS
The ad-hoc programmer performs advanced analysis of data and complex reporting as a “Power User”. There are approximately 120 ad-hoc programmers at BCBSM and approximately 20 users considered advanced power users.

CONCLUSION
The success of implementing SAS EBI at BCBSM within the enterprise can be attributed to the following factors.

PLANNING, PLANNING AND MORE PLANNING
Due to the organizational structure of IT and the complexity of the hardware environment, SAS and BCBSM conducted a lot of planning. Thoughtful planning helped expedite the installation and configuration phases of the project. As part of the planning process, BCBSM used the SAS Enterprise Excellence Center to assist in sizing appropriate hardware for all SAS EBI instances. This sizing activity identified any hardware gaps and determined computing resources required to handle a greater number of users. This activity also outlined initial budgetary considerations for purchasing SAS software.

EARLY ADOPTION OF THE SAS ADMINISTRATOR ROLE
BCBSM was quick to assign resources to the SAS Administrator role required to support the SAS EBI environments. The people in this role shadowed all aspects of the installation and configuration process for SAS EBI. This allowed many of these activities to be transitioned from the SAS consultant resources to BCBSM staff. BCBSM SAS Administrators now independently apply SAS software service packs and software upgrades on an ongoing basis. This role could be a UNIX administrator, but they must be engaged with the SAS administrators and users.

CONFIGURATION MANAGEMENT OF THE SAS EBI ENVIRONMENTS
Having separate SAS EBI environments provided the most flexibility to BCBSM. Environment independence allowed for testing of new software functionality via SAS software upgrades and service pack updates. In addition, this allowed BCBSM SAS Administrator and supporting teams to conduct a controlled release management strategy of all BI reporting content.

Information on the installation and configuration of the SAS Intelligence Platform can be found at http://support.sas.com/documentation/configuration/913admin.html.

CONTACT INFORMATION
Your comments and questions are valued and encouraged. Contact the authors at:
- Michael Bretz
- SAS Institute Inc.
Kevin Cornell
BlueCross & BlueShield of Minnesota
3535 BlueCross Rd. Eagan, MN 55122
phone: 651-662-6673

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. © indicates USA registration. Other brand and product names are trademarks of their respective companies.