The Architecture and Security of SAS® Marketing Operations Management
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Introduction

This white paper describes the architecture of SAS Marketing Operations Management and various aspects of its deployment and security. The information in this paper is valid for version 6.5. For earlier versions of the product, refer to the earlier version of this paper. The following areas are covered:

- High-level architecture overview.
- Architectural components.
- Ecosystem.
- Virtualization.
- Deployment options.
- Deployment best practices.
- Security.

This paper is intended for those involved in purchasing, selling and implementing SAS Marketing Operations Management, including system administrators and anyone seeking an understanding of the solution's architecture and security.

High-Level Architecture Overview

SAS Marketing Operations Management’s architecture includes the following highlights:

- A web-based, multitier marketing solution.
- An intuitive and interactive AJAX-based user interface that can be extended easily.
- Use of common user-interface (UI) widgets, application services, marketing processes and marketing information models. Extensible and configurable information and process models.
- An XPDL-standard-compliant marketing process engine.
- A star schema-based rich marketing information model.
- A service oriented architecture.

SAS Marketing Operations Management is an efficient, effective enterprise marketing solution that uses advanced software and networking technologies. It is a web-based solution that enables marketing professionals to automate and streamline their marketing operations and processes. SAS Marketing Operations Management has an n-tier architecture. Its well-defined, comprehensive web-service interface implements the business logic necessary for a robust and scalable marketing operations management solution.

SAS Marketing Operations Management has a rich user interface framework that includes a comprehensive library of forms, custom controls and widgets to help quickly develop customer need-based user interface screens. All modules are built using this framework to ensure a consistent user experience. The framework-based approach gives users the flexibility to customize the existing user interface according to their specific needs.
At its core, SAS Marketing Operations Management offers powerful information and process management capabilities. Its unique data model represents marketing data in terms of entity and facet objects. It has a unique way of retrieving, adding and updating marketing data to and from the database, which enhances its performance and scalability.

Process modeling is based on the Workflow Management Coalition (WfMC) approved XPDL standards (wfmc.org/standards/xpdl) for representing processes, and it allows integration with various business process modeling or business process execution language tools or software.

The solution’s Process Designer module enables administrative users to define marketing workflow processes based on business process modeling notation (BPMN). Users can also define processes using any software based on BPMN modeling and then import those processes into SAS Marketing Operations Management via the Process Designer.

SAS Marketing Operations Management components have been separated into appropriate n-tier architecture to provide maximum flexibility in terms of configuration and scalability. The solution’s components use industry-standard platforms and internet technologies.
SAS® Marketing Operations Management Foundation

SAS Marketing Operations Management Foundation provides the common infrastructure, application services and configuration tools for all modules within SAS Marketing Operations Management.

SAS Marketing Operations Management Foundation includes:

- Marketing information management.
- Marketing process management.
- Web services.
- Applications framework.
- Modules.

Marketing Information Management

The marketing information object model includes more than 150 predefined marketing entities (plans, activities, budgets, resources, estimates, vendors, digital assets, etc.). Its key features are:

- A highly scalable and flexible star schema database.
- Configurable relationships between marketing entities without requiring any development effort.
- Configurable extension of the schema by association of customer-specific metadata, called facets.
- Support for hierarchical lookup values.
- An operational data store for ad hoc reporting functionalities.
Marketing Process Management

The marketing process management engine includes predefined representation of almost every marketing workflow task (plan approval, project execution and multiple project type configurations, such as product launch, packaging and promotions design, etc.). Its key features are:

- Compliance with WfMC standard XPDL format for defining marketing processes.
- Industry standard BPMN graphical process notation.
- Support for hierarchical process definition and process dependencies.
- Support for manual and automated process initiations.
- Support for predefined task types based on standard marketing processes.
- Support for human resource management.

Web Services

The SAS Marketing Operations Management web services implement all the business logic required by marketing operations management solutions. Web services are used to implement a highly modular, service-oriented architecture.

Applications Framework

The SAS Marketing Operations Management applications framework includes the following:

- **Process designer** - Enables client-specific configuration of marketing processes.
- **User interface designer** - Enables easy creation and extension of user interfaces and provides consistent user interactions for all marketing solutions.
- **Widgets** - Includes commonly used UI objects required for implementing complex marketing functionality for consistent usage across all modules within SAS Marketing Operations Management (e.g., approvals, discussion forums, search, navigation into the digital library).
- **User interface controls** - Includes UI objects that incorporate common user interactions (e.g., search, hierarchical lists, task panes, forms) used by all SAS Marketing Operations Management modules.
SAS® Marketing Operations Management Modules

SAS Marketing Operations Management is built on SAS Marketing Operations Management Foundation and includes several modules, each focused on a well-defined marketing operation. The following modules are included:

- Dashboard.
- Calendars.
- Strategic Planner.
- Offer Management.
- Marketing Workbench.
- Resource Management.
- Approvals.
- Product Information Management.
- Digital Asset Manager.
- Claims Management.
- Knowledge Manager.
- Site Builder.
- Artwork Producer.
- Time Sheets.
- Reports.

Architectural Components

![Architectural Components Diagram]

Figure 3: Architectural components of SAS Marketing Operations Management.

Web Server

The web server hosts the SAS Marketing Operations Management suite. Users have access to the web server via internet or intranet, depending on the deployment.

Cataloger

The cataloger is responsible for importing digital assets into the SAS Marketing Operations Management system. Multiple catalogers can be deployed to manage uploading large volumes of digital assets. The cataloger distinguishes between single and batch file uploads and reduces upload waiting time for users.

Application Server

The application server hosts the web services belonging to SAS Marketing Operations Management Foundation.
Media Server

The media server is an optional component for a standard SAS Marketing Operations Management installation. It is an essential component for a digital asset management-centric deployment. If more than 500 assets or assets greater than 5GB are uploaded or downloaded per month, the deployment could be defined as digital asset management-centric.

The media server hosts the digital asset repository to store digital content. It facilitates faster downloads due to fewer machine hops. It also facilitates the downloading of large files without hampering system usage.

Media Generator

The media generator is an advanced and dedicated component responsible for high-volume processing of assets. It is responsible for generating previews, thumbnails and various renditions of the digital assets.

Media Processor for FLV Generator

This media processor is responsible for FLV preview generation for video files to allow annotations.

Media Processor for InDesign

This media processor is responsible for artwork generation using Adobe InDesign.

Office Processor

The office processor is installed on a Microsoft Office server and is essential for generating previews and thumbnails of Microsoft Office files. It also helps with the processing required to consolidate comments made on Microsoft Office files routed for approval.

Platform and Technology

SAS Marketing Operations Management is based on the following industry-standard platforms and technologies:

Operating System

SAS Marketing Operations Management is supported on Microsoft Windows Server 2008 R2 SP1 Standard (64-bit) and Microsoft Windows Server 2012 R2. Microsoft Internet Information Server (IIS) is used as the application server.

Database

SAS Marketing Operations Management stores all structured data and metadata related to digital content and collaborative workflows in a relational database management system (RDBMS). Currently, the Standard and Enterprise editions of Microsoft SQL Server 2008 R2, Microsoft SQL Server 2012 SP3 and Microsoft SQL Server 2014 SP1 are the only supported databases. The database can be accessed using the .NET data providers.
Internet Technology
This layer contains software that enables users to interact with SAS Marketing Operations Management components across the internet or intranet. This includes:

- SMTP servers for email notifications.
- Secure FTP server for file transfers for cataloging or remote downloads.
- Microsoft IIS for communicating with users via HTTP or HTTPS.

Adobe Acrobat and Microsoft Office
Adobe PDF versions X and XI (professional, reader) and Microsoft Office 2010 and 2013 (Office Standard/Professional 64-bit version) files can be routed, reviewed and approved using the web browser.

.NET Framework, ASP.NET, MTOM, AJAX and Flex
The multiuser and transaction-oriented data access and business logic components of SAS Marketing Operations Management are implemented on .NET Framework and ASP.NET. The user interface is developed using ASP.NET and AJAX. A rich graphical user interface, including dashboards, has been developed using Flex.

SAS Marketing Operations Management uses the standard message transmission optimization mechanism (MTOM) protocol to transfer files across the application server and web server tiers.

Use of a limited number of proven, industry-standard platforms and technologies provides a controlled environment for the application framework, which simplifies implementation and maintenance while enhancing robustness.

Versions of Platform Technology
SAS Marketing Operations Management is based on Microsoft technologies. Please note, however, that the software and hardware versions listed in the table below are subject to change with newer versions of SAS Marketing Operations Management. To ensure that you have the most current list, please refer to the SAS Marketing Operations Management installation document that matches the version of the software that you installed from the SAS Support site.

<table>
<thead>
<tr>
<th>Platform</th>
<th>Platform Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server Operating System</td>
<td>Microsoft Windows Server 2008 R2 SP1 Standard (64-bit) and Microsoft Windows Server 2012 R2.</td>
</tr>
<tr>
<td>.NET Framework</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Database
SAS Marketing Operations Management currently supports Microsoft SQL Server 2008 R2, Microsoft SQL Server 2012 SP3 and Microsoft SQL Server 2014 SP1 (Standard and Enterprise Edition). The architecture allows the system to be ported to a new database by adding a database-specific query processor in the data access layer.
Third-Party Software

SAS Marketing Operations Management requires certain third-party software for the Dashboards, Desktop Cataloger, Artwork Producer and Approvals functionality. A detailed list of software and hardware requirements is provided in the next section.

Software and Hardware Requirements

Software Requirements

Please note: The architecture described in this paper is valid for SAS Marketing Operations Management 6.5 (current version at the time of publication).

Prior to purchase of SAS Marketing Operations Management, refer to the admin/install guide for a comprehensive list of software requirements.
<table>
<thead>
<tr>
<th>Software</th>
<th>License Required / Freely Downloadable / Redistributed</th>
<th>Application Server</th>
<th>Web Server</th>
<th>Cataloger</th>
<th>Media Server</th>
<th>Database Server</th>
<th>Media Processor for InDesign</th>
<th>MS Office Server</th>
<th>Media Generator</th>
<th>Media Processor for FLV Generator</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows Server 2008 R2 SP1 (64 Bit) or Windows Server 2012 R2</td>
<td>License required to be purchased by customer</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>(for 2008 R2 only)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Operating system</td>
</tr>
<tr>
<td>IIS 7.5 on Windows 2008 R2 SP1 or IIS 8.5 on Windows Server 2012 R2</td>
<td>Comes with Windows server</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Web server</td>
</tr>
<tr>
<td>MSMQ v6.3.9600.16384 for Windows Server 2012, or MSMQ v6.1.7600.16385 for Windows Server 2008</td>
<td>Comes with Windows server</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Used for sending messages via queues by all modules in MOM</td>
</tr>
<tr>
<td>.NET Framework 4.6 (needs to be manually installed on Windows Server 2008 R2 SP1 and Windows 2012 R2)</td>
<td>Freely downloadable</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>.NET required by application</td>
</tr>
<tr>
<td>MSXML 4.0 SP3 Parser (msxml 4.0 SP3.msi)</td>
<td>Freely downloadable</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Required for XML processing, Used by all modules</td>
</tr>
<tr>
<td>Microsoft SQL Server System CLR Types (x64) (SQLSysClrTypes.msi)</td>
<td>Redistributed via the CI clearing house as a part of packaged prerequisite software required to be installed before installing Marketing Operations Management 6.5 ZIP file</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
<td>Executing DB script files</td>
</tr>
<tr>
<td>Microsoft SQL Server 2008 R2 Management Objects (x64)</td>
<td>Redistributed via the CI clearing house as a part of packaged prerequisite software required to be installed before installing Marketing Operations Management 6.5 ZIP file</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
<td>Executing DB script files</td>
</tr>
<tr>
<td>Access Database Engine x64 2010 (Version 14.0.4763.1000)</td>
<td>Redistributed via the SAS Marketing Operations Management package</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
<td>Reading Excel using OLE DB</td>
</tr>
<tr>
<td>Microsoft WSE 3.0 (Microsoft WSE 3.0.msi)</td>
<td>Redistributed via the SAS Marketing Operations Management package</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Used to transfer binary files across machines. Used by application server and web services. Used for encryption and decryption of database connection strings, passwords, and URL parameters</td>
</tr>
<tr>
<td>Microsoft SQL Server 2008 R2 or SQL Server 2012 SP3 or SQL Server 2014 SP1 (Standard Edition / Enterprise Edition) (STANDARD...)</td>
<td>License required to be purchased by customer</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
<td>Used by the database for SAS Marketing Operations Management</td>
</tr>
<tr>
<td>Adobe Acrobat X and XI Professional Edition</td>
<td>License required to be purchased by customer</td>
<td>Y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
<td>Adobe Acrobat is required on the Microsoft Office Processor. (Note: If SAS Marketing Operations Management Media annotations is not used for approvals, a per-user Adobe License for all users of approvals should be purchased.)</td>
</tr>
</tbody>
</table>
### User Machine Requirements

Users interact with SAS Marketing Operations Management through web browsers, mail clients and Secure FTP clients. Users do not have to install any proprietary or “fat client” software on their desktops.

- **Windows**: Microsoft Windows 7 or Microsoft Windows 8
- **Macintosh**: OSX 10.9 Mavericks
- **Browsers**: Internet Explorer 9.0 or later (Windows 32- and 64-bit), Firefox 12.0 or later (Windows 64-bit), Google Chrome 15.0 or later (Windows 64-bit) or Safari 5.1.5 or later (Macintosh).

  Note: Disable the pop-up blocker on the browsers that you use for SAS Marketing Operations Management.

- **Adobe Acrobat X or XI Professional, Standard, or Reader**: For offline approvals.
- **Microsoft Office 2010 or 2013**: For opening office documents (reports) and adding comments to Microsoft Word and Microsoft Excel documents during approval.
- **Adobe Flash Player 11.1 or later**: For viewing the dashboard channels, media annotations, resource manager and artwork producer, and so on.
Hardware Requirements

<table>
<thead>
<tr>
<th>Architectural Component</th>
<th>Minimum Storage Requirement</th>
<th>Minimum Hardware Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Server</td>
<td>150GB scalable</td>
<td>Quad-core processor 8GB of RAM</td>
</tr>
<tr>
<td>Web Server</td>
<td>100GB</td>
<td>Quad-core processor 8GB of RAM</td>
</tr>
<tr>
<td>Media Server</td>
<td>500GB scalable to 1TB</td>
<td>Quad-core processor 8GB of RAM</td>
</tr>
<tr>
<td>Media Generator</td>
<td>100GB</td>
<td>Quad-core processor 8GB of RAM</td>
</tr>
<tr>
<td>Cataloger</td>
<td>100GB</td>
<td>Quad-core processor 8GB of RAM</td>
</tr>
<tr>
<td>Media Processor</td>
<td>100GB</td>
<td>Quad-core processor 8GB of RAM</td>
</tr>
</tbody>
</table>

Here are some recommendations to consider while determining the configuration for a specific deployment:

1. The requirements mentioned above are generic product requirements. For specific customer requirements, please contact the SAS Marketing Operations Management Sizing Team (EEC department).

2. The above table gives the minimum hardware requirements for each of the servers. If multiple components are being deployed on the same machine, a more robust hardware configuration is recommended.

3. A database server (for SQL Server on Windows) is required. However, SAS does not have specific recommendations for this server or the database size.

4. The server where the file system resides needs to have a higher storage capacity. In the above table, the media server is shown as a high-storage configuration. In the case where a media server is not set up, the application server needs a high-storage configuration and must be scalable.

5. An improved hardware configuration is recommended for servers where large media processing happens, such as the cataloger, media processor and media generator.
Deployment

SAS Marketing Operations Management may be deployed on-site, in a SaaS environment (hosted by SAS) or, beginning this version, in an Amazon Cloud environment. The SAS Marketing Operations Management architecture facilitates the deployment of each architectural component on the same machine or separate ones. The deployment choice depends on many factors, including:

- Is it a DAM-centric deployment - i.e., is the system primarily being used to upload and download large numbers of digital assets?
- Is the amount of media processing large - i.e., is the system being used to generate large volumes of artwork?
- Is usage in terms of number of users too high - i.e., will the number of users working concurrently on the system be high?
- Is the system going to be accessed by users outside the network - i.e., are users geographically distributed and working remotely over the web to access the system?

The following section explains some of the typical deployment scenarios and recommendations.

Typical Deployment

A typical deployment of SAS Marketing Operations Management comprises:

- A cataloger on one machine.
- A web server on a separate machine.
- An application server on a separate machine.
- A database server hosting the database.
- A media processor on one machine.

Note: This scenario could vary based on your specific environment, preferred security settings and firewall setups, etc.

For example, in some hosted environments, it is preferred that the web server, media server and catalog server be located on the internal network segment as well. An Apache Server Reverse Web Proxy Farm sits in the DMZ, and a second firewall is set in between the DMZ and the internal network segment.

Figure 5: Typical SAS Marketing Operations Management deployment.
DAM and Media Processing-Centric Deployment

If DAM is being used extensively, and the system is primarily being used to upload and download large numbers of digital assets, the deployment would comprise:

- A media server and cataloger on one machine.
- A web server on one machine.
- An application server on one machine.
- A media processor and media generator on one machine.

Note: This scenario could also vary based on your specific environment and preferred security settings and firewall setups, etc., as mentioned in the previous scenario.

![Diagram showing the setup of different servers and components](image)

Figure 6: A sample virtual machine environment setup.

The above deployment is done on VMWare ESX Server, where two virtual machines have been created, and specific architectural components are deployed on each virtual machine. The capacity planning for each machine is done as per the requirement of the component. SAN or NAS can be used as a common storage area. SAS Marketing Operations Management is completely compatible with VMWare enabled virtualization technology with almost no degradation in performance.
Deployment With SAS® Digital Marketing

If SAS Digital Marketing is set up along with SAS Marketing Operations Management, there are two potential scenarios to consider:

- Both SAS Marketing Operations Management and SAS Digital Marketing are installed on-site. In this case, there is a need to configure an external web server, and the deployment could potentially look like this:

- SAS Marketing Operations Management is installed in a hosted environment, and SAS Digital Marketing is installed on-site. In this case, the deployment could potentially look like this:
Application Security

Besides having a secure architecture, there are a number of security features that SAS Marketing Operations Management has, including:

Account and Password Policies

Only authenticated users are allowed to access the application. In order to make the security of the application more robust, SAS Marketing Operations Management applies the following password policies:

- The minimum number of characters for a password is configurable.
- The maximum number of characters for a password via user interface is 30 characters
- Each password must contain a digit.
- Each password must contain at least one of the following characters: # @ ! $ % ^ ? _
- After a configurable number of failed login attempts, the user account is automatically locked. This deters brute force attacks to hack into user accounts. Auto-unlocking after a configurable duration is supported.

URL and Password Encryption

SAS Marketing Operations Management ensures that all URLs are encrypted using a strong encryption algorithm. This makes it difficult for anyone to interpret the URL data.

Secure Communication Channels

SAS Marketing Operations Management supports secure HTTPS or SSL protocols for communication with the web server, as well as communication to an SMTP server over a secure channel. This ensures the encryption of data that is sent over the wire to deter malicious users from accessing data. In particular, it ensures that credentials entered for authentication are encrypted and not accessible to malicious users by merely intercepting message traffic.

Termination of Abandoned Sessions

SAS Marketing Operations Management users can use sign-out interaction to terminate their sessions. If a user abandons a session by closing a browser window, the session is terminated automatically. This prevents any unauthorized entry from the user’s machine if the user is not present.

Masquerading

SAS Marketing Operations Management detects the use of links copied from one browser and pasted into another, and redirects to the login page in case of such events. This prevents malicious users from masquerading.
Module Access Policy and Security Policy

SAS Marketing Operations Management has a rich way of managing users and classifying them into groups, as well as further classifying groups into subgroups. The administrator can define policies to enable or restrict user or group access to a particular module. Going a step further, the administrator can also enable or restrict interactions a user or group is able to perform within a particular module. Such fine-grain control is essential while working with third-party vendors, and it provides them with only restricted access to the SAS Marketing Operations Management application.

Auditing

Auditing is available as an essential function that helps the administrator keep track of users logging on and off. Auditing is also available for user actions performed in the Digital Asset Management module.