

## **SAS® Viya™: What It Means for SAS® Administration**

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### **ABSTRACT**

Not only does the new SAS® Viya™ platform bring exciting advancements in high-performance analytics, it also takes a revolutionary step forward in the area of administration. The new SAS® Cloud Analytic Services is accompanied by new platform management tools and techniques that are designed to ease the administrative burden while leveraging the open programming and visual interfaces that are standard among SAS Viya applications.

Learn about the completely rewritten SAS® Environment Manager 3.2, which supports the SAS Viya platform. It includes a cleaner HTML5-based user interface, more flexible and intuitive authorization windows, and user and group management that is integrated with your corporate Lightweight Directory Access Protocol (LDAP). Understand how authentication works in SAS Viya without metadata identities.

Discover the key differences between SAS® 9 and SAS Viya deployments, including installation and automated update-in-place strategies orchestrated by Ansible for hot fixes, maintenance, and new product versions alike. See how the new microservices and stateful servers are managed and monitored.

In general, gain a better understanding of the components of the SAS Viya architecture, and how they can be collectively managed to keep your environment available, secure, and performant for the users and processes you support.

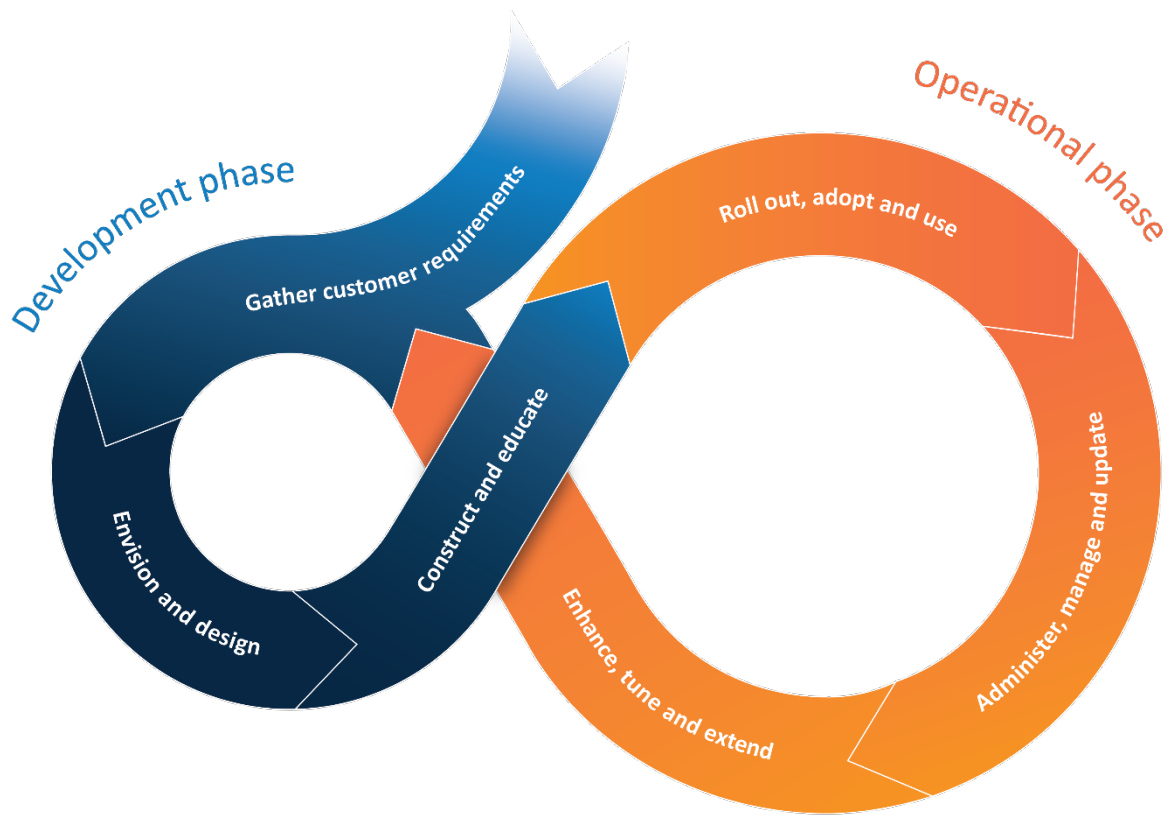
### **INTRODUCTION**

SAS Viya represents the next major evolution of the SAS platform, and the administration processes have evolved alongside. It's important to understand administration in the overall context of planning, deploying, and managing SAS software. Of course, you must also have a general grasp of the components of the SAS Viya architecture and how they work together. This paper will first cover these concepts, and then present the way in which you accomplish common deployment and administration tasks.

The information presented in this paper assumes a SAS Viya 3.2 deployment including both visual and programming interfaces. While it is possible to install SAS Viya solely with programming interfaces (in other words, SAS Studio, native Python, Java, Lua, and R language support, and REST API access), the drag-and-drop visual interface exemplified by web-based products like SAS Visual Analytics and SAS Visual Data Builder comes with several more servers and services to manage. SAS Viya provides a supporting utility to ease this burden.

### **SAS ADMINISTRATION LIFECYCLE**

The process of planning, deploying, and administering SAS software falls under a common lifecycle depicted in Figure 1.



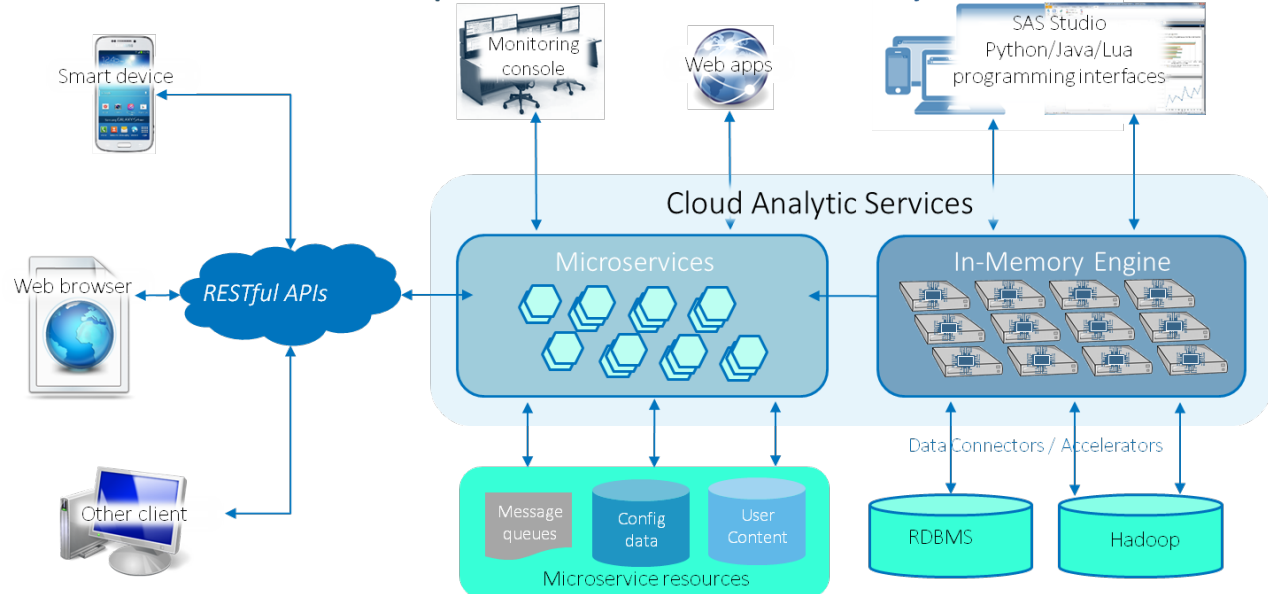
**Figure 1. SAS Administration Lifecycle**

This diagram represents a continuous process from requirement definition to environment administration and tuning, and back again to new requirement identification. Note that this lifecycle applies equally to SAS 9 and SAS Viya. For purposes of this paper, we will focus on the administrative aspects involved in the “Operational phase” portion of this diagram, and specifically in the context of SAS Viya.

## **SAS VIYA ARCHITECTURE**

SAS Viya introduces several modern practices to SAS software architecture. While SAS 9 brought a distributed client/server web-enabled model, with an extensible middle tier, several flavors of job execution servers, and a metadata server to govern them all, SAS Viya brings a more resilient, elastic, unified, and open architecture, which leverages cloud-friendly microservices and a next generation analytics run-time engine. Figure 2 shows a high-level architectural view of SAS Viya.

## Main Components of the SAS® Viya™ Platform



**Figure 2. SAS Viya High-Level Architecture**

To administer a SAS Viya environment, you should have a good understanding of each of the following components.

### SAS CLOUD ANALYTIC SERVICES

SAS Cloud Analytic Services (CAS) is the “heart and soul” of the SAS Viya platform. It’s where all the high-performance analytic processing occurs. It also contains a collection of microservices which effectively take on the responsibility of the middle tier along with other environment support functionality, like authentication and backup.

### In-Memory Engine (CAS Server)

The CAS server is SAS Viya’s run-time engine for analytics and data management. It is an in-memory server that can run on a single machine or be distributed across multiple machines. In a distributed deployment, it can dynamically scale up and down based on workload demands by adding or removing its underlying worker nodes.

### Microservices

CAS microservices essentially break down the monolithic intelligence platform of SAS 9 into dozens of functional components, each doing exactly one thing and doing that one thing well. The value of microservices to an administrator is that they are independently scalable and updatable. Based on the function performed, you might need more instances of one microservice (for example, authorization) as opposed to another microservice (for example, backup). For a highly available deployment, you will want at least two instances of each microservice.

### MONITORING CONSOLE

SAS Environment Manager is a centralized web application to monitor and administer your SAS Viya environment. This environment includes SAS web applications, microservices, the CAS server, data connectors and data connect accelerators, and microservice resources. SAS Environment Manager is covered in detail in the Administration section of this paper.

## WEB APPS

The SAS Viya platform uses HTML5-based web applications to surface both administration and end-user functionality. A special web application, the SAS Environment Manager, provides a centralized monitoring console as well as general SAS administration support. We'll cover the details of its capability later in this paper. Licensed SAS solutions provide web applications like SAS Visual Analytics and SAS Visual Data Builder, which leverage CAS to provide supporting analytic and data management actions.

## PROGRAMMING INTERFACES

SAS Viya supports a variety of direct programming interfaces. As with SAS 9, SAS Studio is used to compose and submit jobs using the SAS programming language. Java, Python, and Lua programmers can take advantage of packages and libraries provided by SAS, which can be installed in these respective development environments (for example, within a Jupyter Notebook) to provide direct access to CAS actions without going through a client supplied by SAS.

## RESTFUL APIS

CAS provides RESTful API support, which is essentially the integration language of the web, to enable web application developers to directly access CAS. Both the microservices and the CAS server are architected to surface public REST APIs for external consumption.

## DATA CONNECTORS / ACCELERATORS

Like SAS 9, SAS Viya can access user data from a growing number of sources. SAS Data Connectors are the SAS Viya equivalent of SAS/ACCESS engines, and they allow serial access to a variety of data sources such as Teradata, Oracle, Postgres, and ODBC sources. SAS Data Connect Accelerators provide parallelized data access using the same SAS Embedded Process technology leveraged by SAS In-Database offerings provided in SAS 9. In fact, the same SAS Embedded Process software deployed to a database can simultaneously support parallel queries from SAS 9 and SAS Viya solutions.

## MICROSERVICE RESOURCES

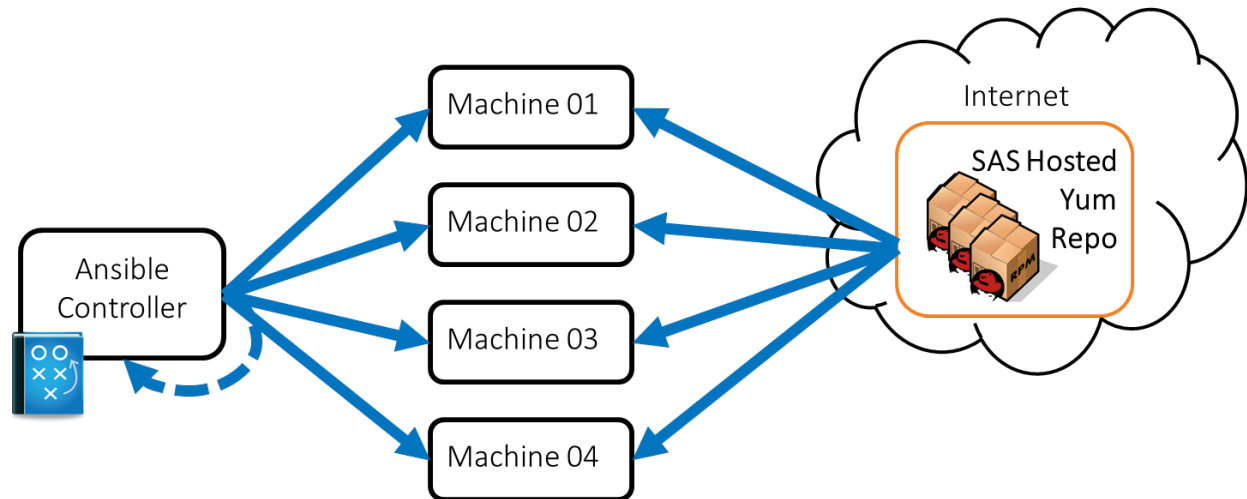
SAS microservices themselves are “stateless” in that they do not persist data. As such, they use microservice resources in the form of persistent data stores when they need to save user content (for example, folders, job definitions, and reports) and configuration data (for example, a list of services deployed and the options used to launch the services). They also report activity in the form of metrics and logs to message queues. SAS applications, user applications, and third-party administrative tools can subscribe to these queues in order to glean relevant real-time information about the SAS Viya operational environment.

## DEPLOYMENT

One of the first things a SAS administrator will notice is that the SAS Viya deployment process is completely different from SAS 9. Industry-standard deployment tools are used rather than the SAS Deployment Wizard.

Figure 3 depicts how a SAS Viya deployment works.

## SAS® Viya™ Deployment



**Figure 3. Ansible-based Deployment Process**

### ANSIBLE INSTALLATION

In a simple multi-machine deployment, the Linux standard Ansible orchestration tool is used to remotely install and configure software. Using an Ansible “playbook”, which is emailed to you with your software order, you map different SAS Viya servers and services to specific machines in your network. Once mapped, Ansible uses SSH to execute installation commands on each of the target machines. These installation commands are Linux standard yum commands, which reach out to a yum repository hosted by SAS and download the associated software as Linux standard rpm packages, which can then be installed locally.

The Ansible controller machine from which you launch your deployment can serve as a target machine to receive SAS software, if you so choose. You can also set up a local “mirror” of the yum repository if your target machines do not have external Internet access.

The Ansible process checks certain system requirements, installs and configures the software, and starts all servers and services. Once this single command completes, you have an operational system. The first post-installation task is typically to hook up your corporate LDAP directory service to your SAS Viya deployment. You do this by using SAS Environment Manager, described in a later section of this paper.

One of the key advantages to the Ansible process is the way in which you download and install SAS software updates. In SAS 9, you downloaded and installed hot fixes and maintenance releases using SAS proprietary utilities such as the SAS Hot Fix Analysis, Download, and Deployment tool (SASHFADD), SAS Download Manager, SAS Deployment Wizard, and SAS Deployment Manager. All these utilities go away with SAS Viya. Instead, you simply rerun your Ansible playbook in order to download and install the rpm packages holding the latest versions of your SAS software components. If you maintain a yum repository mirror, you must first refresh your mirror prior to rerunning Ansible.

### ENCRYPTION

Administrators are invariably concerned with securing their deployment, and encrypting traffic is a key component in any security strategy. Upon completing your install, you can configure your environment to encrypt data, which is transmitted among client and server processes (which is called “data in motion”) as well as data persisted in CAS libraries and tables (which is called “data at rest”).

You can encrypt data in motion for all of the following types of communication in a SAS Viya deployment:

- SAS Studio using HTTPS

- CAS Server Monitor using HTTPS
- Clients to the CAS server using transport layer security (TLS)
- Data Connect Accelerators to the CAS server using TLS
- SAS/CONNECT client to SAS/CONNECT spawner using TLS

The CAS server supports securing data at rest by providing encryption at both the data table level and the level of the containing CAS library. Consult the “Encryption” section of *SAS Viya 3.2 Administration* for details about enabling encryption for data in motion and data at rest.

## ADMINISTRATION

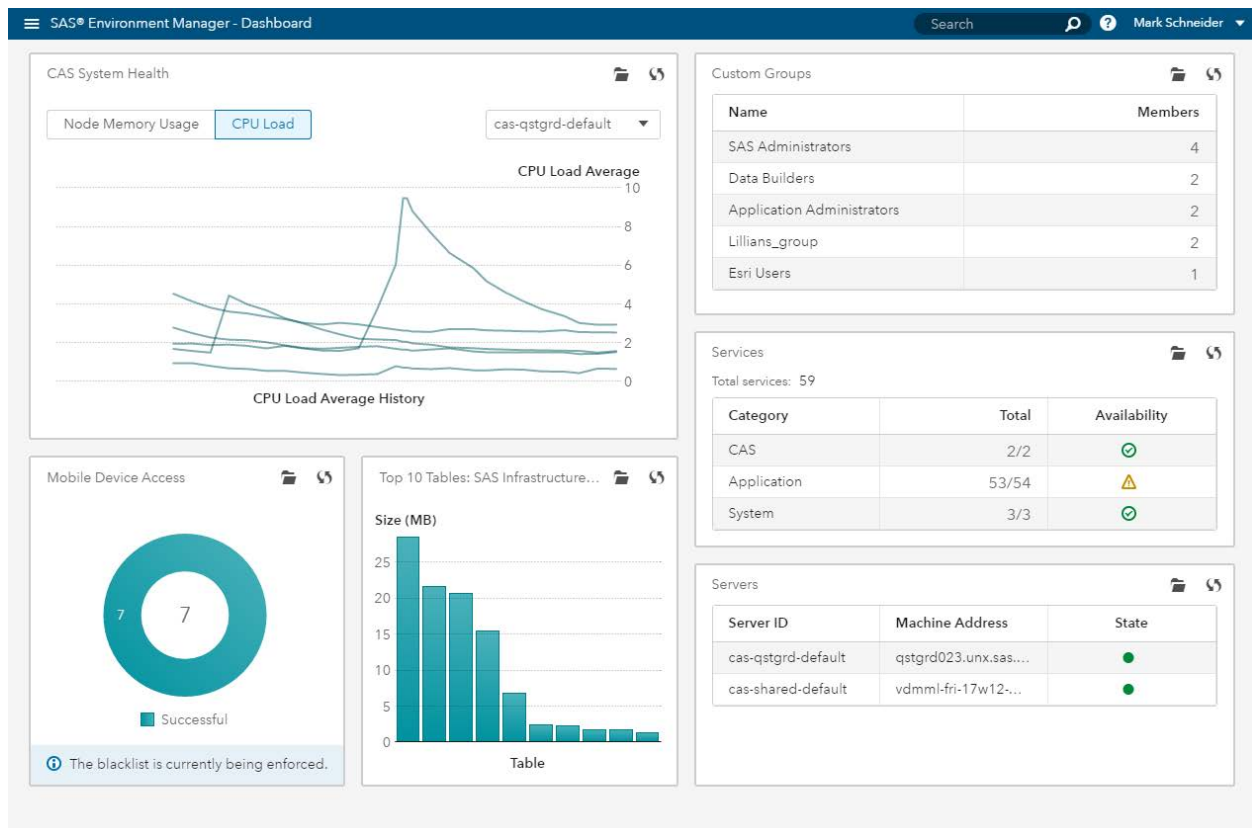
SAS administrators will see dramatic changes in the way they go about managing their SAS Viya environments. While the types of activities performed – such as server management, securing resources, user management, and monitoring – haven’t changed, the way in which you go about these tasks is quite a bit different from SAS 9.

One of the most significant changes is the absence of the SAS Metadata Server. Security information that was previously managed in the SAS Metadata Server is now in the new SAS Infrastructure Data Server, and configuration information is now in the new SAS Configuration Server. Both of these servers are managed using the SAS Environment Manager.

Details on these and other aspects of SAS Viya administration follow.

### SAS ENVIRONMENT MANAGER

The SAS Environment Manager is the primary utility by which you perform various administrative functions. It is the “Monitoring console” in the SAS Viya architecture diagram shown in Figure 2. This web-based application was written from the ground up for SAS Viya, adopting the standard HTML5 interface used by other SAS Viya applications. Figure 4 shows the top-level dashboard for the SAS Environment Manager.



**Figure 4. SAS Environment Manager Dashboard**

The SAS Environment Manager provides control over the following functions.

## Authentication

Authentication is about controlling who can log on to your environment. With SAS Viya, you connect to a preexisting corporate LDAP directory service or Security Assertion Markup Language (SAML) service provider in order to govern user logins. Unlike SAS 9, there is no repository specific to SAS of approved users. Using SAS Environment Manager, you can filter which LDAP user accounts are valid for SAS Viya.

See the “Configure Security” section of the *SAS Viya 3.2 Deployment Guide* for details about connecting to your directory service.

You can manage credentials used to connect to external data sources or Esri, and encryption keys applied to CAS data within the SAS Environment Manager under the **Security → Domains** menu.

## Users and Groups

As mentioned, SAS Viya uses a corporate directory service to specify valid users. User information managed in LDAP is presented in read-only fashion in the SAS Environment Manager interface. This means you can manage your user information in one place – your existing directory service- but you can still see all your information within SAS Environment Manager.

LDAP groups are also conveyed as read-only entities within SAS Environment Manager. This means that you can take advantage of preexisting groups when establishing your SAS Viya security policy. In addition, you can create “custom” groups within SAS Viya that are not reflected in LDAP. SAS Viya is shipped with several predefined custom groups. The groups of particular interest to administrators are:

- **SAS Administrators** – These users can access all tasks in SAS Environment Manager, user content, and application functionality. This group is an “assumable” group, which means that



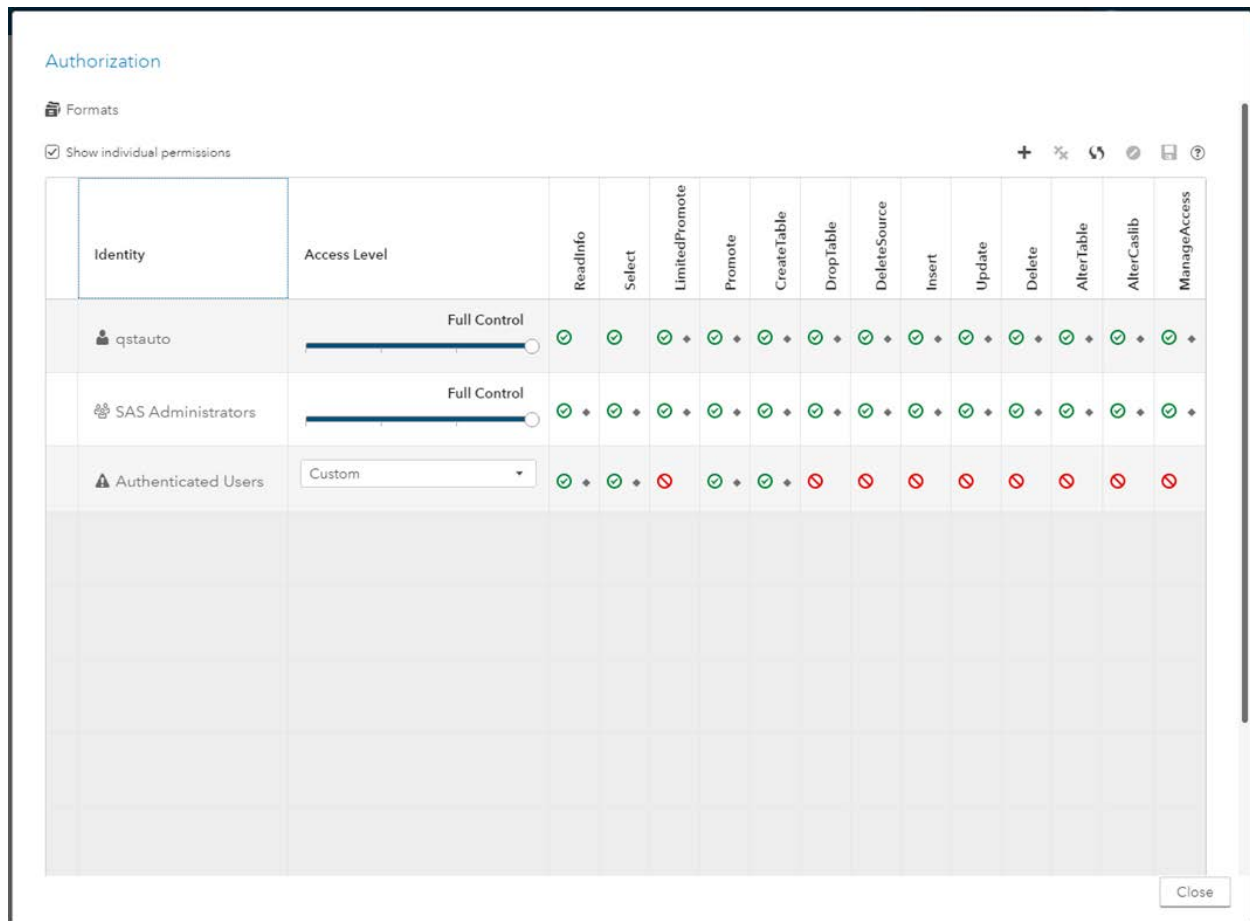
when users belonging to this group log on, they are asked whether they want to “assume” the extra permissions associated with this group. Using assumable groups is a preventative measure to ensure that group members don’t inadvertently execute unintended privileged tasks.

- Application Administrators – These users can manage application-specific administrative functions such as defining web themes and dictating the functions that appear for all users in the SAS Home top-level dashboard.
- Data Builders – These users have access to the SAS Visual Data Builder application.
- Esri Users – These users can access Esri systems for geographic map information.

## Authorization

In SAS Viya, you can authorize users or groups to access data, user content, or application functionality. You can also authorize which mobile devices have access to the environment. Each of the arrows in the SAS Viya Architecture diagram in Figure 2 represents an access point subject to authorization.

To specify the authorization of a user or group for data, you use the SAS Environment Manager’s Data menu to display the data being managed by the CAS server. If you select a particular library or table, you can choose to display the authorization settings related to the data. Figure 5 shows a typical Authorization window.



**Figure 5. Authorization Window**

Permissions can be assigned at a coarse level by using the Access Level slider (Full Control, Write, Read, No Access) or at a granular level (ReadInfo, Select, LimitedPromote, and so on). The granular level controls are specifically designed using terms a database administrator (DBA) is likely to understand.



A similar window is used when you set permissions on SAS Viya user content such as folders, reports, and jobs, although there are fewer permission values (Read, Update, Delete, Secure, Add, and Remove). Because user content is managed in a hierarchical folder structure, you can choose to have permissions conveyed to child members of a folder.

A more advanced type of authorization is surfaced in the form of rules. You can use the **Security → Rules** menu in SAS Environment Manager to control user access to functionality within SAS Viya (for example, controlling who has the ability to back up and restore your environment). You can also use rules to specify conditions on access to objects. For example, you can limit access to a particular report to certain times of the day.

Finally, you can authorize which mobile devices can connect to SAS Viya via the **Security → Mobile Devices** menu in SAS Environment Manager. You can either set up a blacklist of disallowed devices, or a whitelist of permitted devices.

## Configuration

Most SAS Viya configuration occurs automatically when you deploy your software. However, there are times when an administrator needs to adjust certain parameters related to the services running in their environment (which are the "Microservices", the "In-Memory Engine", and the "Microservice resources" in Figure 2). Examples include:

- LDAP settings – See description in the Authentication section
- Memory allocation
- Time-out values
- Logging levels – See description in the Logging section
- Esri map service location

You adjust service configuration settings under the **Resources → Configuration** menu of SAS Environment Manager. The configuration settings for a particular service are stored in a collection of "configuration instances." Each configuration instance is created from a parent "configuration definition," and comprises a collection of name-value pairs used by the service. This approach allows many services to share configuration instances from the same configuration definition.

## Data

At the heart of any SAS Viya deployment is the data that is maintained in the CAS server (the "In-Memory Engine" in Figure 2). CAS tables are distributed across the memory space of a CAS server's worker nodes, allowing for high-performance distributed processing. The CAS server also allocates "spillover" disk space, which is used for unused blocks of CAS tables in order to provide a larger virtual memory footprint. This spillover space is invisible to the file system outside of CAS, so no other processes can gain access to these data blocks. Administrators can disable the spillover feature, but it is on by default because the underlying algorithm is optimized to not hamper performance.

CAS tables are organized into CAS-specific libraries, or "caslibs." A caslib defines both a source location from whence data is loaded (such as a directory path accessible to the CAS server or a Hadoop location) and a location within the CAS server where the data is accessed once loaded. Caslibs can either be isolated to a particular user's running session (session scope) or shared with other users of the CAS server (global scope).

The SAS Environment Manager **Data** menu allows an administrator to view all global scope caslibs and their contained tables. Figure 6 shows a listing of all the tables within a caslib. The **State** column indicates whether a table is loaded into memory within the CAS server.

SAS® Environment Manager - Data				
<div> <div>Library: AppData</div> <div>Filter by: Table</div> <div>Filter</div> </div>				
Table	State	Source Table Name	Row Count	Column Count
ATTRLOOKUP	●	attrlookup.sashdat	3,476	13
CENTLOOKUP	●	centlookup.sashdat	3,476	4
VAAFRICA	■	vaafrica.sashdat		
VAAFRICA1	■	vaafrica1.sashdat		
VAANTARCTICA	■	vaantarctica.sashdat		
VAANTARCTICA1	●	vaantarctica1.sashdat	3,925	6
VAASIA	■	vaasia.sashdat		
VAASIA1	■	vaasia1.sashdat		
VAEUROPE	●	vaeurope.sashdat	64,208	6
VAEUROPE1	■	vaeurope1.sashdat		
VANAMERICA	●	vanamerica.sashdat	98,647	6
VANAMERICA1	●	vanamerica1.sashdat	119,996	6
VAOCEANIA	■	vaoceania.sashdat		
VAOCEANIA1	■	vaoceania1.sashdat		
VASAMERICA	■	vasamerica.sashdat		
VASAMERICA1	●	vasamerica1.sashdat	101,685	6
VAWORLD	●	vaworld.sashdat	123,130	6
ZIPCODE	●	zipcode.sashdat	41,166	21
Count: 18				

**Figure 6. Data Tables in a Caslib**

You can set permissions on tables in a caslib by using the Authorization window, which is available from this listing and shown in Figure 5. Although members of the SAS Administrators custom group have access to all content and functionality within SAS Environment Manager, they do not necessarily have access to all CAS data. Such universal data access is granted to a CAS server “Superuser.” By default, the SAS Administrators custom group is added to the list of users who are able to assume the Superuser role. As a precaution, SAS Environment Manager users who opt in to the SAS Administrators assumable group at login (see a description of assumable groups in the Users and Groups section of this paper) do not by default assume the Superuser role. They must do so explicitly by going to the associated CAS server in the list of servers under the **Data** menu, and choosing to “Assume the Superuser role.”

## User Content

Users of SAS Viya applications like SAS Visual Analytics can save their content in a folder structure. This content is maintained in the “User Content database” shown under Microservice resources in Figure 2. When a user first logs in, the system automatically creates a personal folder for the user. They can then create their own folder structure underneath this folder and store reports, plans, and other content within the structure. They can define this folder structure either in SAS Environment Manager or in client applications such as SAS Visual Analytics.

As an administrator, you can view the entire folder structure and its contents under the **Content** menu of SAS Environment Manager. From here, you can set permissions on individual objects or their containing folders in order to share them with others.

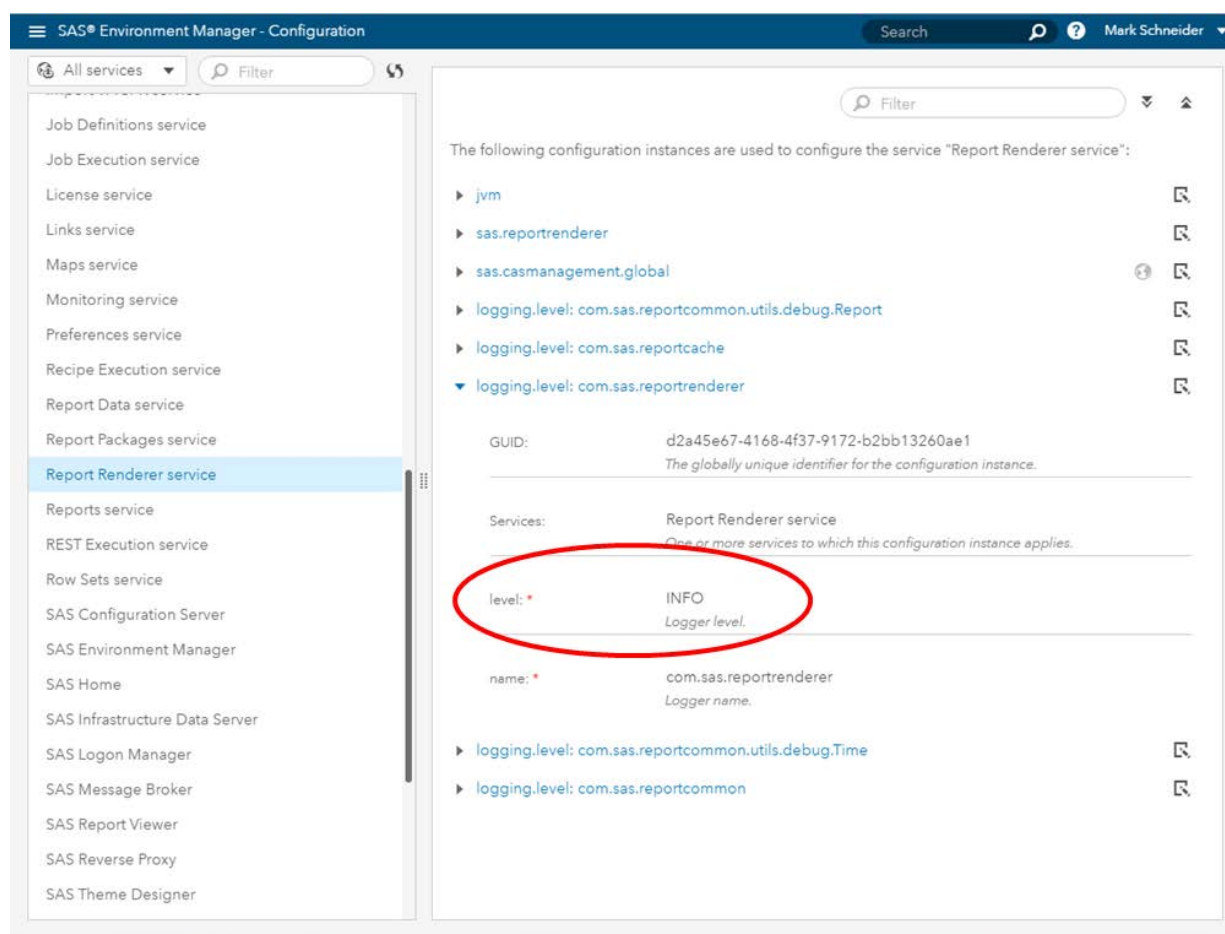
## Logging

All of the servers and services in a SAS Viya environment produce log files, which are stored in the following location:

`/opt/sas/<deployment_name>/config/var/log/<productName>`

where `<deployment_name>` is a unique identifier (typically something like “viya”) assigned at deployment time in order to differentiate one SAS Viya deployment from another on the same machine. For convenience, the deployment process creates a symlink from `/var/log/sas/viya` to the above directory structure so that you can access your SAS Viya logs alongside other software logs on your system.

Logging threshold levels for services are set using the **Resources** → **Configuration** menu of SAS Environment Manager. Figure 7 shows the window used to view and set the logging level for a service, in this case the one used for rendering reports. From here, you can dynamically adjust the amount of detail a particular service writes to its log. For example, you might want to increase the logging level to DEBUG while diagnosing a problem with a service. There is no need to restart a service in order to pick up this change.



**Figure 7. Logging Level for Report Renderer Service**

SAS Viya environments include a collection of servers whose logging levels and content are controlled in the same way as they were in SAS 9 – with corresponding logconfig.xml files, which specify “loggers” and “appenders.” These servers include the CAS server, the SAS workspace server, and the SAS/CONNECT server.

## Monitoring

As shown earlier (Figure 4), the SAS Environment Manager dashboard provides a top-level view of several health indicators related to your environment. From it, you can view the following indicators:

- Memory and CPU usage for all CAS server nodes
- Mobile devices that have accessed or attempted to access your environment
- The SAS Infrastructure Data Server database size
- The most heavily-populated custom groups
- Service availability
- Server status

The dashboard provides a snapshot of the latest information, and is refreshed dynamically.

Many other health and performance metrics are available for viewing, and can be found under the **Resources → Machines and Services** windows. You can view metrics associated with a machine in your environment, or drill down to a specific service instance running on a machine and view its metrics. You can also view individual CAS sessions by drilling to their parent CAS service instance.

Additional monitoring capabilities are available via the CAS Server Monitor and Grid Monitor utilities, which are described in the “Monitoring” section of *SAS Viya 3.2 Administration*.

## COMMAND-LINE INTERFACE

While you can accomplish many administrative tasks through the SAS Environment Manager interface, some tasks are currently only available by executing commands from an operating system console or in a batch script. SAS Viya provides a standard CLI (command-line interface) as well as REST API support for many of its features, including administrative tasks. You can find a full description of the standard CLI syntax in the “Using the Command-Line Interface” section of *SAS Viya 3.2 Administration*.

Two specific areas of administration that are currently isolated to command-line access are backing up your environment, and promoting content from one environment to another. Backups use REST APIs, while content promotion uses the standard SAS Viya CLI syntax. These are described below.

### Backup and Restore

Prior to executing SAS Viya environment backups, you must specify your backup vault location within the **Resources → Configuration** window in SAS Environment Manager. There are other configuration settings you can adjust here, including a backup job time-out value and the retention period for backups stored in your vault.

Because you use REST API calls to execute SAS Viya backups and restores, it is convenient to use the Linux “curl” command as a wrapper for the calls. The following command is a template for such a call:

```
curl -X POST <Header including identity information> \  
      <Execution Options> \  
      <URI for the backup API>
```

You would substitute values for fields in angle brackets (<>). “URI” is the Uniform Resource Identifier, which uniquely identifies the backup RESTful interface resource.

When you run a backup, the associated files are first stored locally on the machines where the data resides. The backup files are then automatically transferred to the aforementioned central backup vault. If any portion of the backup fails, whether it be because of an unresponsive data source, an inability to store backup files locally, or a problem with transferring the files to the vault, the entire backup is considered to have failed and must be rerun.

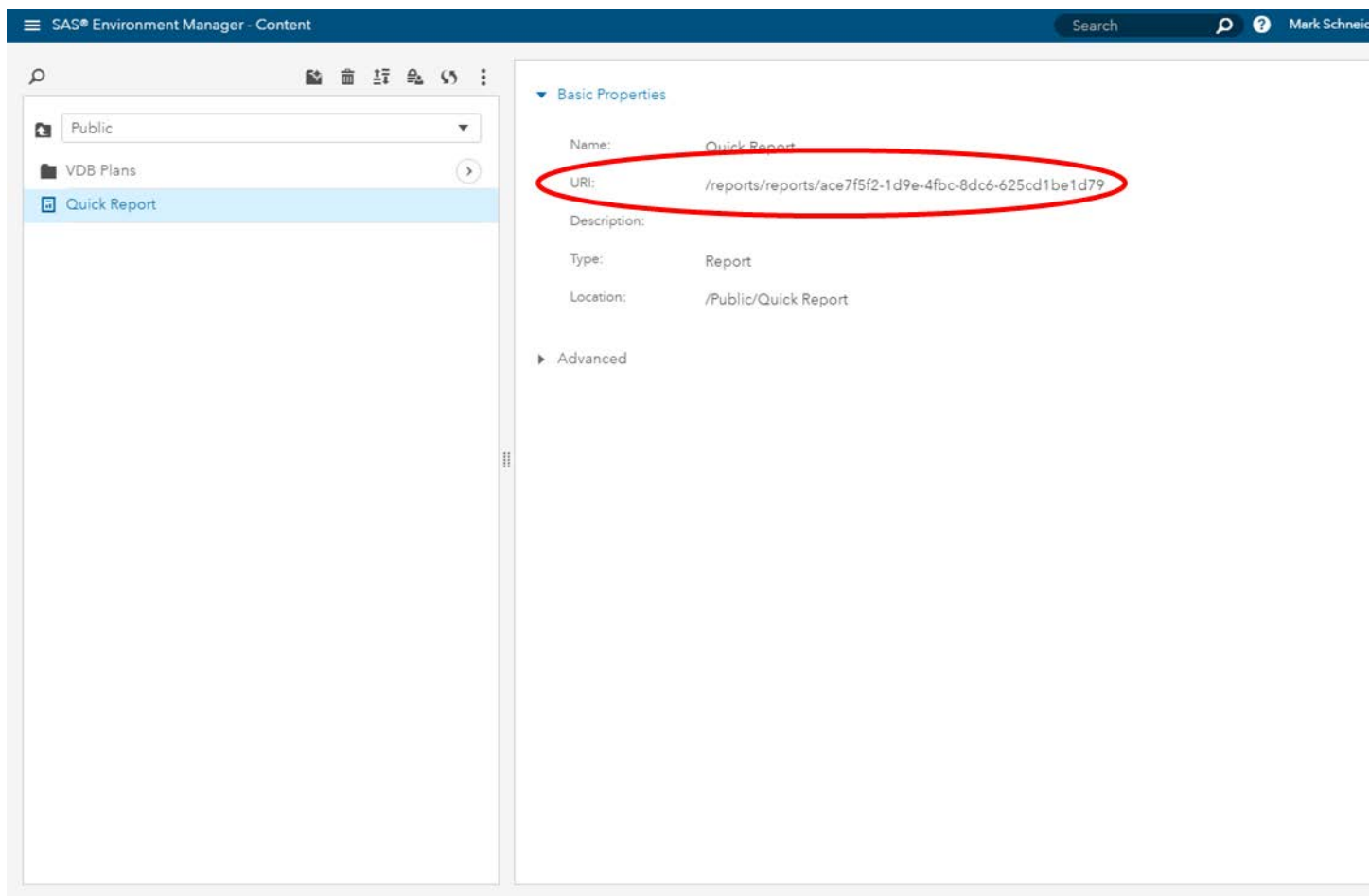
For more details about SAS Viya backup and restore functionality, please consult the “Backup and Recovery” section of *SAS Viya 3.2 Administration*.

## Content Promotion

You can transfer content from one SAS Viya deployment to another. You can also transfer select content (for example, SAS Visual Analytics reports) from a SAS 9.4 deployment to a SAS Viya deployment. Both tasks leverage the `sas-transfer` command-line interface. You download this interface to a client machine by accessing its URL in a browser. For example, on Linux, the URL would be:

```
<SAS_Viya_URL>/transfer/cli/linux/sas-transfer
```

You first need to determine the Uniform Resource Identifier (URI) of the content you want to promote using the `sas-transfer` command. You can easily discover the URI by navigating to the containing folder under the **Content** menu of SAS Environment Manager and selecting the item you want to transfer. Figure 8 shows the selection of a report in the Public folder (the one in which all authenticated SAS Viya users are allowed to store content by default).



**Figure 8. URI of Report in Public Folder**

After you determine the URI, you can execute commands to authenticate to your source SAS Viya environment and create a promotion package. You then authenticate to your target SAS Viya environment and import the package. An example of a typical SAS Viya command that creates a promotion package follows:

```
sas-transfer --profile SourceViya export \  
--resourceUri "<URI_from_SAS_Environment_Manager>" \  
--name "My Promotion Package"
```

See the “Promotion (Import and Export)” section of *SAS Viya 3.2 Administration* for more details about content promotion.

## CONCLUSION

With its unified, open, adaptable, and powerful capabilities, SAS Viya brings a lot of additional value to your organization. With that value come new techniques to plan, deploy, and administer your environment. In many cases, those techniques are simplified when compared to SAS 9. These include deployments orchestrated by Ansible, LDAP integration for user management, and dynamic updates of system settings like logging levels. Investing time in learning the new architecture, and the tools that manage it, will pay off in time savings and increased uptime – two things that are always at a premium for SAS administrators.

## RESOURCES

- SAS Institute Inc. 2017. *SAS Viya 3.2 Administration*. Cary NC: SAS Institute Inc. Available at <http://support.sas.com/documentation/productaz/index.html#v>
- SAS Institute Inc. 2017. *SAS Viya 3.2 Deployment Guide*. Cary NC: SAS Institute Inc. Available at <http://support.sas.com/documentation/productaz/index.html#v>

## CONTACT INFORMATION

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