



SAS Viya



An introduction to system
administration with SAS Viya 3.3

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An introduction to system administration with SAS Viya 3.3

Agenda

- SAS Environment Manager for SAS Viya
 - System management and monitoring
- Command-Line Utilities for system administration
 - SAS Viya Operations Infrastructure
 - sas-admin commandline utility
 - SAS Bootstrap Config Tool
- Authentication Options for SAS Viya 3.3
- Integrating SAS Viya and SAS 9 environments
- Multi-Tenancy with SAS Viya



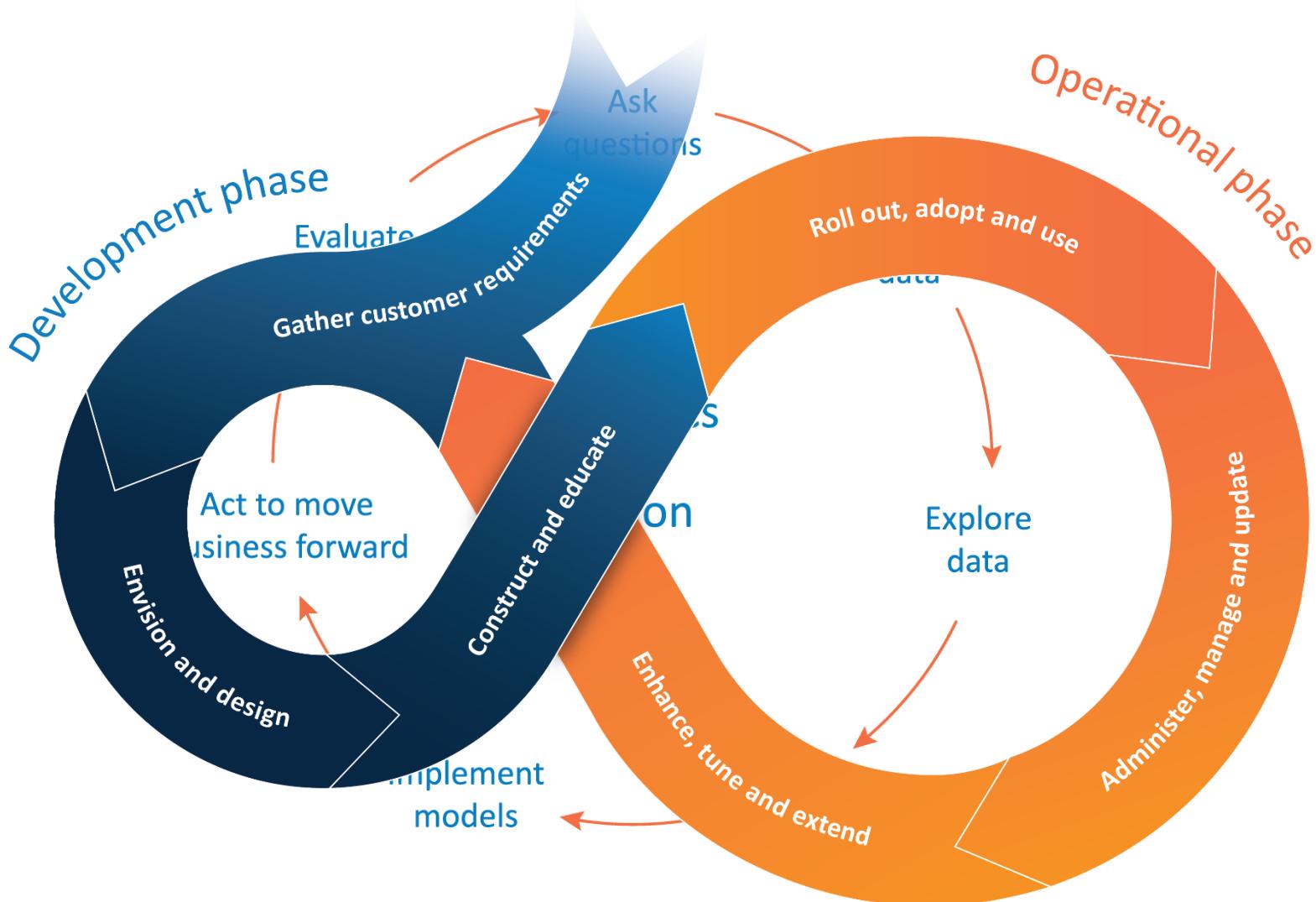
Getting started

SAS Viya 3.3

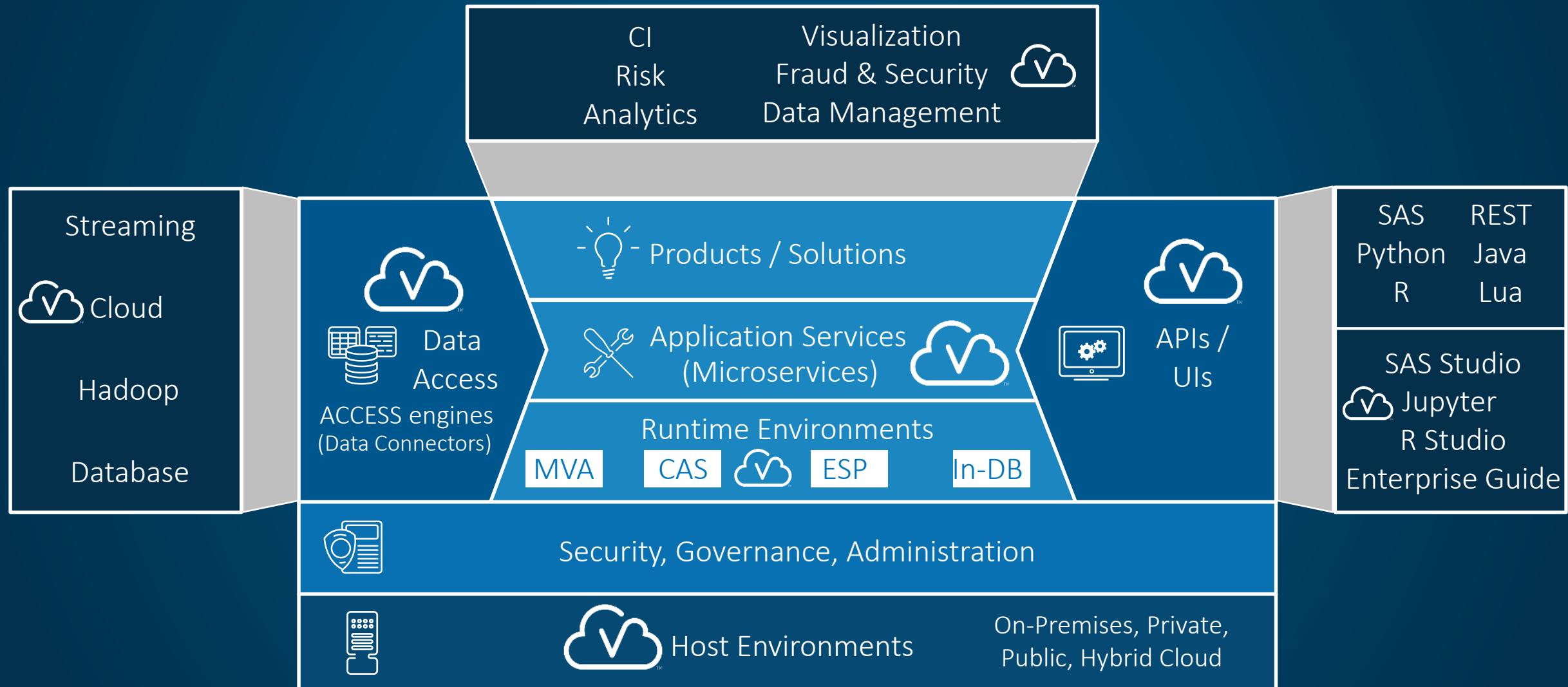


The analytical lifecycle

... is embedded in the administration lifecycle



The SAS Platform Conceptual Architecture



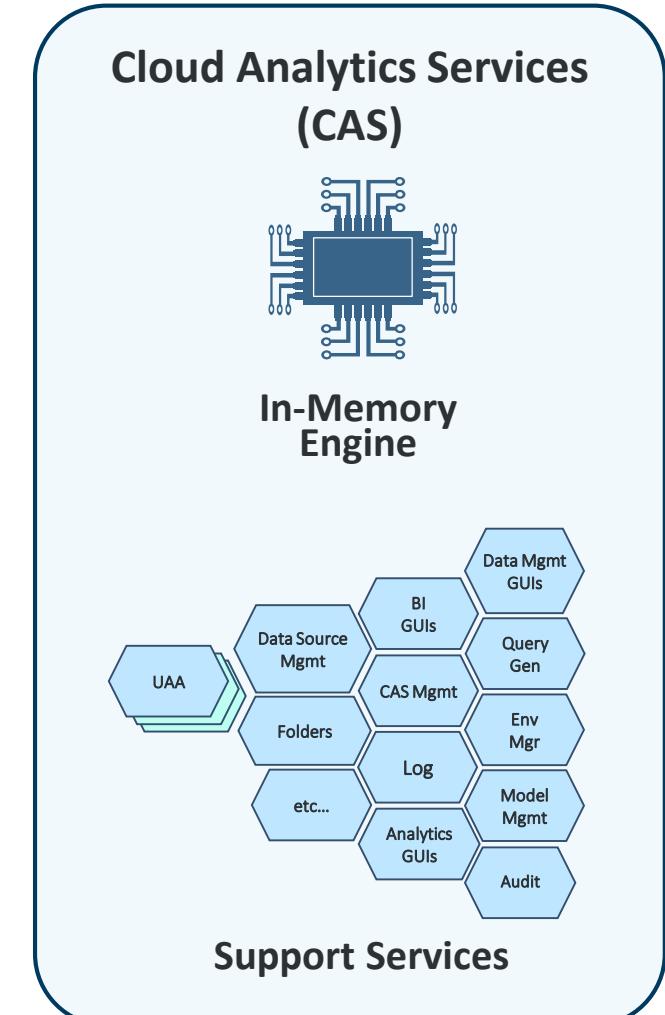
Core components of SAS Viya

„Cloud Analytics Service“ (CAS)

- A distributed in-memory engine designed for advanced analytics
 - And reporting & data preparation as well
 - Might be deployed on a single node as well

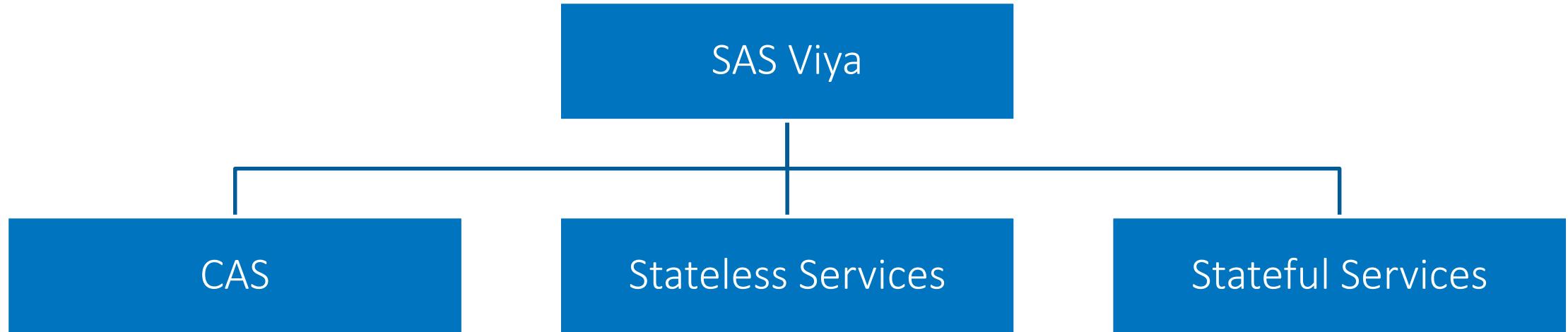
Support Services

- A collection of stateful and stateless services for interacting with the CAS engine
 - Microservices, e.g. access management, logging, administrative tasks
 - Web apps (visual interfaces)
 - Infrastructure services (e.g. SAS Infrastructure Server, SAS Configuration Server, SAS Message Broker)



CAS Server Architecture

Support Services for CAS



Computational engine

Microservices

- Vital to the environment but *not performing analytic functions*
- Act as a *gateway* to the analytics features and functions

Web applications

- Environment Manager
- Visual Analytics ...

Third-party tools

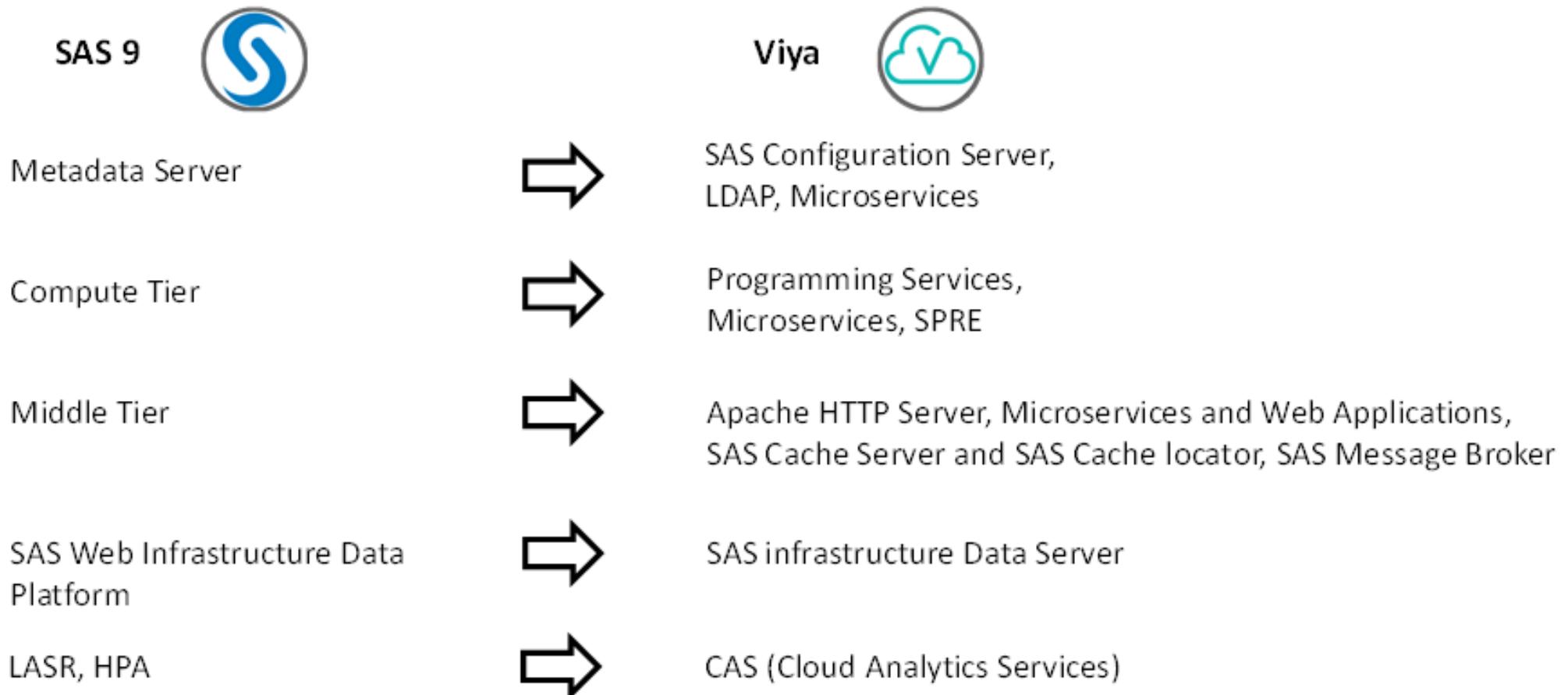
- Data store for configuration data
- Orchestration of Microservices
- Asynchronous communication

Programming backend

- SAS Studio
- SAS Workspace Server

SAS 9.x and SAS Viya

A high-level mapping of components

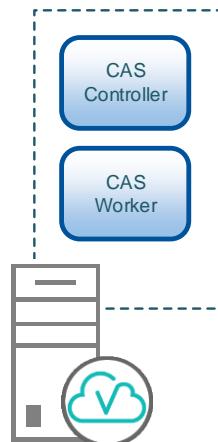


CAS Architecture

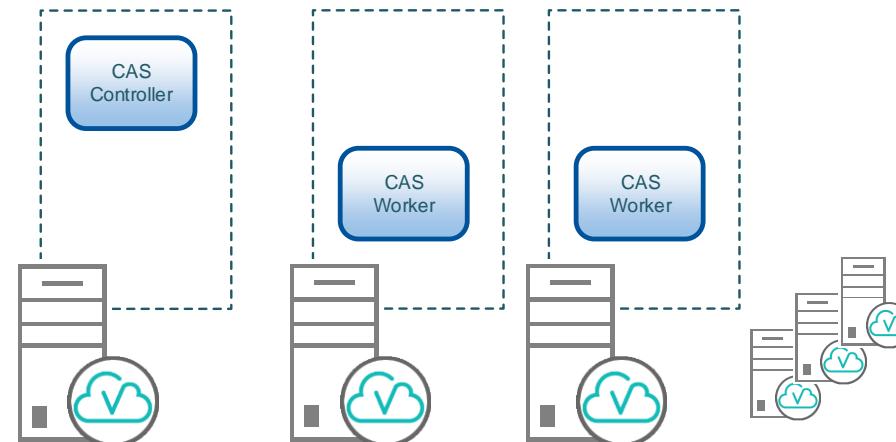
Terms & Roles

Component	Role
CAS Controller	In MPP, the Controller assigns work to the workers and orchestrates the CAS cluster. In SMP, Controller also acts as the Worker.
CAS Worker	Execution engine on every non-Controller node. Operates on blocks of in-memory data per the Controller's instructions.

SMP („Symmetrical Multi-
Processing“) a.k.a. „non-distributed“



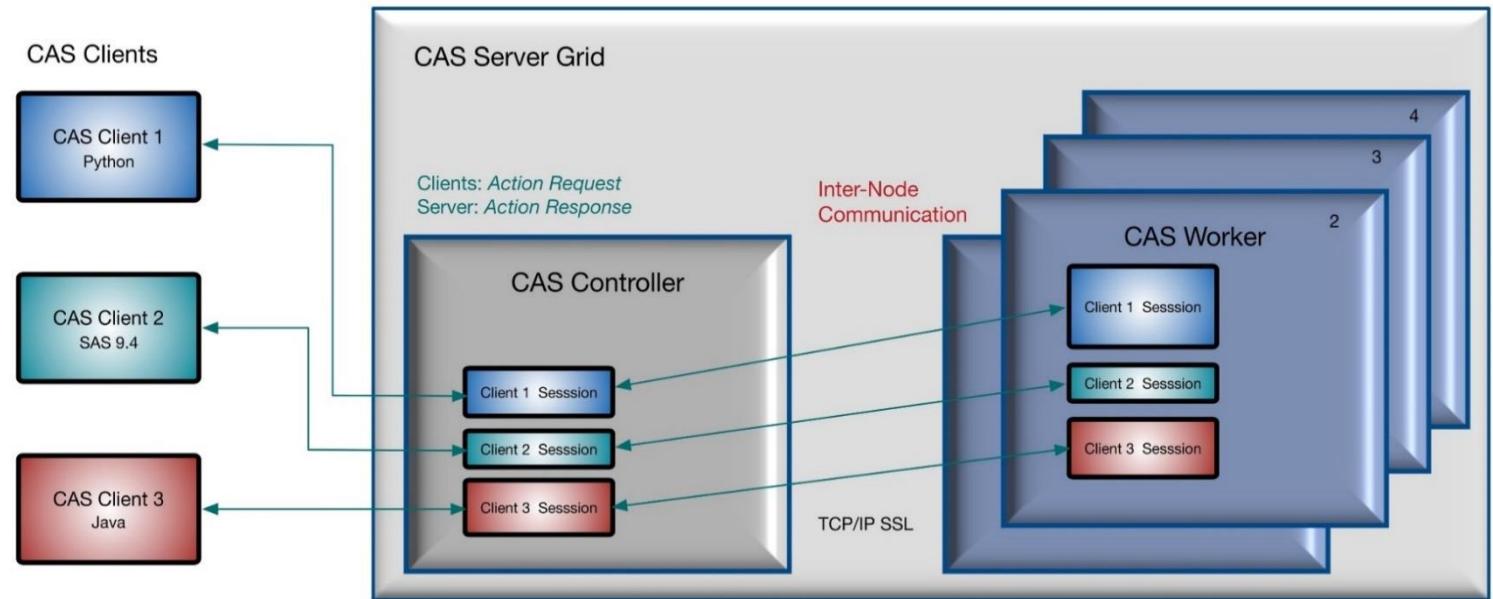
MPP („Massively Parallel Processing“) a.k.a.
„distributed“



CAS Architecture

CAS Sessions

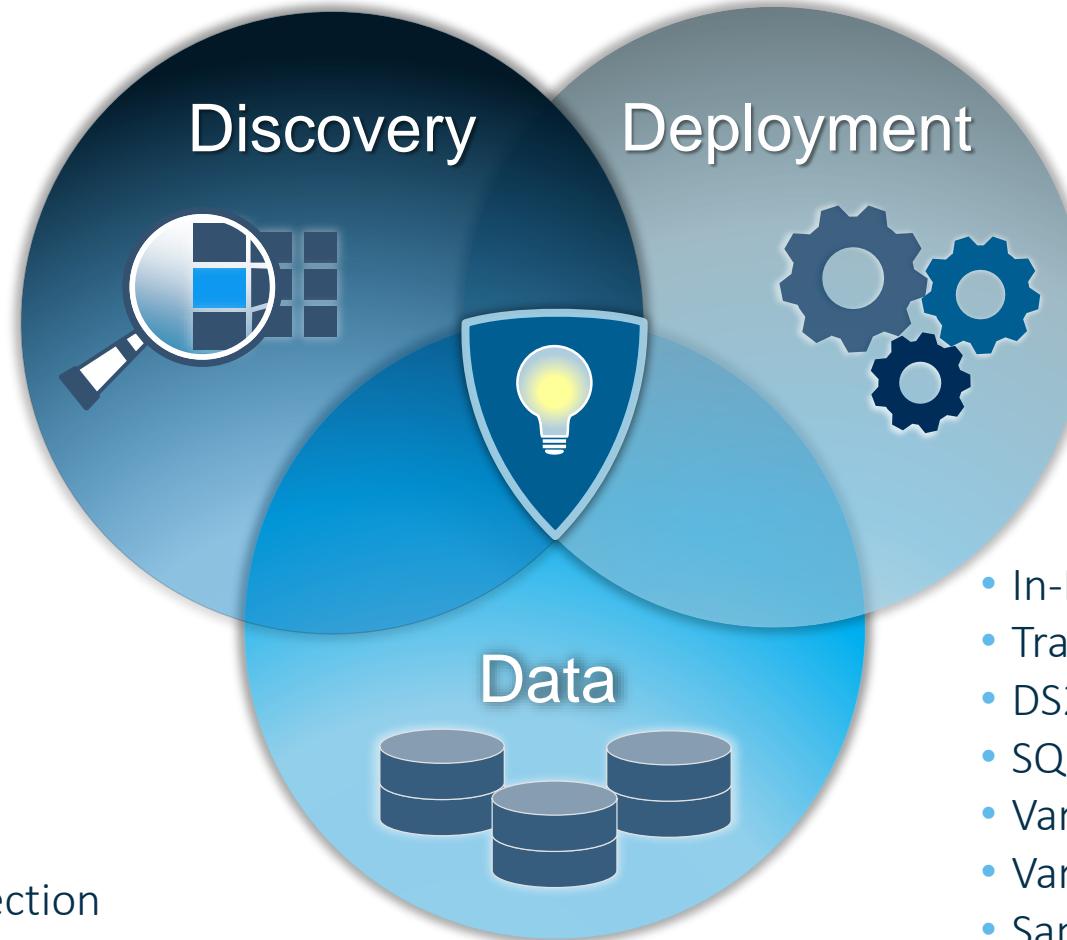
- What is a CAS Session?
 - A private ‘instance’ of CAS available only to the user that created the SESSION.
 - Clients communicate with CAS through SESSIONS to request ACTIONS.
`cas mySession sessopts=(caslib=casuser timeout=1800);`
 - Tables loaded in sessions are not visible to other sessions (unless “promoted”)
- Benefits of Sessions:
 - Identification
 - Fault Isolation
 - Efficiency
 - Resource Tracking



SAS Analytics in action on the Viya platform

CAS built-in capabilities (a.k.a. „CAS actions“)

- Logistic Regression
- Linear Regression
- Generalized Linear Models
- Nonlinear Regression
- Ordinary Least Squares Regression
- Decision Trees
- Partial Least Squares Regression
- Quantile Regression
- K-means and K-modes Clustering
- Principal Component Analysis
- Random Forest
- Gradient Boosting
- Neural Networks
- Support Vector Machines
- Factorization Machines
- Network Analytics/Community Detection
- Text Mining
- Boolean Rules
- Auto-tuned Hyper-parameters



- Assess Supervised Models
- Analytic Item Store
- In-Memory Data Step
- Transpose
- DS2
- SQL
- Variable Binning
- Variable Cardinality Analysis
- Sampling and Partitioning
- Missing Value Imputation
- Variable Selection

Microservices Architecture

- Small in focus, if not in size
- Independently updatable
- Independently scalable
 - Performance, High-Availability
- Replace SAS V9 Middle Tier and Metadata Server, e.g.
 - Administrative tasks (backup, monitoring, license check)
 - Security (authentication, authorization)
 - Data access
 - Supporting services for analytics & reporting (persistence, geospatial analytics)
 - Web Applications (GUIs)

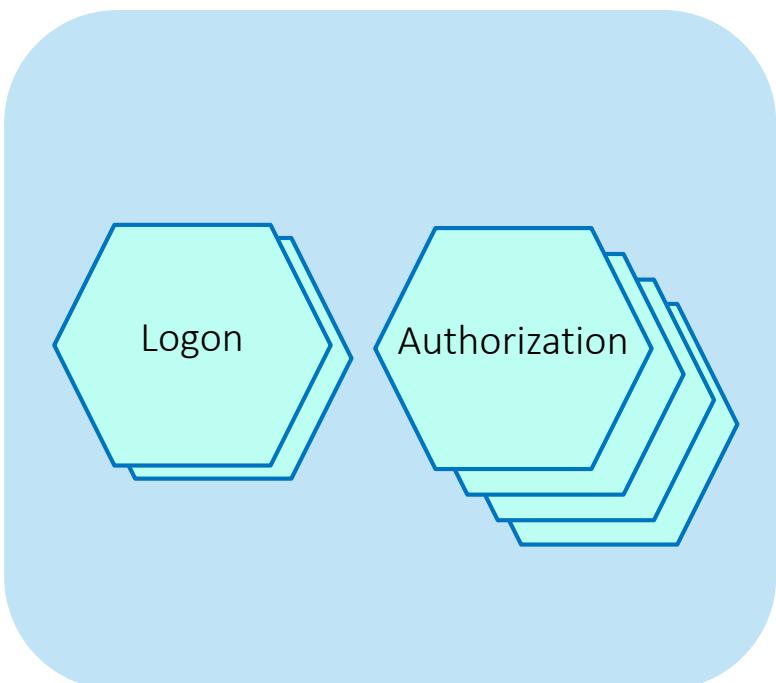


Microservices Architecture

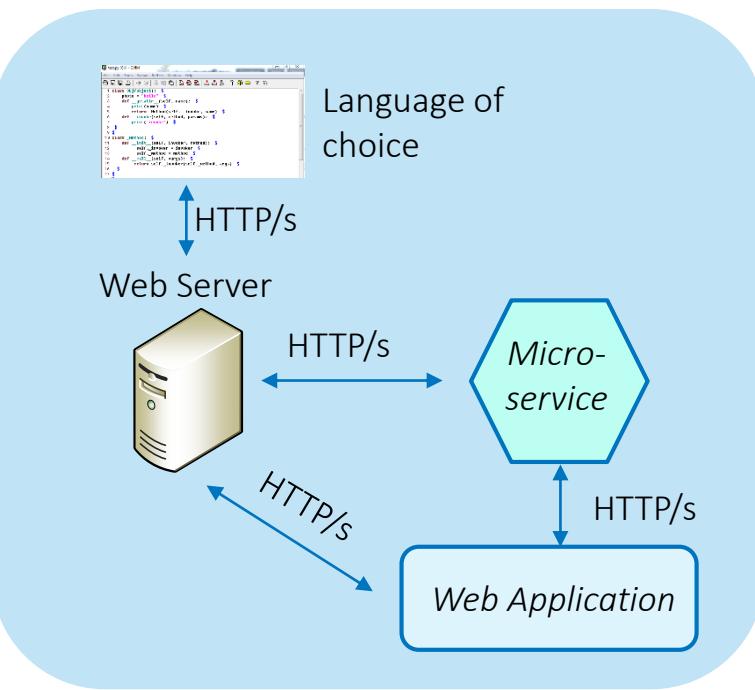
Characteristics

Microservices ...

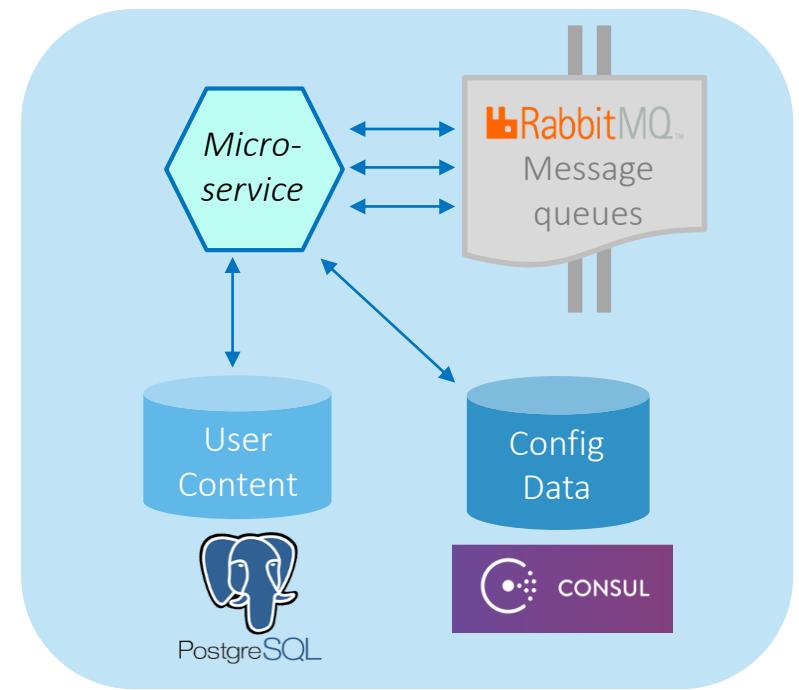
... cover failover requirements
and are easy to scale-out



... communicate using a
REST API



... are stateless but use
stateful services as needed





SAS Environment Manager

for SAS Viya



SAS Environment Manager for SAS Viya

- Completely rewritten in HTML5 for SAS Viya
- Fully integrated into SAS Viya web applications suite
- Takes the role of SAS Management Console in SAS9

The screenshot displays the SAS Environment Manager interface, specifically the 'Manage Environment' section. On the left, a dark sidebar menu lists various management categories: Dashboard, System, Data, Content, Users, Licensed Products, Backup and Restore, Configuration, Contexts, Monitor, Logs, Machines (which is selected and highlighted in blue), Scheduling, Security, Domains, My Passwords, Mobile Devices, and Rules.

The main content area is divided into several sections:

- Machines:** Shows a graph of % CPU Utilization over the last hour (Nov 12, 2017 07:18 PM - Nov 12, 2017 08:16 PM). The graph tracks User, System, Wait, and Stolen CPU usage. A specific machine, 'vy33-viya.aws.local', is selected, indicated by a green checkmark.
- Machine Checks:** Displays a table of checks: Disk utilization of SAS Config filesystem, Memory percent free, and Serf Health Status. The date modified is November 12, 2017 08:18:11 PM.
- Service Instances:** Shows a table of service instances, with 'Folders service' listed as active.
- Configuration:** This section is expanded, showing configuration details for the 'Home service'. It includes fields for GUID (ff8cbd24-4671-4bf8-b705-2120763cd927), Services (Home service), level (INFO), and name (com.sas.home).
- Properties:** A panel on the right provides detailed properties for the selected machine: Hostname (vy33-viya), DNS domain name (aws.local), Address (10.249.5.87), Operating system (Linux), Architecture (x86_64), Kernel release (3.10.0-693.5.2.el7.x86_64), and Kernel version (Kernel version).

At the bottom of the interface, a footer note reads: "Company Confidential – For Internal Use Only Copyright © SAS Institute Inc. All rights reserved."

SAS Environment Manager for SAS Viya

Capabilities

The screenshot shows the SAS® Environment Manager interface. The left sidebar contains a navigation menu with categories like System, Data, Content, Users, Licensed Products, Backup and Restore, Configuration, Contexts, Monitor, Logs, Machines, Scheduling, Security, Domains, My Passwords, Mobile Devices, Rules, Resources, and Quality Knowledge Bases. The main content area is titled "Dashboard" and lists "System" capabilities, which are detailed below.

System

- Data - manage CAS data, CAS libs, formats (incl. set permissions)
- Content - manage reports, folders, pipelines, data plans (incl. set permissions)
- Users - manage custom user groups, view users and groups
- Licensed Products - view licensing information („setinit“)
- Backup & Restore - view backup history, manually start a backup / restore
- Configuration - manage system configuration
- Contexts - manage compute & launcher contexts (for launching SAS sessions)

Monitor

- Logs - view aggregated log files
- Machines - view node metrics and health checks
- Scheduling - manage scheduled jobs

Security

- Domains - manage authentication domains, private and shared credentials
- My Passwords - manage passwords for private credentials
- Mobile Devices - manage the whitelist / blacklist for mobile devices
- Rules - manage permissions on content (folders, reports ...) and capabilities

Resources

- QKB - import and remove QKBs

SAS Environment Manager for SAS Viya

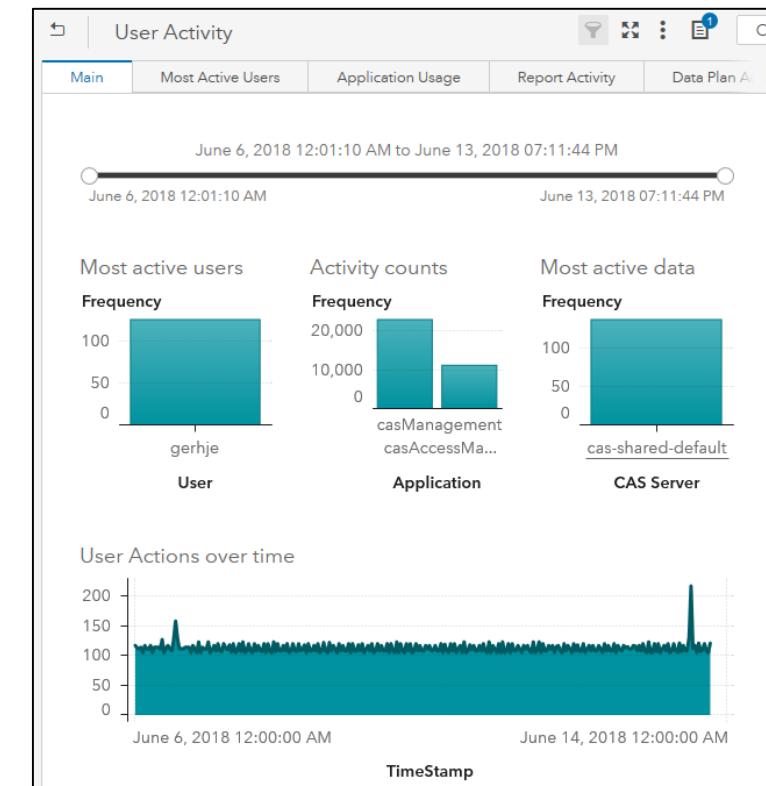
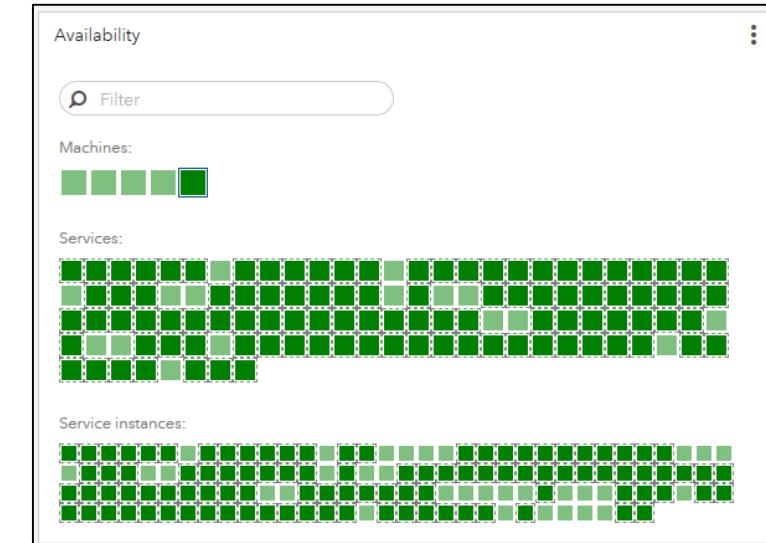
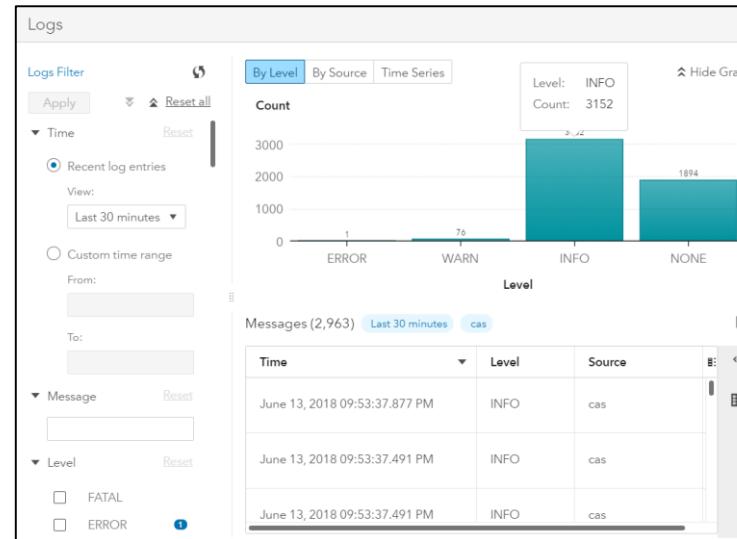
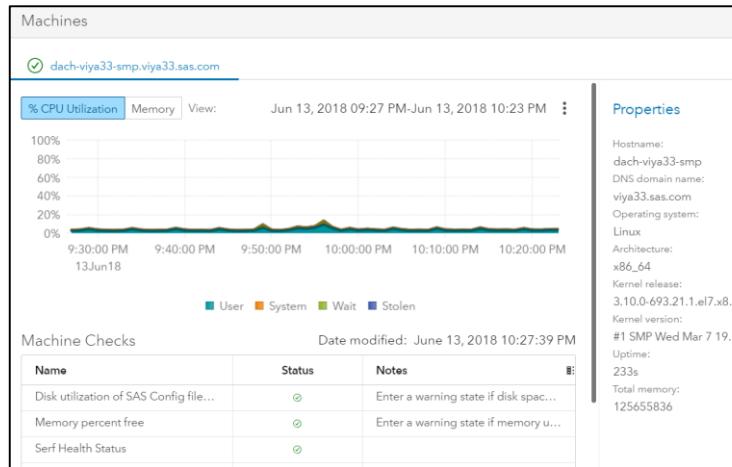
Focus: System Management and Administration

- Configuration of all Microservices is stored in the SAS Configuration Server (a.k.a. Consul) as key/value pairs
 - Used as Service registry: all Microservices register themselves at startup in Consul
 - Used as Key/Value store for configuration data
 - Consul agent usually deployed on all machines in a deployment
- Environment Manager is the primary visual interface to access service configuration
 - Can be accessed through REST API as well

SAS Environment Manager for SAS Viya

Focus: Monitoring

- Displays service health
- Displays key machine metrics
- Provides Auditing information (pre-defined VA report based on collected events)
- Shows collected logging output from all services





Environment Manager

Demo



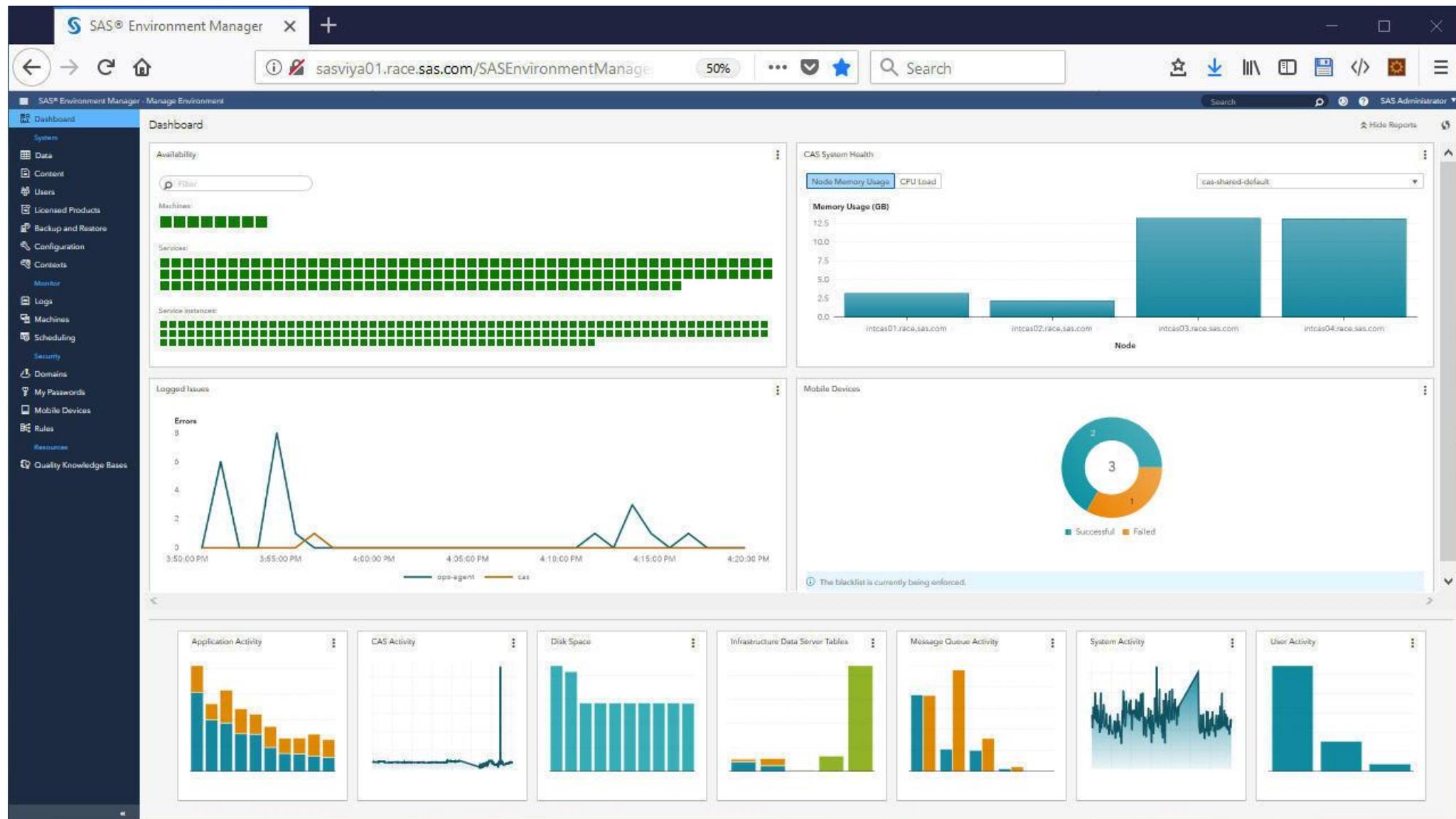
Command-Line Utilities for system administration



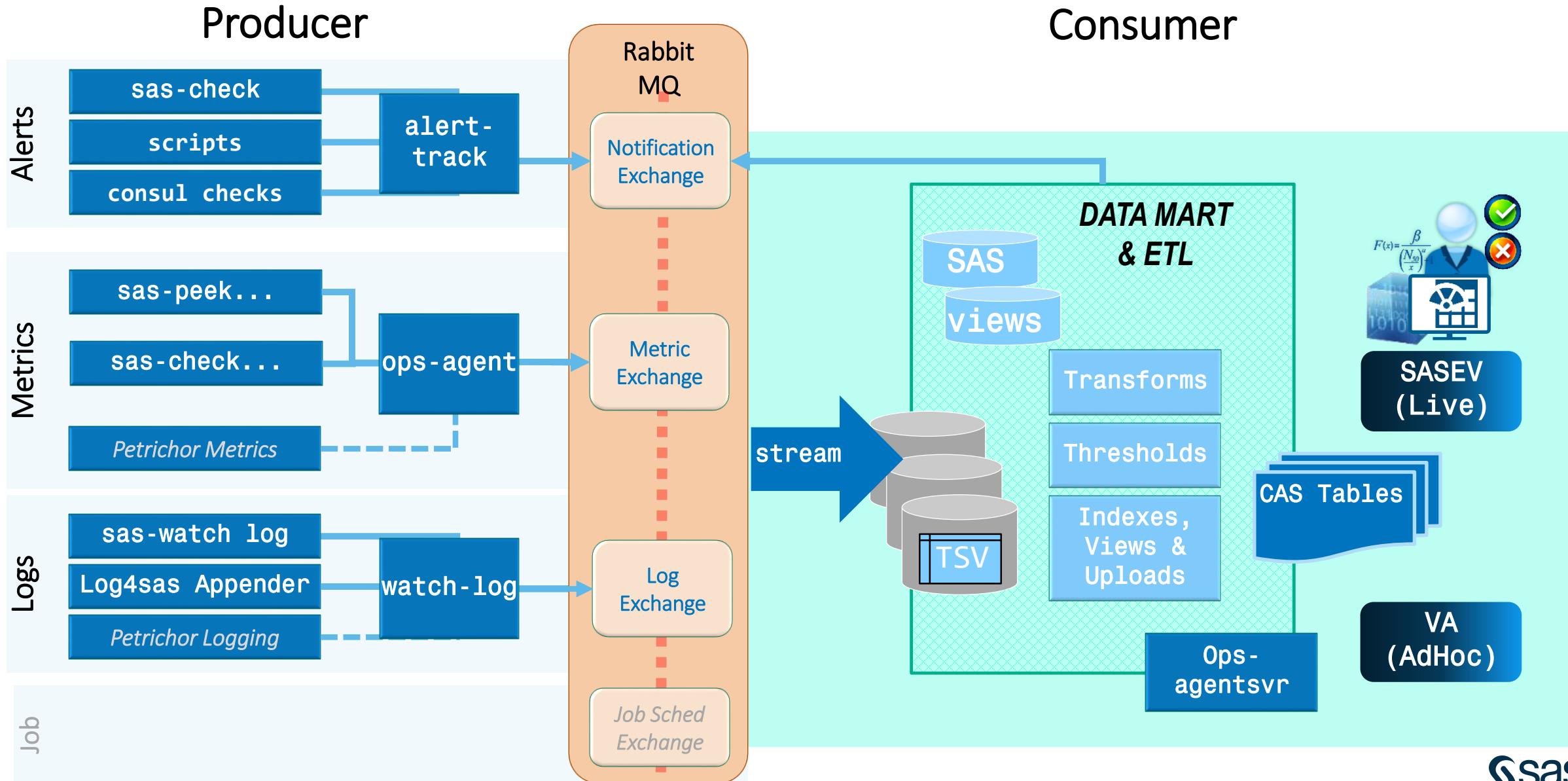
Command-Line Utilities for system administration

- Monitor system health and usage
 - sas-ops: SAS Operations Infrastructure commandline utility
- Automation of administrative tasks
 - sas-admin: commandline utility for core administration functionality
- Low-level repair and troubleshooting
 - Sas-bootstrap-config: SAS Bootstrap Config Tool

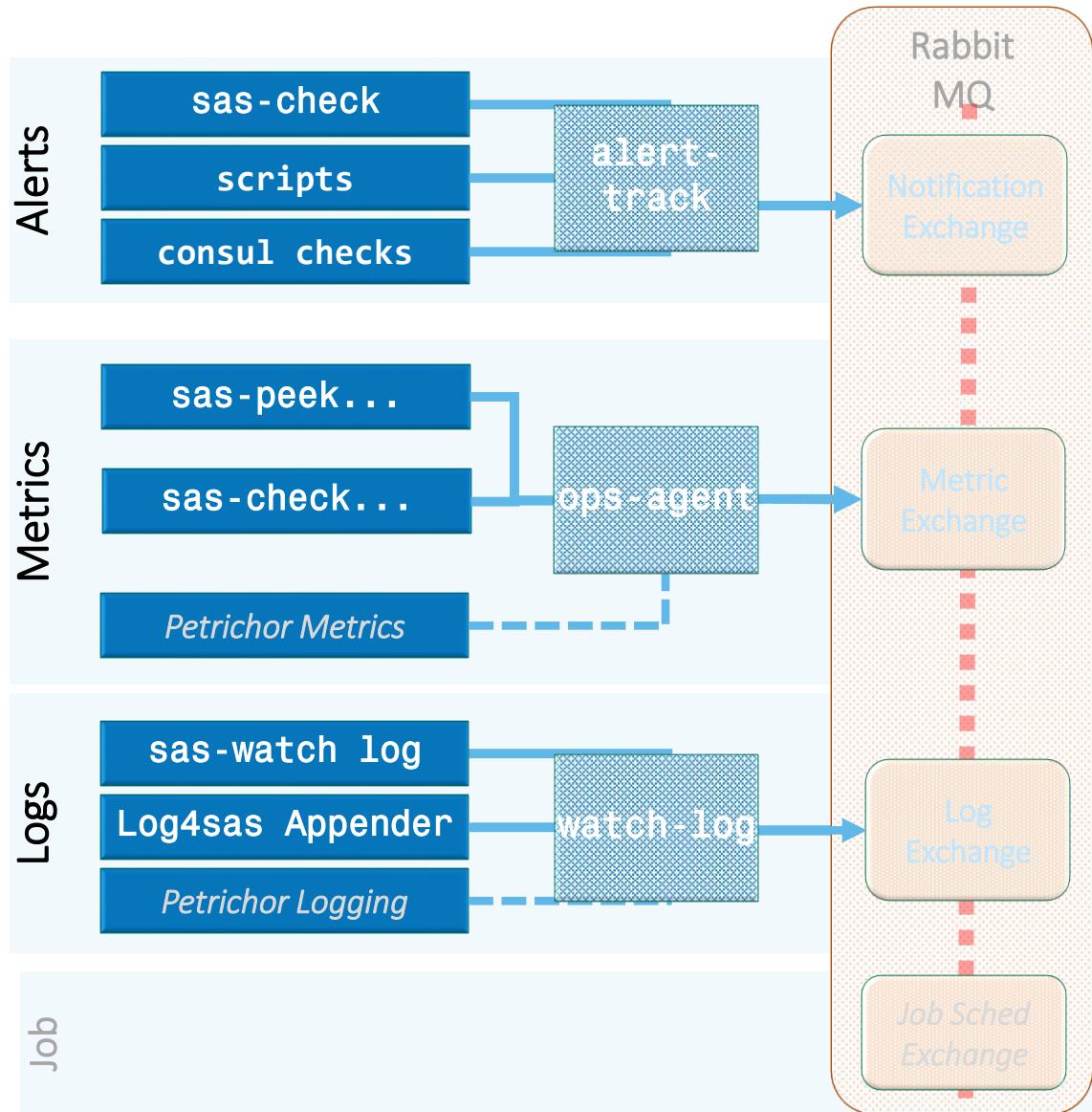
Where does this information come from?



SAS Viya Operations Infrastructure flow



Producer commands



- **sas-peek:** Collect metrics data for a specific resource or service.
 - `sas-peek cpu`
 - `sas-peek cas`
- **sas-watch:** Monitor an object.
 - `sas-watch log`
 - `sas-watch cas`
- **sas-check:** Collect metric data and compares it to a defined threshold value.
 - `sas-check memory`
 - `sas-check filesystem`

Example: Read CPU metrics on a host

```
[root@gerhje-viya33-viya bin]# ./sas-peek cpu -level 1
{"version":1,"collectorName":"sas-peek-cpu","collectorVersion":"1.3.31+7c33385","timeStamp":"2018-06-14T04:23:42.358810-04:00","properties": {"consulNodeName": "gerhje-viya33-viya.sas.com", "hostname": "gerhje-viya33-viya.sas.com", "os": "linux_amd64"}, "measurements": [{"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iNA==", "properties": {"cpuIndex": "0"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iNQ==", "properties": {"cpuIndex": "1"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iNg==", "properties": {"cpuIndex": "2"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iNw==", "properties": {"cpuIndex": "3"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iMA==", "properties": {"cpuIndex": "4"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iMQ==", "properties": {"cpuIndex": "5"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iMg==", "properties": {"cpuIndex": "6"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iMw==", "properties": {"cpuIndex": "7"}, "metrics": null}]}
[root@gerhje-viya33-viya bin]#
[root@gerhje-viya33-viya bin]#
[root@gerhje-viya33-viya bin]# ./sas-peek cpu -level 1 | jq
{
  "version": 1,
  "collectorName": "sas-peek-cpu",
  "collectorVersion": "1.3.31+7c33385",
  "timeStamp": "2018-06-14T04:23:46.097738-04:00",
  "properties": {
    "consulNodeName": "gerhje-viya33-viya.sas.com",
    "hostname": "gerhje-viya33-viya.sas.com",
    "os": "linux_amd64"
  },
  "measurements": [
    {
      "resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iNA==", "properties": {"cpuIndex": "0"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iNQ==", "properties": {"cpuIndex": "1"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iNg==", "properties": {"cpuIndex": "2"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iNw==", "properties": {"cpuIndex": "3"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iMA==", "properties": {"cpuIndex": "4"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iMQ==", "properties": {"cpuIndex": "5"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iMg==", "properties": {"cpuIndex": "6"}, "metrics": null}, {"resourceType": "system_cpu", "resourceId": "HfLcZVmh4VDs0by0Pf/iMw==", "properties": {"cpuIndex": "7"}, "metrics": null}
  ]
}
```

SAS Viya Operations Infrastructure command line interface

- sas-ops commands:

- alerts Stream alerts or show the most recent alerts
- datamarts Display data mart information
- env Display summary of relevant environment information
- info Display properties of the components of the deployment
- logs Streams log events
- metrics Streams metric events
- notifications Streams notification events
- notify Publish a notification message
- services Lists services, service details, and health
- tasks Lists tasks defined for sas-ops-agent
- validate Performs validation of the deployment



Example: Streaming metrics of all nodes in environment

```
[root@gerhje-viya33-viya bin]# ./sas-ops metrics --format pretty
Listening for metrics...CTRL+C to quit
{
  "version": 1,
  "collectorName": "sas-peek-system",
  "collectorVersion": "1.3.31+7c33385",
  "timeStamp": "2018-06-14T04:32:28.952103-04:00",
  "properties": {
    "consulNodeName": "gerhje-viya33-cas-1.sas.com",
    "hostname": "gerhje-viya33-cas-1.sas.com",
    "os": "linux_amd64"
  },
  "measurements": [
    {
      "resourceType": "system",
      "resourceId": "aNHN5Jxf2k2HHkXvWyMDMA==",
      "properties": {
        "cpucount": "4",
        "uname": "Linux gerhje-viya33-cas-1.sas.com 3.10.0-693.11.1.el7.x86_64 #1 SMP Fri Oct 27 05:39:05 EDT 2017 x86_64 (none)"
      },
      "metrics": [
        {
          "name": "totalCpu",
          "unit": "ms",
          "type": "counter",
        }
      ]
    }
  ]
}
```



sas-admin

Commandline Utility for administrating Viya services

- The sas-admin CLI's are an interface to the SAS Viya REST services.
 - Individual plug-ins operate as interfaces to functionality from within sas-admin

Plugin	Purpose
audit	Gets SAS audit information.
authorization	Gets general authorization information, creates and manages rules and permissions on folders.
backup	Manages backups.
restore	Manages restore operations
cas	Manages CAS administration and authorization
configuration	Manages the operations of the configuration service
compute	Manages the operations of the compute service.
folders	Gets and manages SAS folders.
fonts	Manages VA fonts
devices	Manages mobile device blacklist and whitelist actions and information.
identities	Gets identity information, and manages custom groups and group membership
licenses	Manages SAS product license status and information
job	Manages the operations of the job flow scheduling service
reports	Manages SAS Visual Analytics 8.2 reports
tenants	Manages tenants in a multi-tenant deployment.
transfer	Promotes SAS content.

Example: Listing all CASLibs

```
[root@gerhje-viya33-viya bin]# ./sas-admin cas caslibs list --server=*
NOTE: All CAS servers will be processed as if the following was specified: --server=*
Get /casManagement/servers?limit=1: oauth2: token expired and refresh token is not set
Use the "verbose" option to see further details of this error.
[root@gerhje-viya33-viya bin]# ./sas-admin profile set-endpoint "http://gerhje-viya33-viya.sas.com"
[root@gerhje-viya33-viya bin]# ./sas-admin profile set-output json
[root@gerhje-viya33-viya bin]# ./sas-admin auth login -user gerhje
Enter credentials for http://gerhje-viya33-viya.sas.com:

Password>
Login succeeded. Token saved.
[root@gerhje-viya33-viya bin]# ./sas-admin cas caslibs list --server=*
NOTE: All CAS servers will be processed as if the following was specified: --server=*
{
  "items": [
    {
      "description": "Personal File System Caslib",
      "name": "CASUSER(gerhje)",
      "path": "/home/gerhje/casuser/",
      "scope": "global",
      "server": "cas-shared-default",
      "type": "PATH"
    },
    {
      "description": "Personal HDFS Caslib",
      "name": "CASUSERHDFS(gerhje)",
```

SAS Bootstrap Config Tool

- The SAS Bootstrap Config Tool allows you to interact with the SAS Configuration Server from the command-line
- To interact with the key/value store use:

```
/opt/sas/viya/home/bin/sas-bootstrap-config kv <command> <arguments>
```

Commands	Description
bulkload	Loads key/value pairs into Consul
delete	Deletes a given key in the Consul KV store
exists	Returns the exit code 64 if the key does not exist. Return 0 if it exists
help	Show a list of commands or help for one command
read	Reads a value for a key
write	Writes a key/value pair to Consul

SAS Bootstrap Config Tool: Examples

- Read the key/value properties defined for the SAS Logon Manager:

```
[root@gerhje-viya33-viya bin]# /opt/sas/viya/home/bin/sas-bootstrap-config kv read --recurse config/SASLogon/  
config/SASLogon/jvm/java_option_debug1=-Dsun.security.krb5.debug=true  
config/SASLogon/jvm/java_option_debug2=-Dsun.security.jgss.debug=true  
config/SASLogon/jvm/java_option_xms=-Xms512m  
config/SASLogon/jvm/java_option_xmx=-Xmx512m  
config/SASLogon/logging.level/com.sas.logon=INFO  
config/SASLogon/sas.identities.providers.ldap.connection/anonymousBind=false  
config/SASLogon/sas.identities.providers.ldap.connection/host=gerhje-viya33-auth.sas.com
```

- Set the value of a single key/value property defined for the SAS Logon Manager:

```
[root@gerhje-viya33-viya bin]# ./sas-bootstrap-config kv write --force config/SASLogon/sas.logon.kerberos/stripRealmForGss true  
[root@gerhje-viya33-viya bin]# ./sas-bootstrap-config kv read config/SASLogon/sas.logon.kerberos/stripRealmForGss  
true
```



Authentication in Viya 3.3



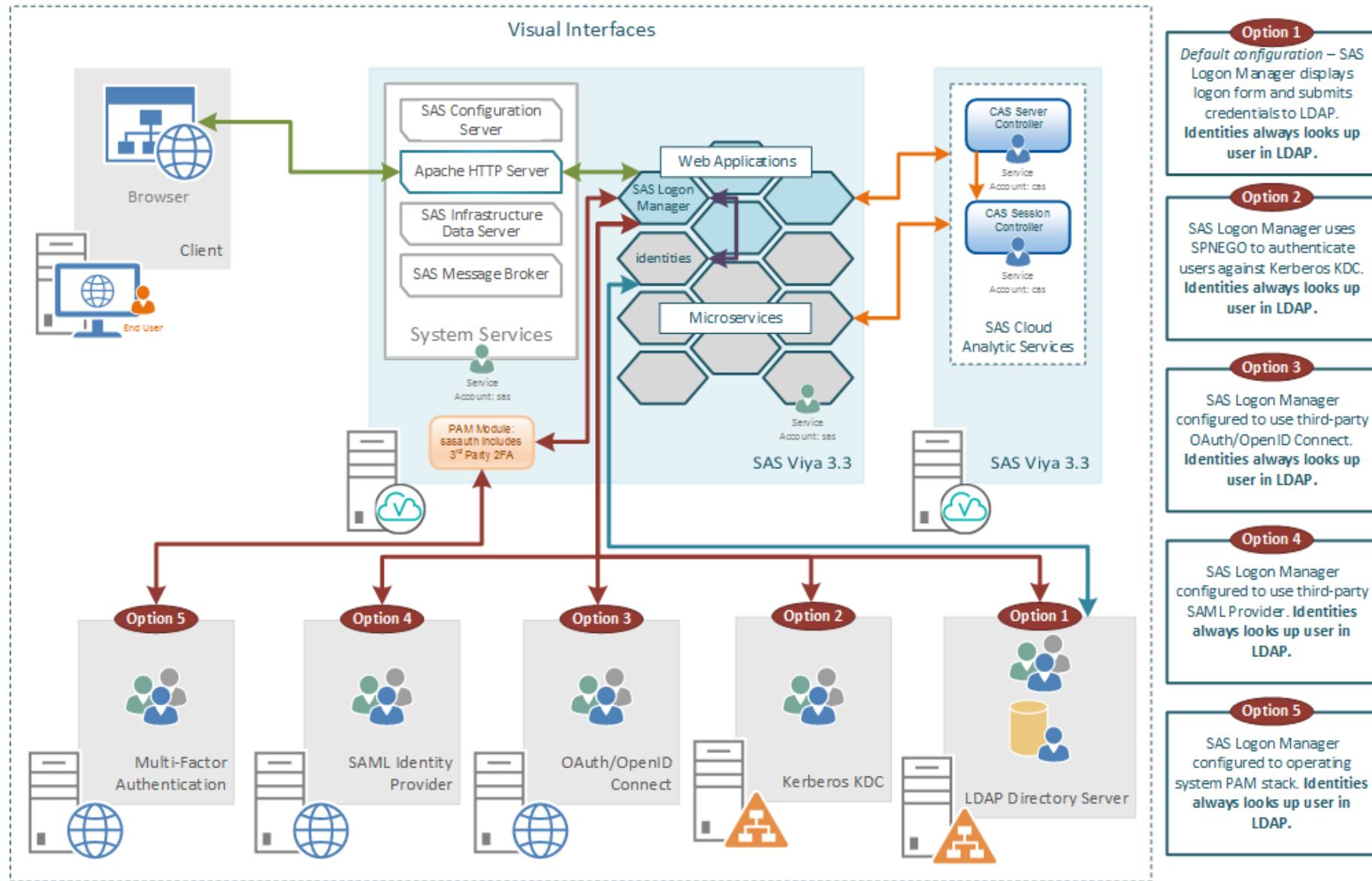
Authentication Options

Key architecture considerations for authentication

- Visual interfaces support five different options for authentication
 - LDAP Provider
 - Standard username and password form
 - Kerberos or Integrated Windows Authentication
 - Provides Single Sign-On from the client host to the Visual interfaces
 - SAML Provider
 - Provides Single Sign-On from third party provider
 - OAuth/OpenID Connect Provider
 - Provides Single Sign-On from third party provider
 - Pluggable Authentication Modules (PAM)
 - To support Multi-Factor Authentication via third-party tools
- Visual interfaces always require an LDAP Provider for SAS Identities microservice



Authentication Options

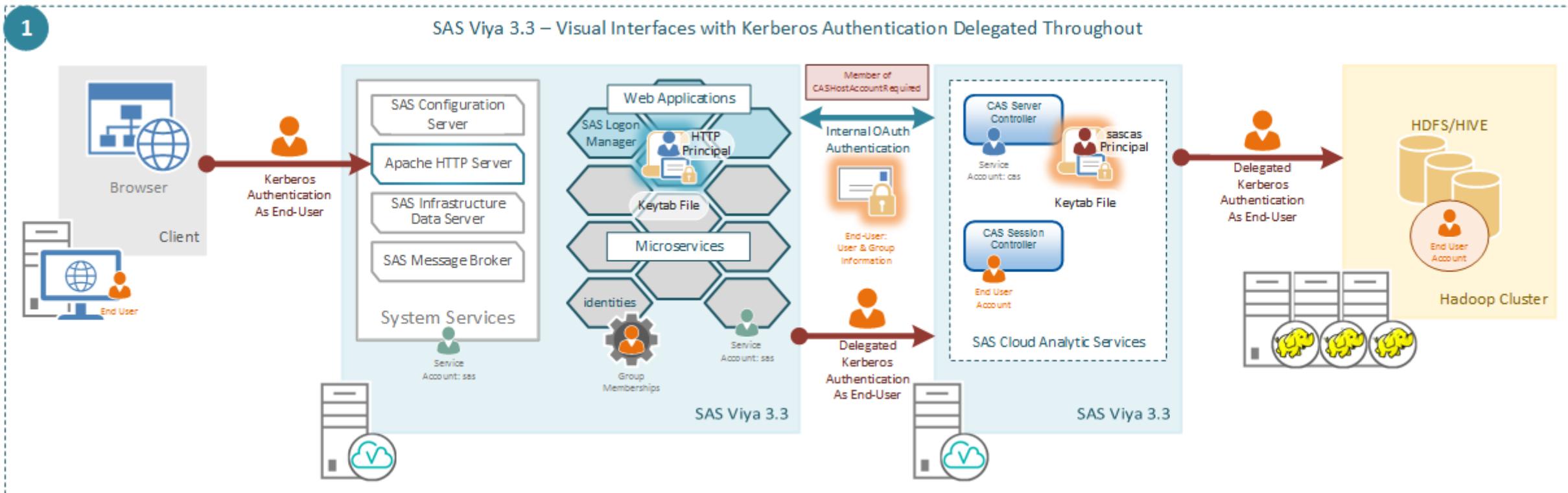


Authentication Options

- Out-of-the-box configuration approach is LDAP authentication with username and password
- Switching to another authentication approach should be a post-deployment task
 - SASLogon service needs to be reconfigured (through EV)
- Careful planning required for choosing the right approach
 - Special requirements might rule out some authentication options
 - Only some approaches provide single signon: Kerberos (Integrated Windows Authentication), potentially SAML and OAuth as well
 - Kerberos (IWA) is required if kerberized data sources (Hadoop) are present and connections to Hadoop need to be made as the end-user



Case Study: Kerberos Delegation Throughout



- Note: this picture can be extended to include SAS9 as well
 - Kerberos ticket will be passed from SAS9 compute server to Viya and on to Hadoop (full delegation)

Authentication Options

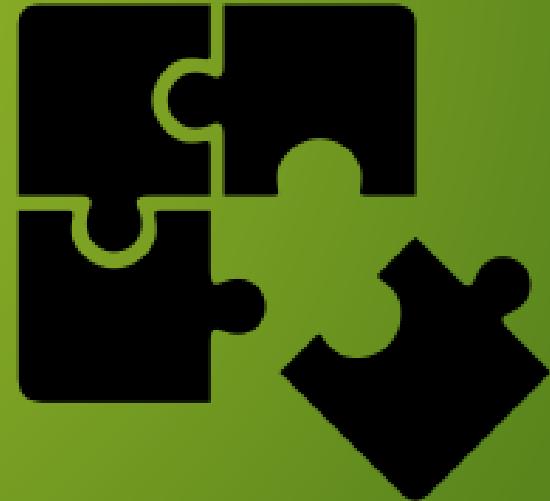
Programming clients

- Programming interfaces (e.g. SAS Studio) only support username / password for authentication
 - Authentication is via Pluggable Authentication Modules (PAM) implemented in the host operating system
- SAS Viya 3.3 still contains a traditional SAS compute runtime (Object Spawner and Workspace Server)
 - Standard GUI for programming is SAS Studio
 - All SAS Studio users are required to be known to the underlying Operating System (to PAM)
 - PAM configuration can point to a variety of authentication providers (Host, LDAP/AD ...)

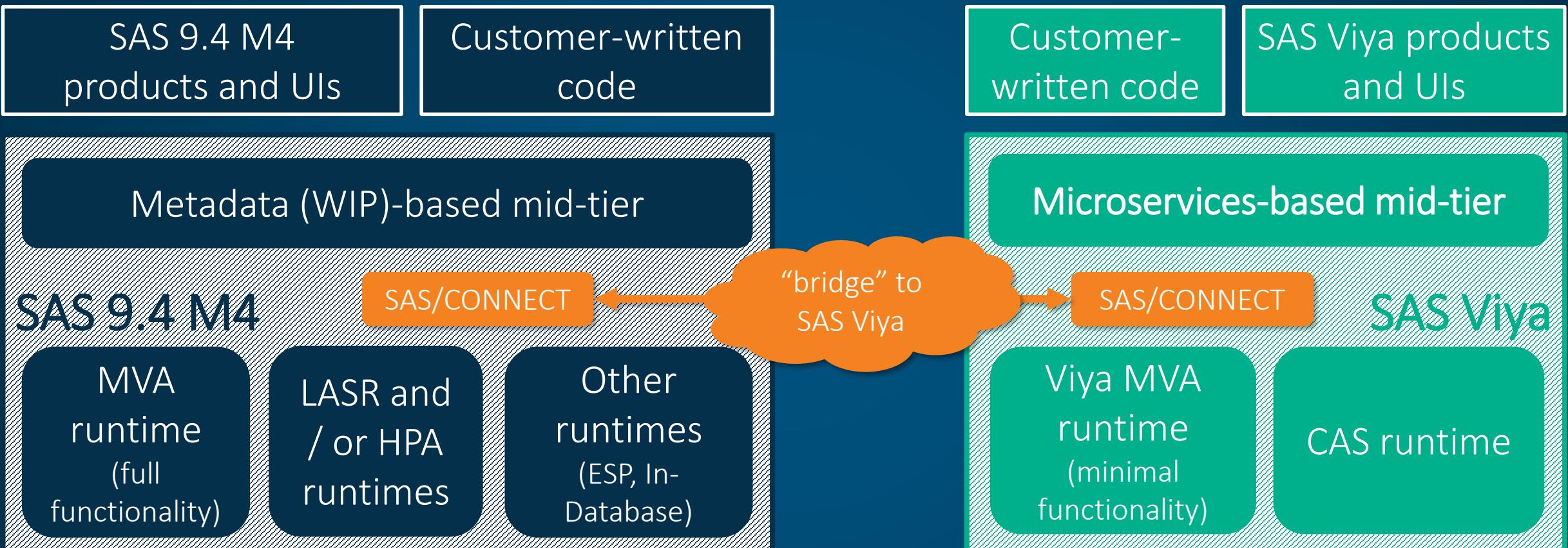




Integrating Viya with SAS 9x

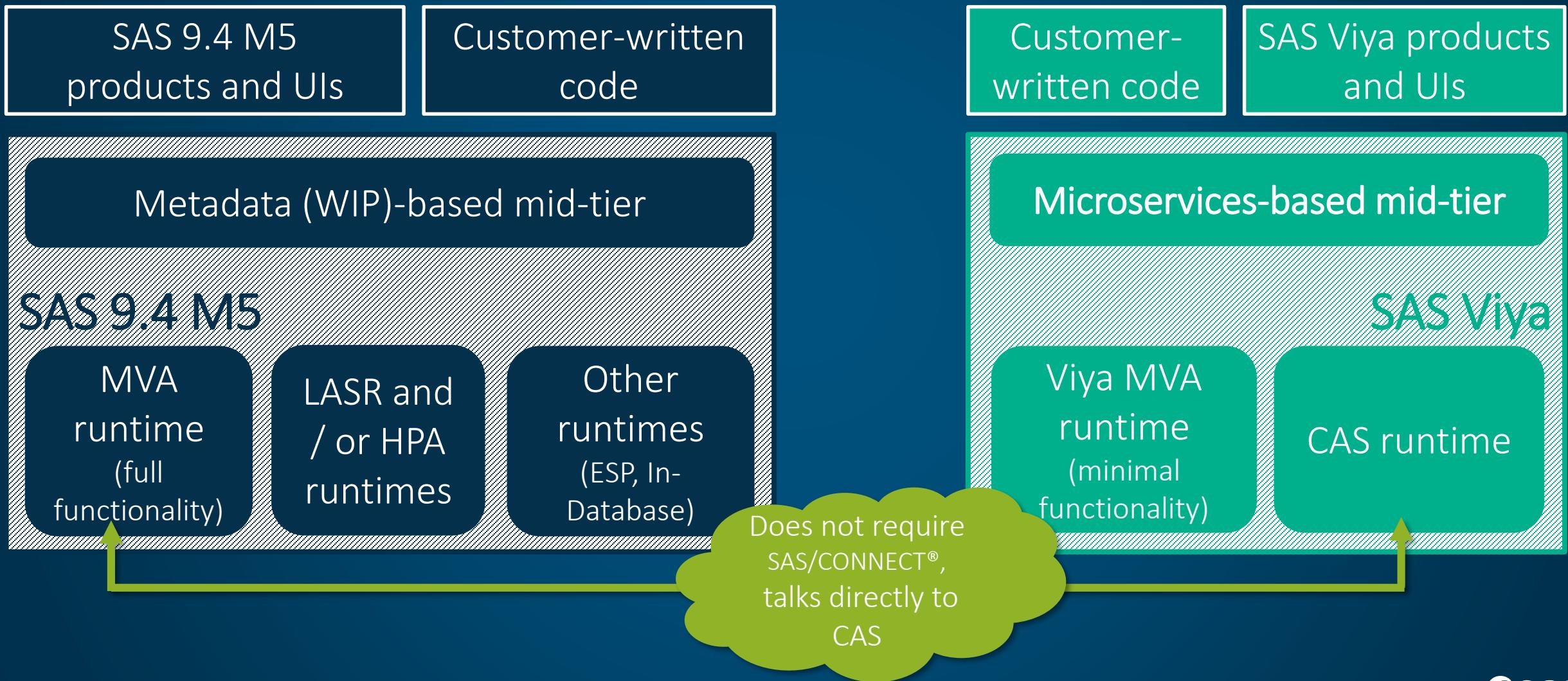


SAS9.4 releases below M5 (Sept. 17)



- ✓ SAS 9 data accessible within SAS Viya
- ✓ SAS Viya models publishable to SAS 9
- ✓ Remotely execute code from / to both (using SAS/Connect)

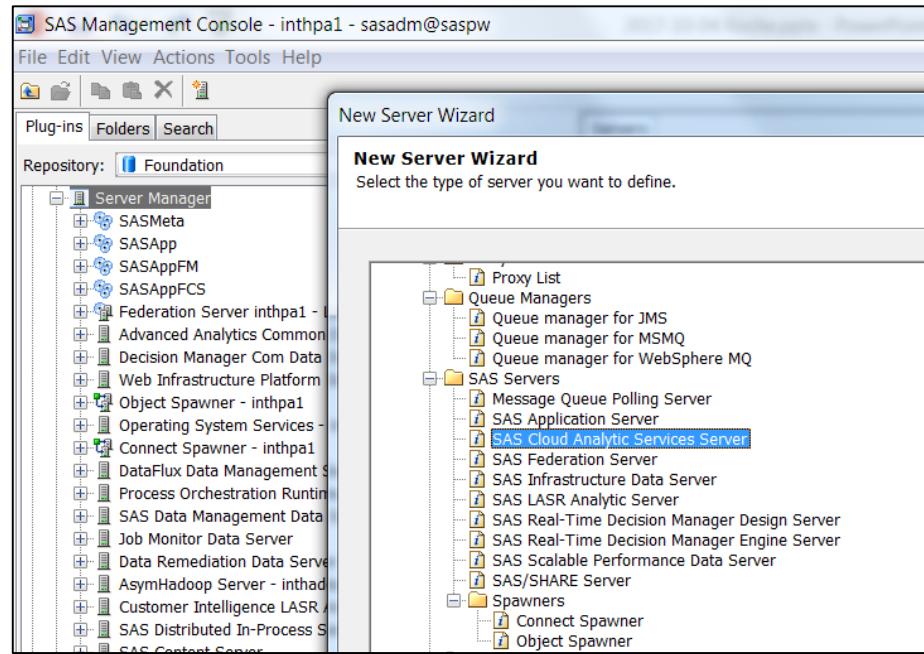
SAS9.4 M5 Architecture



SAS 9.4 M5

Turn SAS 9.4 into a first-class Viya citizen

- Enable connectivity between MVA and CAS without SAS/CONNECT
- Accessing CAS server via SAS programming environments
 - (EG, SAS Studio, Enterprise Miner, ...)
- Availability of CAS PROCs and statements
- CAS-enabled DATA step
- Transcoding of existing encodings (in MVA) to UTF-8 (CAS)
- All SAS9.4 platforms profit from new Viya bridges (except Windows 32-bit and z/OS)



SAS 9.4 M5

Summary of Integration Methods and Use Cases

9.4 M5 Session Type	CAS Connection Options
Workspace Server	<ol style="list-style-type: none">1. Do nothing, it just works! SAS9 credentials must also work to log into Viya: both its LDAP provider and the CAS PAM stack.2. CAS Server and credentials can be defined in Metadata. Adding the CASSERVERMD option to a CAS connect statement triggers lookup of host, port and credentials in metadata.
Token Authentication Servers	Any server using Token Authentication, such as a Stored Process Server, can generate a One Time Password in SAS9 that CAS can accept and validate, when Viya is properly configured so its SASLogon can communicate with WIP in SAS9.
IWA	A Kerberos Ticket Granting Ticket from SAS9 is propagated through to CAS and used to authenticate the user in Viya.



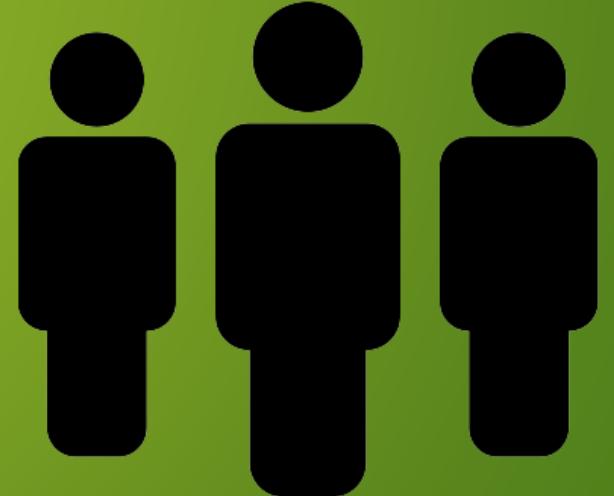
SAS9 Integration

Demo





Viya Multi-Tenancy



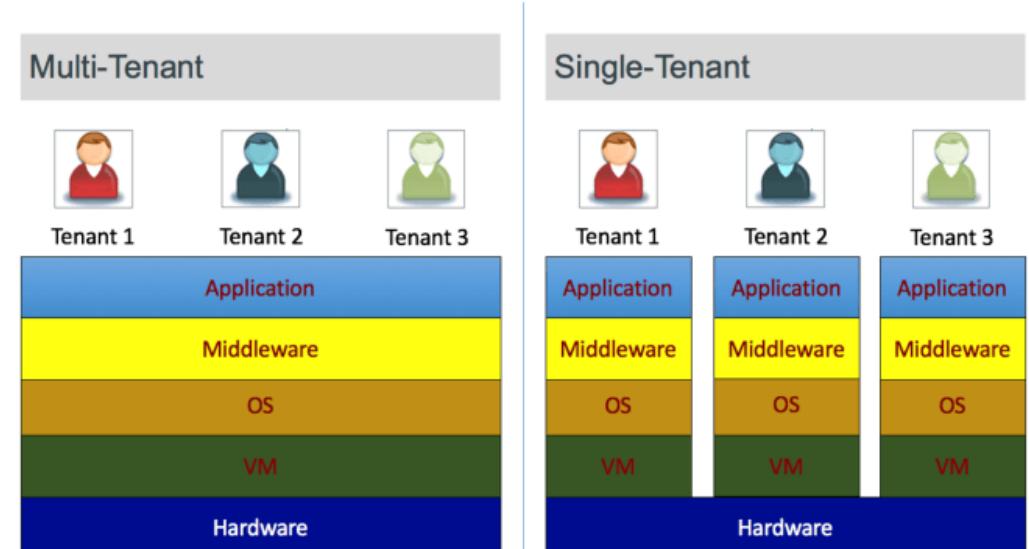
Multi-Tenancy

Introduction

Multi-Tenancy - a concept that allows **several groups** of users to interact with a **single instance** of the software

Each group is called a *tenant*

- Multiple potential approaches to set up multi-tenancy in SAS Viya
 - By implementing a **security concept**
 - Using a **service-provider approach** (3.3+)
- Both approaches have pro's and con's



<https://diginomica.com/2015/12/08/does-multi-tenancy-really-matter-anymore/>

Multi-Tenancy

Multi-Tenancy through permissions

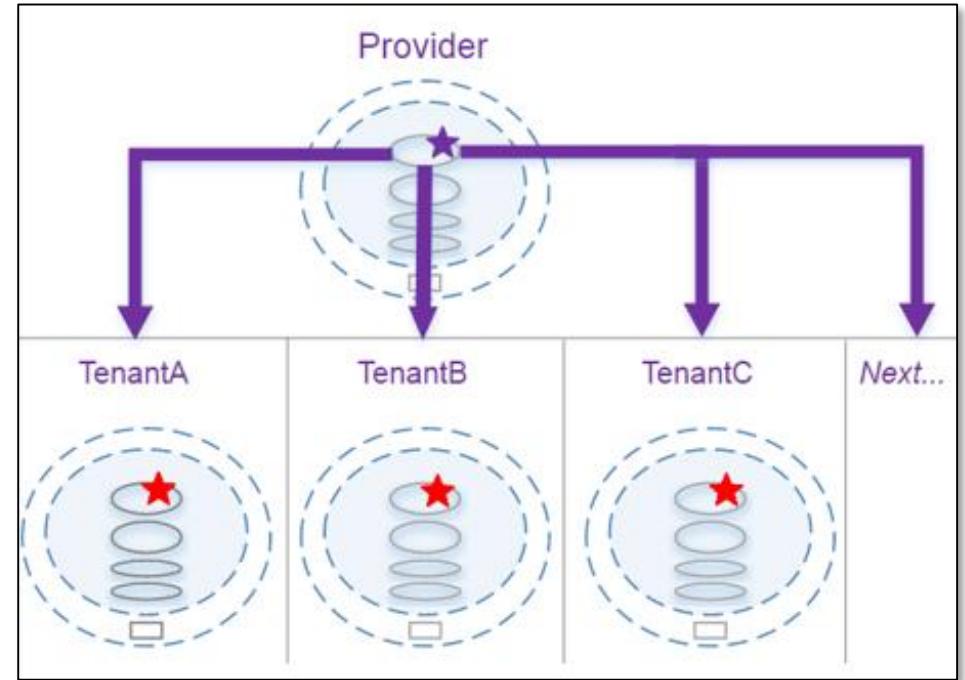
- Implement a security concept based on user groups
 - Grant access to resources that user groups should be able to use
 - Hide access from other groups' resources
- Usually means to set up CASLIBs and folders for specific groups
 - CASLIBs permissions protect data
 - Folders permissions protect content (reports, pipelines ...)
- Works out-of-the-box
 - Comparable to approach known from previous SAS versions
- Potential issues
 - Users with administrative permissions will see all data
 - From a deployment perspective counts as a „single tenant“
 - Viya 3.3: only one CAS server for all tenants(*)

* Will change with Viya 3.4

Multi-Tenancy

Service-provider approach

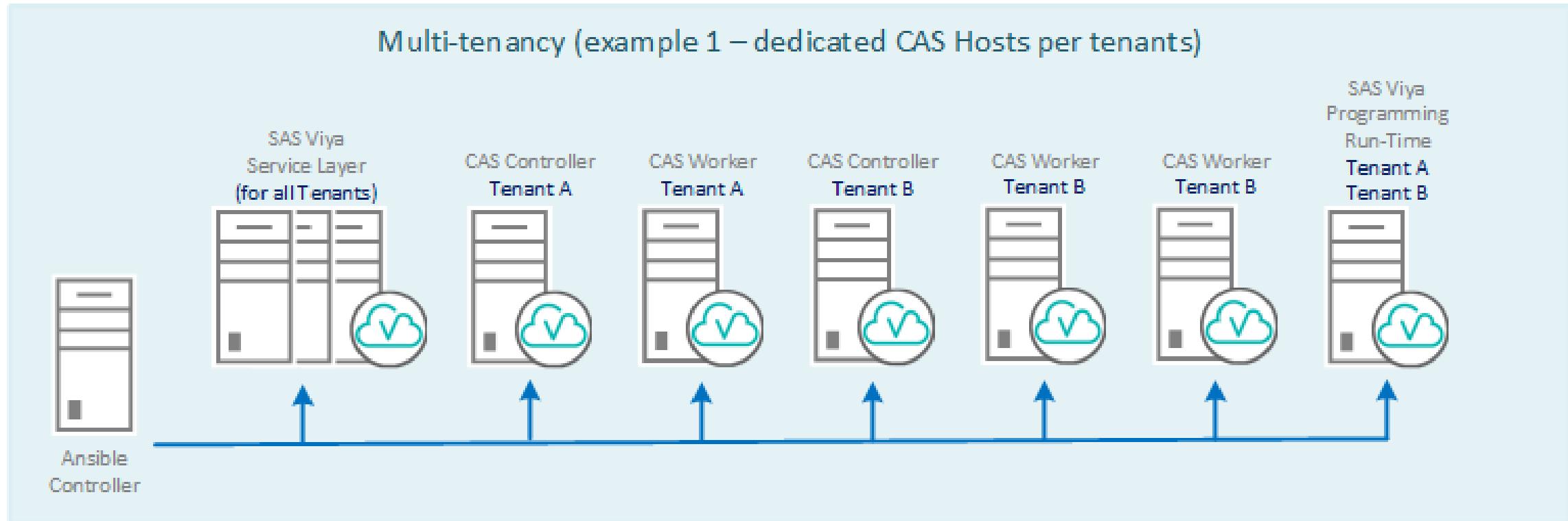
- First tenant („tenant zero“) is the „provider“ tenant
 - Only provider tenant is created during initial deployment
 - Administrators of provider tenant can manage other tenants (onboarding, removing ...)
 - Subsequent tenants have local administrator accounts
 - Provider tenant has administrator access to all tenants
- Tenants are fully isolated (no user can be member of 2 tenants at the same time)
 - Each tenant can have their own CAS server
 - The type (SMP/MPP) and size of the MPP CAS Server can vary between tenants
 - Requires specific LDAP/AD structure(*)
- Decision has to be made prior to deployment
 - Cannot change deployment type for existing environments



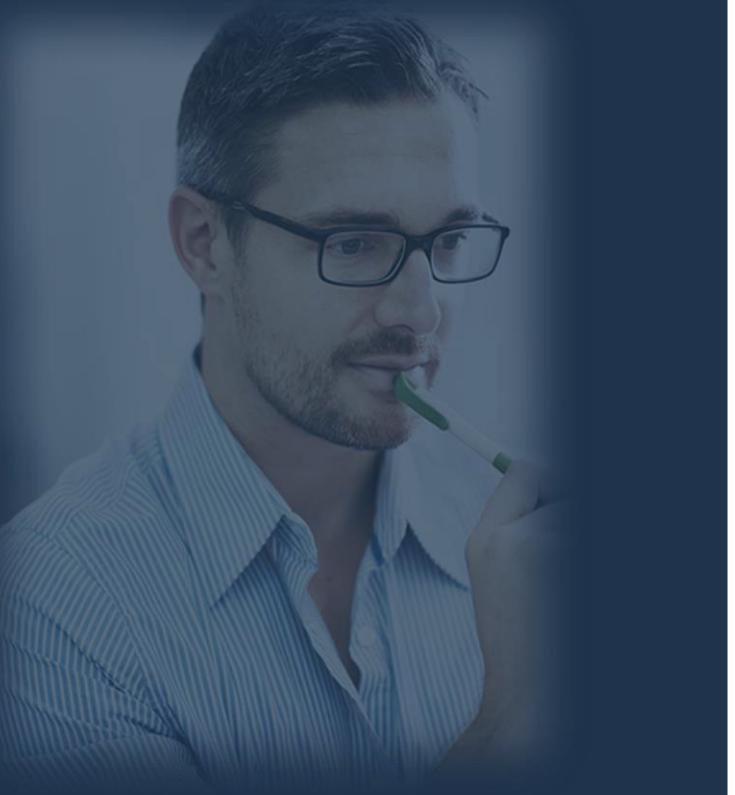
* Requirements become less restrictive with Viya 3.4

Multi-Tenancy

Service-provider approach: sample architecture view



An introduction to system administration with SAS Viya 3.3



Summary

- SAS Environment Manager for SAS Viya
 - System management and monitoring GUI
 - Takes the role of SAS Management Console in SAS 9.x
- Command-Line Utilities
 - Monitoring & auditing: SAS Viya Operations Infrastructure
 - Automation: sas-admin commandline utility
 - Repair & troubleshoot: SAS Bootstrap Config Tool
- Authentication Options for SAS Viya 3.3
 - LDAP, Kerberos, SAML, OAuth/OpenID, PAM
- Integrating SAS Viya and SAS 9 environments
 - Pre 9.4 M5: SAS/Connect
 - 9.4 M5+: native, metadata-aware
- Multi-Tenancy with SAS Viya
 - Either through permissions or through dedicated deployment („service-provider approach“)



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