Troubleshooting Tips and Techniques for a SAS® 9.2 Business Intelligence Environment

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ABSTRACT

As a SAS® 9.2 administrator, you are challenged every day with managing the health of your SAS Business Intelligence (BI) environment. Knowing the underlying architecture and its tools is the key to keeping your system running smoothly and diagnosing problems quickly. This paper provides an overview as well as specific examples to address these questions:

- How do your SAS 9.2 servers interact with your SAS BI clients?
- What tools are available to help monitor and diagnose your system?
- How do you find the information that will help you most when you investigate problems?
- How do you use that information to pinpoint the source of the problem?
- What can you do to mitigate the effects of any problems that do occur?

This paper is most useful to SAS administrators who have questions from their own experience maintaining a SAS Business Intelligence environment.

INTRODUCTION

The third maintenance release for SAS 9.2 (TS2M3) introduces compelling new functionality and power. The tools for troubleshooting in a SAS Business Intelligence environment are no exception. This paper gives an overview of the tools that are available in SAS 9.2 (TS2M3), as well as tips on how to use those tools to monitor, protect, and debug this complex, interconnected structure.

Before you can use these troubleshooting tools effectively, it is helpful to have a basic understanding of the underlying architecture of your system. This paper begins by investigating the structure of the environment and understanding how it is intended to work. The next discussion focuses on the tools that can help administrators recognize incipient problems and gather information about problems that are already occurring. One of the most important information sources is logs, which is discussed in detail. Logging has changed in SAS 9.2, and this paper discusses the new locations, options, and configurations. A high-level framework of sequential questions is presented to help administrators think about how to approach troubleshooting in a SAS BI environment. The paper concludes with tips for solving or mitigating some of the more intractable problems that customers have encountered. The extensive list of links that is available in the "Appendix" provides easy access to the documentation and papers that are most useful in providing technical support for SAS 9.2 BI systems.

This paper is not intended to offer a comprehensive discussion of troubleshooting tools and techniques. Instead, it is a reference that compiles information from many different resources that SAS Technical Support finds to be helpful for this topic. Although this paper describes functionality that is available in SAS 9.2 (TS2M3), most of the content is also pertinent for SAS software releases earlier than SAS 9.2.

UNDERLYING ARCHITECTURE—HOW THE SERVERS AND CLIENTS INTERACT

THE BIG PICTURE—WHAT'S OUT THERE? WHAT DO THESE THINGS DO?

Having a picture of the components of your environment and understanding how they fit together lays a good foundation both for troubleshooting and for maintaining a healthy system. Figure 1 shows an example SAS Business Intelligence deployment. Your system might differ, depending on which SAS products you have installed.
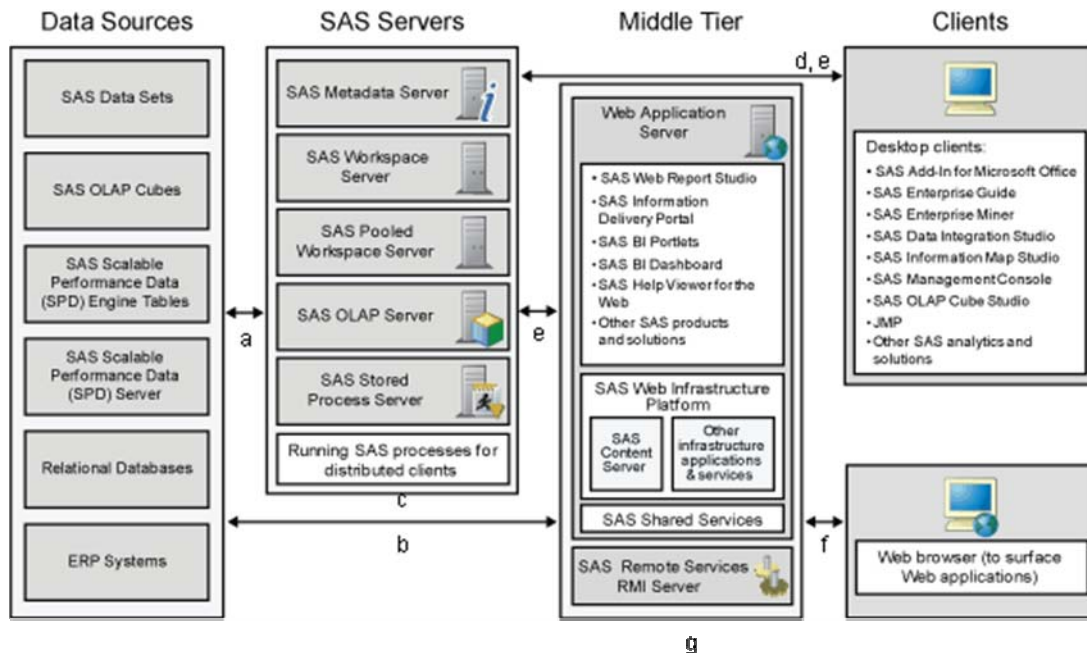
Figure 1. Example SAS Business Intelligence Deployment

The "Appendix" contains links to relevant documentation that provides more details about the function of each of these components. Logging and component monitoring are discussed later in this paper.

Here is how each of these pieces communicates:

  a. Communication between third-party hierarchical and relational databases and the SAS servers typically occurs through SAS/ACCESS® software. SAS/ACCESS interfaces provide fast and efficient data transfer between SAS servers and data sources.

  b. Applications and services in the middle tier access data from the database server via a Java Database Connectivity (JDBC) data source. This data source is usually configured within the Web application server during the initial configuration of your SAS BI system. In a deployment that includes SAS Shared Services, a data source is created to be used exclusively by SAS Shared Services. SAS® BI Dashboard, SAS® Content Server, and some SAS solutions can also use JDBC.

  c. The servers in the SAS tier typically communicate using the SAS Integrated Object Model (IOM), which uses the standard Internet protocol TCP/IP.

  d. SAS BI desktop-client applications that are written in Microsoft programming languages access SAS servers in Microsoft Windows operating environments by using the Microsoft Component Object Model (COM). SAS desktop clients that access SAS servers on other server platforms use the IOM Bridge for COM. Microsoft Office and .Net clients that use the SAS middle tier communicate with middle-tier components using HTTP.

  e. Java clients that access the SAS BI servers use the industry standard Common Object Request Broker Architecture (CORBA) over TCP/IP.

  f. Web browser clients communicate with the SAS BI middle-tier components using HTTP. Web applications also use HTTP to communicate with other Web applications that are installed on the Web application server.

  g. SAS Web applications on the Web application server communicate with SAS Remote Services using Java Remote Method Invocation (RMI).

The following section takes you through an example that shows the sequence in which these communications happen in order to produce a dynamic report.

HOW THESE PIECES FIT TOGETHER—AN EXAMPLE

Working through an example makes it easier to see how the various pieces of your environment interact.

This example traces the communication between different components of the SAS BI platform in order to produce a dynamic report that is entitled Report1 in SAS® Web Report Studio. This report gets data from a query that is based on an information map. Note that the following description is simplified in the interest of brevity.

1. Type the URL for SAS Web Report Studio to see the login display. This login display results from the communication between your Web browser and the Web application server that contains SAS Web Report Studio. The Web application server handles the low-level work of receiving, packaging, and sending messages between the browser and SAS Web Report Studio.

   When SAS Web Report Studio receives the login request, it recruits the Web Infrastructure Platform (WIP) to help. The WIP also resides on your Web application server and is a collection of services and applications that provides common functionality for SAS Web applications. In particular, the WIP contains the SAS Logon Manager that SAS Web Report Studio uses to generate and send back the login display that you need.

2. Once you type your login information and press ENTER, the information is sent back to the middle tier. SAS Web Report Studio again uses the SAS Logon Manager, this time to authenticate the user.

3. The SAS Logon Manager needs to use some lower-level functionality that is provided by another piece of the WIP, the Web Infrastructure Platform Services. These services include auditing, authentication, and monitoring for SAS Web applications. The authentication service communicates with SAS$^{®}$ Foundation Services (through SAS Remote Services), which handles the communications with the SAS$^{®}$ Metadata Server and keeps track of the user's context and session if authentication is successful.

4. The request for authentication is then sent to the SAS Metadata Server. The SAS Metadata Server looks up the user's authentication and authorization information using data that is stored in the SAS$^{®}$ Metadata Repository as well as the authentication mechanism for the operating system. Information about whether the user has been authenticated and whether the user has the right to use SAS Web Report Studio is sent back to the middle tier and then back to SAS Web Report Studio. SAS Web Report Studio then creates the next page for the user to see.

5. When you request a particular report, the request goes from the browser back to SAS Web Report Studio on the middle tier. SAS Web Report Studio must then obtain both the structure for the report (how it will look) and the data. The structure for the report is stored in the SAS$^{®}$ Content Server. In order to find the SAS Content Server, SAS Web Report Studio sends a query to the SAS Metadata Server asking where the SAS Content Server resides. SAS Web Report Studio also queries the SAS Metadata Server to make sure that your SAS ID is authorized to view this report and use the data sources that are associated with it.

6. Once SAS Web Report Studio knows how to find the SAS Content Server, it can send a query and receive the stored XML that describes the structure of the report. However, it will also need the data. Again, a request is sent to the SAS Metadata Server for information about where the data resides, the information map that is required to decode the query, and whether you have the authority to read that data.

7. Once SAS Web Report Studio receives the required information, it asks the SAS object spawner to give it access to a SAS Workspace Server or SAS$^{®}$ Stored Process Server. For this example, the SAS Workspace Server and SAS Stored Process Server are essentially just instances of SAS that will let you execute queries. SAS Web Report Studio sends the query to the SAS session that it obtained. The SAS server then uses a configured data source engine, such as SAS/ACCESS, to contact the database, send the query, and receive the results. The ResultSet is rephrased into the business language that is used by the information map and is sent back to SAS Web Report Studio, which sends Report1 to your browser.

The SAS Metadata Server plays a central role in the preceding example and in almost all SAS Business Intelligence functionality. It provides information about:

- the data sources and data structures that are accessed by SAS applications
- resources that are created and used by SAS applications, including information maps, OLAP cubes, report definitions, stored process definitions, and scheduled jobs
- the servers that run SAS processes
- the users and groups that use the system
- the level of access that a user or group has to each resource (SAS Institute Inc. 2010a).

In this example, the Web application SAS Web Report Studio provides the business logic. The WIP and SAS Remote Services provide the common underlying services that are needed by multiple SAS Business Intelligence applications. The servers spawned by the SAS object spawner provide the computational power. The Web application server provides the low-level communication services that are needed by all Web applications. SAS/ACCESS provides the functionality that is needed to get to external data.

Once you have an idea of which component provides which piece of functionality, your troubleshooting task is already reduced. Rather than searching through the entire system, you can identify the layer that is most likely to be responsible for a given problem. You can then use the tools for monitoring and diagnosing that are discussed in the next section to help you pinpoint where in the layer the problem resides.

TOOLS FOR MONITORING AND DIAGNOSING

The tools that are discussed in this section are useful not only for troubleshooting, but also for monitoring a healthy system so that you can recognize when a system is first deviating from normal. The following categories of monitoring tools and diagnosing tools are not hard boundaries. Many of the monitoring tools are helpful for highlighting which part of a system might be malfunctioning. Similarly, most of the diagnosing tools can be (and often should be) used for auditing and monitoring a healthy system. In SAS Technical Support, these tools are most often used for diagnosis:

Monitoring

- SAS Management Console monitoring tools
- Deployment Tester
- SAS 9.2 Enterprise Business Intelligence Audit and Performance Measurement instrumentation package
- SAS BI platform customization for common operating system monitoring tools
- SAS Web Administration Console
- Application Response Measurement (ARM)
- SAS 9.2 Hot Fix Analysis, Download, and Deployment Tool

Diagnosing

- logs
- SAS Business Intelligence color coding and reporting tools
- ViewRegistry report
- metadata security auditing and reporting tools
- Metadata Analysis and Repair function
- SAS Customer Support Web site

MONITORING

SAS® Management Console Monitoring Tools

The SAS 9.2 Management Console can show an administrator a wealth of information about the current status for the primary SAS BI servers. It also includes the ability to validate that the SAS servers are available to receive requests. The section of the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* entitled, "Checking the Status of Servers" (SAS Institute Inc. 2010t) provides detailed instructions for:

- checking the status of the SAS Stored Process Server, SAS Workspace Server, SAS Metadata Server and repositories, and SAS object spawner. This includes information about which clients are currently connected, their entry time, a graph of server activity for a given object spawner, and much more.
- validating that the SAS Metadata Server, SAS Workspace Servers, SAS Pooled Workspace Servers, SAS Stored Process Servers, SAS® OLAP Servers, and SAS Content Server are available to take requests

SAS administrators might also use the Deployment Tester, which is described in the "Deployment Tester" section of this paper, to run more extensive validation tests.

The SAS® BI Lineage Plug-in for SAS Management Console identifies connections and dependencies among metadata objects that are associated with reports or information maps. Examples include showing the various data sources on which a report depends and showing the various reports, information maps, and stored processes that would be affected by removing a particular data column. For further details about this tool, see "Using the BI Lineage Plug-in" in the *SAS® 9.2 Intelligence Platform: System Administration Guide*, Second Edition (SAS Institute Inc. 2010t).

Deployment Tester

The Deployment Tester runs validation tests on SAS BI applications and servers. It consists of automatically installed Deployment Tester servers, the Deployment Tester plug-in for SAS Management Console, and a batch client. It checks that the following components were successfully deployed during installation:

- SAS Stored Process Server
- SAS Workspace Server
- SAS Pooled Workspace Server
- SAS Remote Services
- SAS Foundation
- SAS OLAP Server

Documentation for the Deployment Tester is in the SAS Management Console Help.

SAS® 9.2 Enterprise Business Intelligence Audit and Performance Measurement Instrumentation Package

This package is a downloadable collection of utilities for sites that are using SAS BI in Windows and UNIX operating environments. These utilities provide the following:

- static performance, auditing, and usage reports
- a Web page to monitor your SAS servers and the SAS Web applications in real time
- the ability to set up e-mail alerts when a SAS server or SAS BI Web application becomes unavailable

These utilities get much of this information from the SAS logs and ARM logs, but they put the information in a format that is more accessible. Figure 2 shows an example of the Web page for monitoring server status.

Figure 2. Example Server Status Report

The technical paper "SAS 9.2 Enterprise Business Intelligence Audit and Performance Measurement for Windows Environments" explains this about the auditing reports:

> The audit reporting components allow SAS System and IT administrators the ability to analyze SAS Metadata Server authentication patterns, user logon behaviors, authorizations changes, and authentication or permission errors. The auditing reports may also be used to detect fraudulent attempts to penetrate the SAS®9 analytic services. Finally, the performance usage reporting components provide fine-grained analysis of various performance metrics for the analytic servers. Metrics include the ability to identify the most active users of the system, processor utilization, memory utilization, and response time for the servers, along with a number of reports to analyze SAS procedures, SAS Stored Processes, and SAS data library access. (SAS Institute Inc. 2009a)

For more details about these utilities and instructions for requesting your free copy of them, see the "SAS® 9.2 Audit and Performance Measurement" Web page (SAS Institute Inc. 2011i).

SAS BI Platform Customization for Common Operating System Monitoring Tools

Many IT organizations routinely use industry standard tools to monitor their business intelligence environments. This section describes the SAS tools that enable administrators to integrate SAS servers, processes, and logs with other monitoring processes and interfaces.

Xymon and BBWin

Xymon and BBWin are free third-party, open-source system monitoring tools for UNIX and Windows, respectively. . SAS provides documentation and two SAS programs for automatically generating the configuration files to enable these tools to monitor SAS BI servers, processes, and logs. Figure 3 shows an example of one of the detailed views that is available.
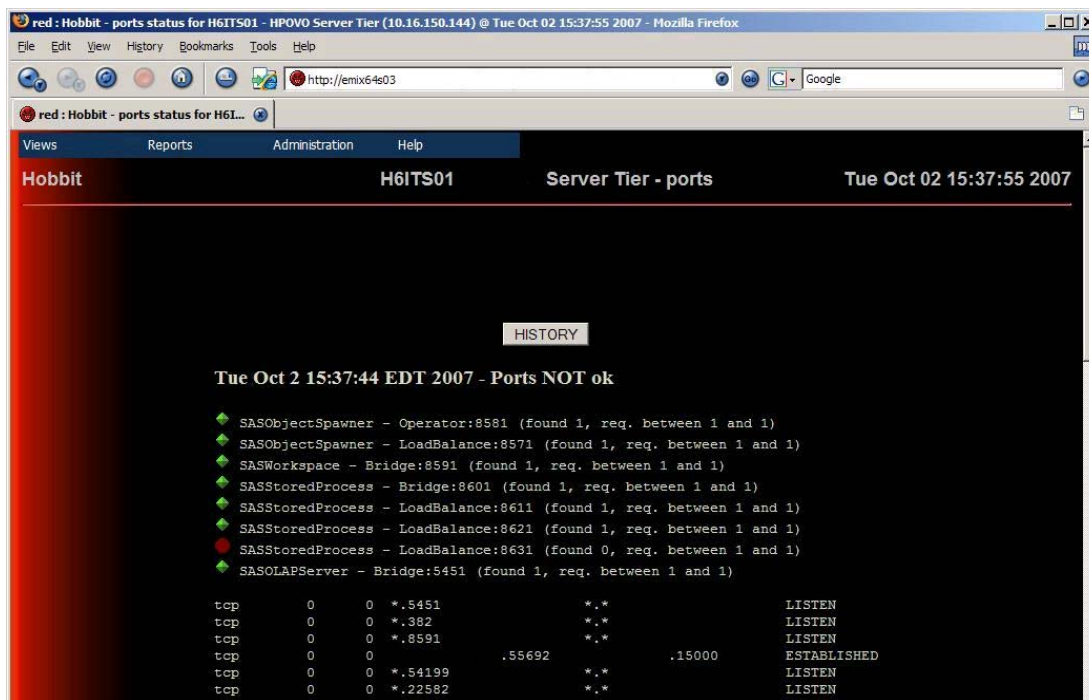

Figure 3. Detailed View of the Ports Information

For further information about these tools and how to download them, see the "Xymon Monitor: An Open-Source System Management Facility" Web page (SAS Institute Inc. 2011v) and the technical paper "Using Hobbit Monitor with SAS® 9.1.3 BI Servers–An Appetizer" (SAS Institute Inc. 2008).

Other operating system monitoring tools

SAS provides additional tools that enable SAS BI applications to integrate with third-party enterprise IT system management facilities such as BMC PATROL, HP Systems Insight Manager, HP OpenView Operations Manager, and IBM Tivoli Monitoring. You can read about and download these tools from the "Enterprise Management Integration" Web page (SAS Institute Inc. 2011f).

SAS Web Administration Console

The SAS Web Administration Console is a Web application that enables a SAS BI administrator to:

- see which users are logged on to SAS BI Web applications
- notify users via e-mail of impending maintenance
- quiesce SAS BI Web applications
- log users off of SAS BI Web applications
- view configuration information for SAS BI Web applications

For more information, see "Using the SAS Web Administration Console" in the *SAS® 9.2 Intelligence Platform: Web Application Administration Guide, Fourth Edition* (SAS Institute Inc. 2011u).

Application Response Measurement (ARM)

ARM is an industry standard Application Programming Interface (API) for monitoring performance and availability across applications. ARM collects data on such things as application response time, users and usage patterns, and what servers are being used.

SAS offers two macros that process the ARM logs that SAS applications create:

- **%ARMPROC** converts an ARM log into a set of six SAS data sets that can be queried or used for reports.
- **%ARMJOIN** merges those data sets and produces views and other data sets from this information, which makes the information easier to interpret.

For further details, see the "ARM SAS Documentation for Version 9" Web page (SAS Institute Inc. 2011c) and the "ARM-Reporting on Performance Data" Web page (SAS Institute Inc. 2011d).

If you are interested in the data that is available through ARM, however, refer to the SAS 9.2 Enterprise Business Intelligence Audit and Performance Measurement Instrumentation Package discussed previously. This package provides a user interface for the ARM information for sites that do not have a third-party ARM monitoring tool installed.

SAS® 9.2 Hot Fix Analysis, Download, and Deployment Tool

The SAS 9.2 Hot Fix Analysis, Download, and Deployment Tool (SAS92HFADD) enables administrators to analyze a SAS deployment registry, create a customized report that lists the hot fixes that are available for any SAS 9.2 deployment, and generate scripts to automate the download and installation of hot fixes.

This tool is available for Windows and UNIX environments. Additional information about this tool and download instructions are available on the "SAS 9.2 Hot Fix Analysis, Download and Deployment Tool" Web page (SAS Institute Inc. 2011k).

DIAGNOSING

Logs

When you need to troubleshoot a problem in your SAS BI environment, gathering information from logs is often the first step after clearly defining the problem. The information in log files can also be essential for auditing and tracking changes that affect a system's health. The "Administering Logging for SAS Servers" section in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t) gives a wonderfully clear and thorough description of logging. This section lists the logs for each of the various SAS BI components, their locations, their default settings, and how to change those settings.

The logging for SAS 9.2 enables administrators to have fine-grained control of

- which logging information is collected
- where each type of logging information is sent
- how the log messages are formatted

The logging information that is collected is controlled by adjusting the loggers. The type of logging information that is sent is controlled by adjusting the logging appenders and filters. The format of the log messages is controlled by modifying the pattern layouts.

Logging is further discussed in the "Finding the Information—More on SAS® 9.2 Logs" section of this paper, which includes examples of logging formats and locations.

SAS Business Intelligence Color Coding and Reporting Tools

The SAS Business Intelligence Color Coding and Reporting Tools provide color coding for log files, graphs to summarize activities, and detailed reports for each request. There are four tools with a GUI interface:

- The **SAS Business Intelligence Color Coding Tool** provides customizable color coding and highlighting for SAS BI log files.
- The **SAS Stored Process Server Report Tool** creates reports and a graph of the SAS Stored Process Server requests that are processed by the SAS object spawner.
- The **SAS Workspace Server Report Tool** creates reports and a graph of the SAS Workspace Process Server requests that are processed by the SAS object spawner.
- The **SAS Stored Process Server Log Report Tool** creates reports and a graph of the SAS Stored Process Server activity.

To download the tools, see SAS Note 19889 "SAS® Business Intelligence Color Coding and Reporting Tools are available on the Download site" (SAS Institute Inc. 2007).

ViewRegistry Report

The ViewRegistry Report is a utility that is available with SAS 9.2 (TS2M2). This utility is installed automatically in the `SASHOME/deploymntreg` folder. It reports all of the SAS products and hot fixes for a site that are known to the SAS Deployment Registry. For further details about this utility, see SAS Note 35968 "Using the ViewRegistry Report and other methods to determine the SAS® 9.2 software releases and hot fixes that are installed" (SAS Institute Inc. 2010o).

Metadata Security Auditing and Reporting Tools

The SAS metadata security report macros gather the permissions metadata that is stored in the SAS Metadata Repository and write it to SAS data sets. There is also a sample report included with the Base® SAS samples in SAS 9.2 that produces a nice color-coded summary from these data sets. These are particularly useful for auditing changes in authorizations at sites that require such auditing. For usage examples, see the technical paper "Using SAS® 9.2 Metadata Security Reporting and Auditing Features" (Boozer and Hatcher 2009). For full documentation, see Chapter 10, "Security Report Macros," in the *SAS® 9.2 Intelligence Platform: Security Administration Guide* (SAS Institute Inc. 2011e).

Metadata Analysis and Repair Function

When you review the logs or experience system behavior that leads you to suspect the metadata repository has become corrupt, you can turn to another tool that is provided by SAS 9.2. The Metadata Analysis and Repair function should be used whenever one of the following might have prevented the SAS Metadata Server from completing a write operation:

- machine crashes
- SAS Metadata Server process crashes
- operating system anomalies
- file system anomalies

Run this tool at scheduled intervals as part of your preventive maintenance! The Metadata Analyze and Repair function can help identify damage and remove or repair orphaned objects and associations. Note that it is essential that the SAS Metadata Server is offline when you run this tool, or potentially irreparable harm to the metadata repository can occur.

The "Metadata Analysis and Repair Function" section in this paper describes the tool in more detail.

SAS Customer Support Web Site

Although this resource is listed last among the tools, the SAS Customer Support site (support.sas.com) is among the most useful tools for any SAS administrator. These sections are of particular use:

- The SAS Product Documentation Web page (SAS Institute Inc. 2011q) and the SAS Intelligence Platform Web page (SAS Institute Inc. 2011n) provide online access to SAS 9.2 BI documentation. The search facility that is available on the SAS Customer Support site enables the reader to quickly find documentation that is pertinent to their problem.
- Samples and SAS Notes (SAS Institute Inc. 2011h) enable you to search for helpful problem notes that are written by SAS Technical Support. You can search on pieces of an error message that you receive or by keywords that describe the actions that elicited the problem.
- SAS Discussion Forums (SAS Institute Inc. 2011m) enable you to interact with many knowledgeable long-term SAS users.

FINDING THE INFORMATION—MORE ON SAS® 9.2 LOGS

The logs for SAS 9.2 are considerably easier to find than in previous releases of SAS. The logging levels for each SAS server are organized in a way that makes it easy to choose to increase or decrease the level of detail for a particular category of messages or to choose to send that category to an entirely different location. The SAS 9.2 documentation on logging is both clear and detailed, so there is no need to repeat the information in this paper. However, it is worth covering a few highlights and providing copious links to resources. Note that discussing logs for individual clients is beyond the scope of this paper, but logging has also improved for many clients with SAS 9.2.

Tip: Regularly scanning the logs, either with an automated tool or just by skimming them for errors, is a simple but effective way in which SAS BI administrators can keep their systems running smoothly.

INSTALLATION LOGS

For initial installations, the logs that are used most often are listed in SAS Note 35426 "Logs that can be used to troubleshoot the SAS® 9.2 (TS2M0) installations" (SAS Institute Inc. 2009b). This SAS note includes the log locations that are specific to the different operating systems as well as a list of logs and the types of information that they contain.

SERVER LOGS

Logging information goes to both the **Log** tab in SAS Management Console and to a log file for each of these servers:

- metadata servers
- object spawners
- OLAP servers
- pooled workspace servers
- stored process servers
- table servers

For these servers, a new log file is created each time the date changes and each time a new server or spawner process is started. Conspicuously absent from the preceding list is the workspace server, which for performance reasons is not initially configured to create a rolling log file. If you need to create a rolling log file for this server for troubleshooting purposes, see "Create a Log File for Workspace Server Troubleshooting" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t).

LOG FORMAT

The log files begin with a header that identifies the server's host machine, operating system, operating system release number, SAS release number, and server start-up command. This information alone is often enough to help pinpoint the source of a problem. By default, the header is followed by logging entries using a layout that includes the following information:

1. the event date and time
2. the logging level
3. the thread identifier (in brackets)
4. the client ID
5. the user identity that is associated with the current thread or task
6. the generated message, preceded by a hyphen

Here is an example from a SAS Metadata Server log with labels that correspond to the preceding list:

```
        1                 2              3          4      5              6
   2008-10-15T11:42:49,294 INFO [00005671] User123@D1234 - Server paused.
   Mode: OFFLINE
```

The technical paper "Using SAS® 9.2 Metadata Security Reporting and Auditing Features" (Boozer and Hatcher 2009) provides additional examples of log messages, their formats, and the appropriate settings.

The format for a log file name is server-type_current-date_process-id.log. For example, events for metadata server process 6188 on October 12, 2008 are written to a file called MetadataServer_2008-10-12_6188.log. By default, these log files are placed in the path *server-configuration-directory*`\Logs`. For example, log files for the metadata server are written to the path *SAS-configuration-directory*`\Lev1\SASMeta\`
`MetadataServer\Logs`.

For a list of default log locations for servers and spawners, see "Default Locations for Server Logs" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t). In a custom installation, you can choose to place all of your log files in a single directory, which is typically *SAS-configuration-directory*`\Lev1\Logs`.

LOG CONFIGURATION

As a best practice, use the initial logging configuration files that are installed by the SAS® Deployment Wizard during normal operations. There are some situations that call for a change in logging configuration (SAS Institute Inc. 2011a):

- You can adjust logging levels dynamically by using the Server Management features of SAS Management Console. This feature is useful when you want to change the configuration temporarily without stopping the server or spawner. See "Using SAS Management Console to Monitor SAS Servers" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t).

- You can permanently modify a server's logging configuration by changing its logconfig.xml file. Before modifying a configuration file, be sure to make a backup copy. The following are some examples of changes that you might want to make to a server's logging configuration:

  - Configure RollingFileAppender to use a different log filename, to roll over log files more or less frequently, or to roll over log files based on file size rather than date.
  - Specify additional loggers to redirect a particular category of message or a particular message level. This will enable you to create separate logs for different purposes such as an audit log, a debug log, and a transaction log.
  - Use filters to limit the events that are written to a particular log location.
  - Configure a different message layout. For additional options and detailed configuration instructions, see the *SAS® 9.2 Logging: Configuration and Programming Reference* (SAS Institute Inc. 2011l).

- You can use the alternative logging configuration files that are provided for troubleshooting. For performance reasons, use these increased levels of logging only when you are collecting logs for troubleshooting, then return immediately to the default logging levels. For details, see the following topics:

  - "Enable More Detailed Logging for Server Troubleshooting" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t)
  - "Create a Log File for Workspace Server Troubleshooting" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t)
  - "Enable More Detailed Logging for SAS Object Spawner Troubleshooting" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t)

PINPOINTING THE PROBLEM—TROUBLESHOOTING TECHNIQUES

If you consider all of the tools and logs that are described in the preceding sections, you have an embarrassment of riches—access to a wealth of useful information that is more than you could possibly use. How do you determine how to pinpoint your problem? You start by asking the right questions.

QUESTIONS TO ASK

The key to avoid becoming overwhelmed when you are troubleshooting is to have a set of questions that can focus your search for answers. This high-level assessment is one such framework.

Is this a new installation?

If so, check the following:

1. the system requirements for each SAS application or solution that you are installing— be careful to
   a. sum together the memory and disk space requirements for each tier, including those for all required third-party products
   b. verify the version and patch level for the operating system and all third-party products
2. the deployment plan—does it correctly reflect what you are attempting to install? Check the details diagram that accompanied your deployment plan.
3. the software download—did it downloaded correctly? Is there a chance that the file is corrupt? Have you installed successfully from this depot in the past?
4. the pre-installation checklist, checklist.pdf—read this document carefully because tips are occasionally added between the usual tables and checklists.
5. alert notes—access these on the SAS Customer Support Web site (support.sas.com).

If none of these suggestions yield a solution, follow the troubleshooting steps in the "Overview of Troubleshooting Your Initial SAS 9.2 Deployment" section of the *SAS® 9.2 Intelligence Platform: Installation and Configuration Guide* (SAS Institute Inc. 2011r).

Did you restart the server and middle tier?

This question is so common in Technical Support that it has become a cliché. Restarting your server can reduce page swaps, trigger applications to write data and log messages, and clear buffers, memory caches, locks on data, some processes that are not responding, and file handles. It also enables you to start with fresh logs,

which improves your ability to find the pertinent messages for your problem. Although it does not solve all problems, restarting the SAS BI servers and middle tier will often resolve a problem at least temporarily, and give you more time to look for the underlying source of the problem.

The order in which you start your servers is important. This information is available in your instructions.html file. Server dependencies are thoroughly discussed in the "Overview of Server Operation" section in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011b). Because of its importance, the following information from the "Overview of Server Operation" section is worth emphasizing.

The following start-up order meets the dependency requirements:

1. Start the SAS Metadata Server.
2. Start the SAS OLAP Server.
3. Start the SAS object spawner.
4. Start the SAS/SHARE server.
5. Start the SAS/CONNECT spawner.
6. Start the SAS Table Server.
7. Start the SAS Services Application (SAS Remote Services).
8. Start the SAS Deployment Tester server.
9. Start the Web application server. (The SAS Content Server starts automatically when the application server is started.)

Servers should be stopped in the inverse order, with the metadata server stopped last (SAS Institute Inc. 2011b). Note that this is just one of many orderings that satisfy the preceding requirements.

Under UNIX or z/OS operating systems, use the sas.servers script in the ***SAS-configuration-directory*/Lev1/** directory by typing the command >sas.servers restart. For further information about this command, see "Using the sas.servers Script on UNIX or z/OS to Start or Stop All Servers" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t).

To restart the middle tier, see the instructions that are included in your instructions.html file in the ***SAS-configuration-directory*/Lev1/Documents** directory. This file has instructions for restarting the WebSphere, WebLogic, and JBoss servers and the SAS Services Application (SAS Remote Services).

Is all or part of the SAS BI system unavailable to all users?

Note: If part of your BI system is unavailable to only one user or only to newly added users, see "Are you seeing unexpected behavior or errors?".

1. Check the status of all of the SAS servers and spawners on each machine. If you have not set up one of the operating system monitors that was mentioned in the "SAS BI Platform Customization for Common Operating System Monitoring Tools" section, then do the following:
   a. Under Windows, use the services display that is available from the Control Panel.
   b. Under UNIX or z/OS, use the sas.servers script in the ***SAS-configuration-directory*/Lev1/** directory by typing the command >sas.servers status. The script reports the status of any of the following servers that are installed on the machine in which it runs: SAS Metadata Server; SAS object spawner; SAS OLAP Server; SAS/CONNECT spawner; SAS/SHARE server; SAS Table Server; SAS Services Application (SAS Remote Services); and SAS Deployment Tester server.

2. If all of the servers appear available, use the validation tests that are listed in the "Validate the SAS Metadata Server, SAS Workspace Servers, SAS Pooled Workspace Servers, SAS Stored Process Servers, and SAS OLAP Servers" section of the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t) and listed in your instructions.html file for each tier to make sure that the SAS BI servers are responsive.

   If one or more of the servers are not available or do not validate, go through the server logs following the order of the server start-up list. Check the log of the first server in the list that did not start up or did not validate. If the error message is not obvious or if there is no error message, check the logs of the servers that precede that server in the start-up list.

3. Once you have reviewed the logs and performed the validation tests, you are ready to act on the information that you found.
   a. Search SAS notes using keywords or different pieces of any error messages that you find.
   b. Identify all recent changes in the operating system environment for each tier. In particular, check:

- user names and passwords, especially of the sassrv, sastrust, and webanon users
- membership in operating systems permissions groups, especially for sassrv, sastrust, and webanon—see "Recommended Operating System Protections for Windows Machines" and "Default Operating System Protections for UNIX and z/OS Machines" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t)
- directory permissions (see the links in the preceding bullet), directory changes, and directory disk space allocations
- database availability and database client application changes or updates
- port availability—see "Default SAS Ports" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t)
- resource usage by other applications, especially ports and memory—see the "Other Operating System Monitoring Tools" section for a list of helpful tools.

4. Identify all recent changes in the SAS metadata environment, with particular focus on changes in authorization for both individuals and groups. The SAS Metadata audit log is helpful for this if you have one. For reference, check the "Overview of Initial Roles, Groups, and Users" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t).

5. If one or more users are unable to use a SAS Workspace Server, check "Requirements for Accessing a Standard Workspace Server" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t).

Is data unavailable?

If you are unable to see the data in your application but can use other functionality, or if you see errors reporting an inability to get data or contact the database, see "Connecting to Common Data Sources" and especially "Troubleshooting SAS/ACCESS Connections to RDBMS" in the *SAS® 9.2 Intelligence Platform: Data Administration Guide* (SAS Institute Inc. 2011s).

Check authorizations in the SAS Metadata Server, either using the tools previously described or by looking directly at the SAS Metadata Server logs. It is often helpful for this type of problem to examine any authorization changes that have been made to the PUBLIC group in SAS Management Console.

Are you seeing poor performance times?

1. See the suggestions for optimizing SAS BI system performance in "Optional Setup Tasks" section of the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t).

2. For an AIX system, refer to the "SAS® 9.2 Deployment Tester, AIX System Tuning" Web page (SAS Institute Inc. 2011j) to investigate use of the SAS Deployment Tester's AIX System Tuning package.

3. Monitor each machine's memory, disk space, and CPU usage for potential resource constraints.

4. Follow the questions that are listed in the "Are you seeing unexpected behavior or errors?" section.

Are you seeing unexpected behavior or errors?

1. Identify the boundaries of the problem as precisely as possible. This often highlights the source of the problem.

   a. Are the problems occurring at particular times and not others? If so, are there other jobs, applications, network demands, or database demands that might be creating resource constraints? Check scheduled batch jobs and scheduled maintenance for the database, operating system, and SAS system. Depending on which servers your particular application uses, the SAS Stored Process Server logs or SAS Workspace Server logs tend to be the most useful in this case. For Web applications, also see the SAS Remote Services logs and the Web application server logs for both the server instance where your Web application is installed (for example, SASServer6) and the server instance where the Web Infrastructure Platform is installed (for example, SASServer2).

   b. Are the problems occurring for some users and not others? If so, are there differences in the following:
      - usage patterns
      - releases of SAS or third-party products that are installed
      - permissions (database, operating system, metadata server roles, groups, and inherited permissions)
      - client PCs—Check to see whether the problem happens for one user but not another user on the same PC, to rule out differences in PC configuration. The metadata server log is especially useful for this type of problem, because the problem is often differences in roles, groups, or explicitly granted authorizations. The SAS BI Lineage Plug-in for SAS Management Console might also be

useful to show the objects that the desired functionality depends on, such as showing the information maps, tables, and OLAP cubes that are necessary to run a given report.

c. Are the problems occurring for particular queries? If so, use the stored process server or workspace server logs to isolate the actual queries. (For more details about logging, see the section "Finding the Information—More on SAS® 9.2 Logs".) Run the queries directly on the database, without any SAS products, to see whether the problem can be attributed to the database. The SAS logs that tend to be most useful for this are the SAS Stored Process Server logs and the SAS Workspace Server logs, depending on which type of SAS server is used to run the query. You might need to increase logging to get more information, especially in the case of the SAS Workspace Server.

d. Are the problems occurring for particular applications and not others? What do the applications have in common? The SAS Metadata Server log and SAS object spawner log are often most useful for this type of problem. For Web applications, also look at the Web application server logs and the SAS Remote Services logs. The SAS BI Lineage Plug-in for SAS Management Console might also be useful for this problem because it can help pinpoint a common dependency among the applications that are having difficulty.

e. Are the problems occurring only for Web applications?

    i. Have you completed all pre-installation steps that are listed on the "Pre-Installation Steps for JBoss, WebLogic, and WebSphere Application Servers with SAS® 9.2" Web page (SAS Institute Inc. 2011g)?

    ii. Are all ports that are listed in your instructions.html file available? Some port conflicts happen because of a change in firewall policy. Some are even intermittent because a given application might not occupy a particular port at all times.

    iii. Are there errors or useful messages in the logs for the Web application server and for the SAS Remote Services application? Pay particular attention to log messages that were recorded at the time the problem occurred. The log location for each server (SASServer1, SASServer2, and so on) is listed as an "Application Server Log Directory" in your instructions.html file.

    iv. If you find errors in the logs, search the SAS notes on the SAS Customer Support Web site (support.sas.com) to find information about potential sources for the error.

2. Try to re-create the problem. Can the problems be re-created consistently? If so, try to reduce the complexity and number of steps that you undertake when you re-create the problem. Here are some common strategies for reducing the complexity:

a. Re-create the problem using only Base SAS. This reduces or eliminates involvement of the SAS BI servers and of network issues.

b. Re-create the problem using a simple scheduled job, if the original problem is caused by a complex scheduled job. See whether the problem occurs when the job is run manually, rather than scheduled, so that the scheduler can be ruled out as a source of error.

c. Re-create the problem with a vastly simplified information map if the original problem involved a complex information map.

d. Re-create the problem when no other applications are running in order to reduce possible contribution from resource contention.

e. Temporarily increase authorization levels in both the SAS Management Console and in the operating system to eliminate the possibility that the problem is caused by insufficient authorization.

f. Restart the system and create new, clean log files immediately before reproducing the problem. This isolates the pertinent log messages in all of the logs. (For more logging advice, see the "Finding the Information—More on SAS® 9.2 Logs" section in this paper.)

3. Check for changes in the SAS BI system. These might include changes in:

a. hot fix level

b. underlying information maps

c. usage patterns

d. installed applications

e. authorization

f. scheduling

4. Check for changes in the third-party products, computers, and network on which the SAS BI system is installed. These might include changes in:
   a. authentication mechanism (LDAP, PAM, Web authentication, and so on)
   b. authorization (operating system, Web application server, database)
   c. database structure
   d. third-party product versions and fixpacks, including database clients, Java, and Web application server
   e. firewall configuration
   f. network configuration (for example, limiting of multicast, change in subnets)

GENERAL RULES

1. Apply the latest hot fixes for all of your SAS applications. The problem might be caused by a defect that has been fixed.
2. Check SAS notes to see whether the problem might be caused by a known defect. The first search terms that you use might not yield the results that you need, so try different combinations of keywords and different subsets of the error message that you are receiving.
3. Issues that are intermittent are usually caused by resource contention of some sort. This can be a resource shortage, such as too little memory for peak usage of a particular application or too many applications competing for limited memory. It can also be a conflict between applications attempting to get a lock on the same resource, such as a data row, data table, file, or port. Resources that are generally subject to competition include: data, ports, network bandwidth, number of processes, resources within a process (for example, ulimit or a Windows per-process memory limit), memory, disk space (especially for log directories and WORK directories), file handles, I/O pipe throughput (for large amounts of data), CPUs, workspace servers, and stored process servers.
4. If you become stuck, write the problem description with as much detail as possible, including a timeline for which application had unexpected behavior, what you and other users of the SAS BI system and its machines and data were doing at the time of the problem, and which users were involved. Go through each tier in Figure 1 and write down potential sources of the problem. Gather logs from each of the involved components and view the log messages from the time of the problem.
5. Even seemingly catastrophic errors are less stressful if you have implemented a solid backup and recovery plan for your SAS BI system. SAS 9.2 tools make it simple. See the "Backup and Recovery" section in this paper which describes how to create a backup.

PREVENTING, MITIGATING, AND SOLVING

Troubleshooting will be dramatically easier if you first familiarize yourself with your SAS BI system when it is running normally. Moreover, this familiarity often enables an administrator to spot potential trouble before it causes concern to the SAS BI system users. The section "Overview of the State of Your System" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t) contains a short list of the components to review and also contains links to the essential information about each. It has, among other things, links for the configuration directories that stores configuration files, logs, scripts, and special-purpose SAS data sets for each SAS server machine and each middle-tier machine; the main configuration files that control the operation of the system; and the initial SAS users, groups, and roles that have been defined, both on the host operating systems and within the SAS Metadata Repository.

Another essential (and brief) page for preventing small problems from becoming large ones is "Best Practices for Ensuring the Integrity of Your System" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t). It has instructions that are vital for preventing your SAS Metadata Server, the central node in your SAS BI system, from becoming unusable.

In order to prevent problems that are caused by unanticipated interdependencies among the individual SAS BI Metadata Objects, regularly use the new SAS BI Lineage Plug-in for SAS Management Console. You can read more about this tool in the "Using the BI Lineage Plug-in" section of the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t).

Two tool sets that are invaluable to keeping the SAS BI system available to users are the backup tools and the Metadata Analyze and Repair function. These tools are discussed in the following sections.

BACKUP AND RECOVERY

The best way to prepare for problems and protect against potential disasters is to take regularly scheduled backups of your SAS BI system. It cannot be stressed enough how essential this is to the continued functioning of your system. SAS provides backup and restore utilities as well as a Backup Wizard in SAS Management Console that

make this an easy task with high payoff—see "Using the Backup Wizard in SAS Management Console" in the *SAS®9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t). To get started, read "Best Practices for Backing Up and Restoring Your System" in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t).

Perform full system backups on the metadata repository, SAS Content Server, SAS Table Server database, SAS Shared Services database, and configuration files. Schedule these backups to run weekly or, preferably, daily. Also schedule full backups of your BI system before and after any major change. Such changes include: changing authorization templates or groups; applying hot fixes; or upgrading third-party product versions or fixpacks. Note that the backups of all of the various components must be synchronized because the data is interconnected. Instructions on how to ensure that the backups of your SAS BI components remain in sync can also be found in the "Best Practices for Backing Up and Restoring Your System" section in the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t). .

In addition to performing regular full backups, in certain situations it can be appropriate to back up specific metadata objects or folders in the SAS folders tree of SAS Management Console. In these situations, you can use the promotion tools, which include the Export SAS Package wizard, the Import SAS Package wizard, and the batch export and import tools. The table in the "Copying, Promoting, Importing, and Exporting Your Metadata" section of the *SAS® 9.2 Intelligence Platform: System Administration Guide, Second Edition* (SAS Institute Inc. 2011t) lists each tool, the purpose of each tool, the tool's location in SAS Management Console (if applicable), and a reference for documentation about the tool for copying, promoting, importing, and exporting metadata.

There are further improvements coming to the backup and restore process in SAS 9.3. The SAS 9.3 Metadata Server includes a new server-based facility that performs metadata server backups automatically on a scheduled basis. This facility can also be used to perform ad hoc backups and to perform roll-forward recovery. The facility replaces the %OMABAKUP macro, which became available in SAS 9.1 and SAS 9.2, and the Backup and Restore Wizard in SAS Management Console, which is available with SAS 9.2.

The backup and recovery facility will provide the following features:

- A schedule of daily backups is configured by the SAS Deployment Wizard. Therefore, daily backups are taken without the need for administrator intervention. Metadata server backups are also launched automatically in certain situations; for example, a backup is automatically taken when the SAS Deployment Wizard is finished installing and configuring your software.
- If necessary, administrators can use SAS Management Console to change the schedule and the configuration options, including the backup directory location and the backup retention policy. Backups can also be run on an ad hoc (unscheduled) basis from SAS Management Console, from the operating system command line, or from SAS.
- When repositories are restored in the event of a metadata server failure, transactions recorded in the journal file can be used to perform roll-forward recovery to a specified point in time after the last backup was taken.
- SAS Management Consoled displays detailed backup and recovery history, including the current status of each set of backup files. Backup and recovery history is also stored in XML files in the metadata server directory.
- The backup process executes in a separate thread while the metadata server is running. Therefore, the server does not need to be paused during backups unless **Journaling** has been disabled or the **Reorganize Repositories** back up option has been selected.
- The metadata server runs its own backup and recovery processes. These processes do not rely on any other servers, such as workspace servers, DATA step batch servers, or scheduling servers. Because the metadata server has permission to access all of the needed files, there is no need to set up a host account with special operating system rights and permissions.

METADATA ANALYSIS AND REPAIR FUNCTION

This tool can identify and repair damage to the metadata repository. Running this tool in Analysis mode should be a regularly scheduled part of your SAS BI system maintenance because it helps identify any problems that might be lurking in your metadata repository.

Before you use this tool, you must put the repository into Administration Access mode and as shown in Figure 4.

> **Note: Running the repair option while the repository is in Online mode can actually cause the sort of corruption that the tool is designed to repair.**
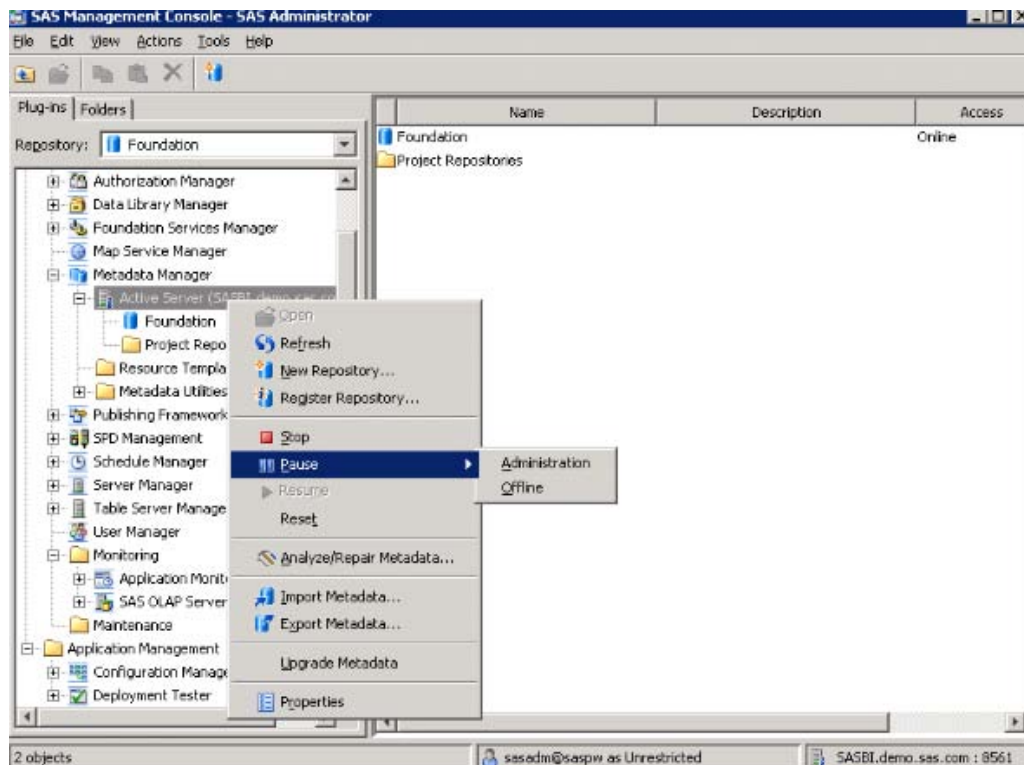
Figure 4. Putting the Repository into Administrative Access Mode

> **Tip**: As a further precaution, run a metadata backup before **and** after you perform any maintenance, which includes running this tool in Repair mode.

You should run this tool only on one repository at a time, especially for large repositories. To launch the Metadata Analysis/Repair Tools wizard, first log in to SAS Management Console using an ID for the Metadata Server: Unrestricted role. Navigate to the Metadata Manager plug-in and select either the **Active Server** node or a specific repository. Next, right-click the node or repository that you selected and select **Analyze/Repair Metadata...** from the sub-menu.

The wizard presents the list of the analysis and repair tools that are available to run, as shown in Figure 5.
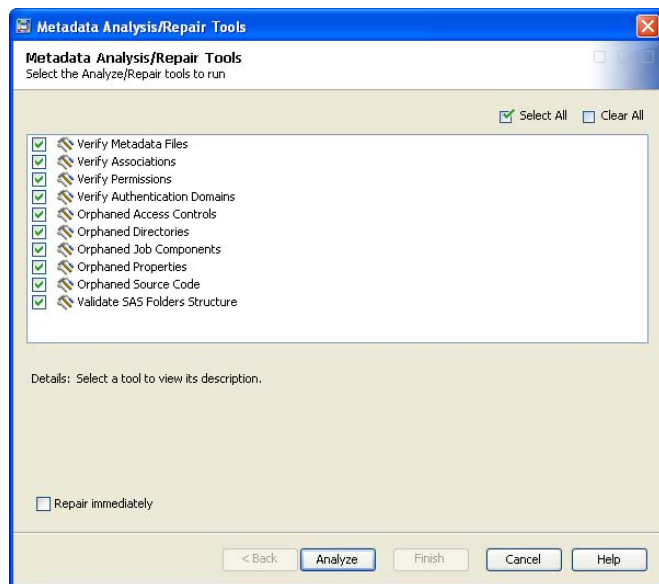
Figure 5. Available Analysis and Repair Tools Shown on the Metadata Analysis/Repair Tools Page

There is no harm in running all of the tools, although it can take hours for very large repositories. You can check them all if your site has a small repository. For large repositories or for sites with heavy usage, run the tools one at a time. Rather than selecting **Repair immediately**, click **Analyze** first, then select **View log** to see the analysis. This enables you to investigate any questionable entries before you make repairs.

The *orphan tools* look for specific types of objects that are left in the repository and are no longer being referenced. It is not uncommon for the tool to find a large number of orphans the first time it is run. The repair tool can safely delete these orphans, leaving the repository smaller and tidier.

In the rare event that the repository has become corrupt in a way that prevents it from being opened, the tool can still be used. See SAS Note 36575 "New XML tags are available for the omaconfig.xml file to analyze and repair a damaged SAS® Metadata Repository" (SAS Institute Inc. 2010b) for details.

SAS® DEPLOYMENT MANAGER

The SAS Deployment Manager can help to solve problems by enabling the SAS administrator to remove and re-create a piece of a SAS BI system implementation. In particular, it enables a SAS administrator to remove components (so that they can be reinstalled or reconfigured correctly), update passwords for the service accounts, rebuild Web applications, and renew the SAS software license for some SAS solutions that depend on a SAS middle tier. See the "Removing a SAS Configuration" section in the *SAS® 9.2 Intelligence Platform: Installation and Configuration Guide* (SAS Institute Inc. 2011r) for additional details.

REPORT THE PROBLEM

If you have tried the tools and techniques that are describes in this paper and still have been unable to resolve the issue with which you are confronted, the experts at SAS Technical Support are available to offer award-winning service and decades of insight. Although Technical Support consultants learn about new products and acquire new skills all the time, we remain sorely deficient at divining the state of a system without having the logs and other vital troubleshooting information. Sending this information when you initially submit a problem will speed our progress to a solution and endear you to your colleagues both at your site and here at SAS. For a list of the minimum logs and information that you should send for any problem that is associated with a SAS BI system, see SAS Note 41489 "Necessary information to provide when requesting assistance from SAS Technical Support" (SAS Institute Inc. 2011p). Submitting logs for a specific SAS solution or SAS BI client that is experiencing problems is also very useful.

CONCLUSION

This paper provides an overview of the many resources that are available to you as a SAS 9.2 (TS2M3) BI system administrator. It also provides guidance on which tools are most useful for which types of problems and an organized set of steps to follow during the frequently disorienting process of troubleshooting. There is no substitute for your own experiences, however. Consider using these tools at your site. Hopefully, this paper provides the guide that you need, both before any problems occur and in the heat of a challenging problem.

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APPENDIX

This section provides links to documentation that SAS Technical Support has found most useful in our own troubleshooting endeavors. The documentation is divided into three sections: logging, troubleshooting guides, and general information.

TROUBLESHOOTING RESOURCES

Logging

- **Administering Logs and other Local Files**
  support.sas.com/documentation/cdl/en/bidaag/61231/HTML/default/viewer.htm#a003314426.htm
- **Create a Log File for Workspace Server Troubleshooting**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/a003285844.htm
- **Default Locations for Server Logs -**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/a003141387.htm
- **Enable More Detailed Logging for SAS Object Spawner Troubleshooting**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/a003282016.htm
- **Enable More Detailed Logging for Server Troubleshooting**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/a003281553.htm
- **Ongoing System Administration Tasks**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003286197.htm

Troubleshooting Guides

- **Managing Metadata Server Performance**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003141847.htm
- **Resolving Issues Related to Scheduling with Platform Suite for SAS**
  support.sas.com/documentation/cdl/en/scheduleug/61559/HTML/default/viewer.htm#p1lpqq3hxen6zbn1hswgbeuoozje.htm
- **"The SAS® OLAP Server: Understanding and Solving Common Problems"**
  support.sas.com/resources/papers/proceedings09/304-2009.pdf
- **"Troubleshooting an Installation of Platform Product Suite for SAS"** (this is an old resource but still has some useful information) support.sas.com/techsup/technote/ts779.pdf
- **"Troubleshoot Your Performance Issues: SAS Technical Support Shows You How"**
  support.sas.com/resources/papers/proceedings09/333-2009.pdf
- **Troubleshooting the Promotion Tools**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003139377.htm
- **Troubleshooting the SAS Server Tier (for a new installation and configuration)**
  support.sas.com/documentation/cdl/en/biig/60946/HTML/default/viewer.htm#a003282991.htm
- **Troubleshooting SAS Web Applications (for a new installation and configuration)**
  support.sas.com/documentation/cdl/en/biig/60946/HTML/default/a003283274.htm
- **Using Configuration Settings to Optimize Metadata Server Performance**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003141735.htm

General Information

- **"Best Practices for Installing and Configuring IBM WebSphere Network Deployment Before Running SAS Deployment Wizard"** (see page 6)
  support.sas.com/resources/thirdpartysupport/v92m3/appservers/WASConfigBeforeRunningSDW.pdf
- **Best Practices for Middle-Tier Configuration**
  support.sas.com/documentation/cdl/en/biwaag/63149/HTML/default/viewer.htm#a003052109.htm
- **Checklist for a More Secure Deployment**
  support.sas.com/documentation/cdl/en/bisecag/61133/HTML/default/viewer.htm#a003285213.htm
- **"Configuration and Tuning Guidelines for SAS®9 in the Microsoft Windows Server 2008 Operating Environment"**
  support.sas.com/resources/papers/WindowsServer2008ConfigurationandTuning.pdf

- **Connecting to Common Data Sources**
  support.sas.com/documentation/cdl/en/bidsag/61236/HTML/default/a003112367.htm
- **Default SAS Ports**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003141390.htm
- **First-Priority Setup Tasks**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/a003285781.htm#a003357523
- **Managing the Java Heap Used By Desktop Applications**
  support.sas.com/documentation/cdl/en/bidaag/61231/HTML/default/viewer.htm#a003316377.htm
- **Optional Setup Tasks**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003285788.htm
- **Overview of the Configuration Directory Structure**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003181764.htm
- **Overview of Initial Roles, Groups, and Users**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003286446.htm
- **Quick Reference for SAS Management Console** (lists tasks that can be performed, which components within SAS Management Console are used for them, and what documentation describes how to do those tasks) support.sas.com/documentation/cdl/en/bidaag/61231/HTML/default/viewer.htm#a003150696.htm
- **Reference: Configuration Files for SAS Servers**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003147155.htm
- **Requirements for Accessing a Standard Workspace Server**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003272572.htm
- **SAS 9.2 Audit and Performance Measurement**
  support.sas.com/rnd/emi/EbiApm92/index.html
- **SAS 9.2 (TS2M3) Support for Web Application Servers and HTTP Servers**
  support.sas.com/resources/thirdpartysupport/v92m3/appservers/
- **"SAS 9.2 Web Applications: Tuning for Performance and Scalability"**
  support.sas.com/resources/thirdpartysupport/v92/appservers/WebTierScalabilityAndPerformance.pdf
- **Starting and Stopping Web Application Servers**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003150768.htm
- **"The Art of Managing SAS® 9.2 Middle Tier"** (contains a good overview of the configuration directories for the middle tier, as well as some troubleshooting tips for the middle tier)
  support.sas.com/resources/papers/proceedings10/309-2010.pdf
- **"Understanding SAS/ACCESS® Software's Role with Querying and Reporting in a Business Intelligence Environment"** (a good resource for troubleshooting issues with accessing data for query and reporting) support.sas.com/resources/papers/proceedings10/333-2010.pdf
- **Using the SAS Management Console to Operate SAS Servers**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003262380.htm
- **Using the Server Performance Counters and Information Fields**
  support.sas.com/documentation/cdl/en/bisag/64088/HTML/default/viewer.htm#a003261028.htm

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