Oracle Financial Services Compliance Studio

Architecture Guide

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OFS Compliance Studio Architecture Guide

Document Control

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Table of Contents

1 Preface

This preface provides information for the Oracle Financial Services Compliance Studio (OFS Compliance Studio) Architecture Guide.

Topics:

1.1 About this Guide

This document provides the architecture details and the key components of OFS Compliance Studio. In addition, it also describes the application authentication process and use cases.

1.2 Audience

Oracle Financial Services Compliance Studio Architecture Guide is intended for implementation consultants and administrators who can view the high-level architecture of the Compliance Studio solution.

1.3 Related Documents

You can access the following additional documents related to the OFS Compliance Studio application from the Oracle Help Center (OHC) Documentation Library.

- *Oracle Financial Services Compliance Studio Installation Guide (On-Premise)*
- *Oracle Financial Services Compliance Studio Administration and Configuration Guide*
- *Oracle Financial Services Compliance Studio User Guide*
- *Oracle Financial Services Compliance Studio Matching Guide*
- *Oracle Financial Services Compliance Studio Data Model Guide*

To find additional information about how Oracle Financial Services solves real business problems, see our website.

1.4 Conventions

The following table explains the text conventions used in this guide.

Table 1: Document Conventions

Convention	Description
Italics	Names of books, chapters, and sections as references
Bold	Emphasis and need attention
Hyperlink	Hyperlink type indicates the links to external websites, internal document links to sections.

1.5 Abbreviations

The following table lists the abbreviations used in this document.

Table 2: Abbrivations

Abbreviation	Meaning
OFS	Oracle Financial Services
OFSAAI	Oracle Financial Services Analytical Applications Infrastructure
OHC	Oracle Help Center
MOS	My Oracle Support
OFSAA	Oracle Financial Services Analytical Application
BD	Behavior Detection
FCDM	Financial Crime Data Model
MMG	Model Management and Governance
SSO	Single Sign-On
SSH	Secure Shell
OOB	Out of the Box
PGX	Parallel Graph Analytics
AML	Anti-Money Laundering
ML	Machine Learning
ML4AML	Machine Learning for AML
ORE	Oracle R Enterprise
SAML	Security Assertion Markup Language
AAI	Advanced Analytics Infrastructure
HTTP	Hypertext Transfer Protocol

HTTPS	HTTP over SSL or HTTP Secure
SSL	Secure Socket Layer
TLS	Transport Layer Security
ETL	Extract, Transform and Load
SSH	Secure Shell Protocol
UI	User Interface
IDP	Identity Provider
REST	Representational State Transfer
GER	Global Entity Resolution
LDAP	Lightweight Directory Access Protocol
SID	System Identifier
REPL	Read Eval Print Loop

2 OFS Compliance Studio Architecture

This chapter focuses on the following architecture, components, and use cases.

Topics:

2.1 Introduction

OFS Compliance Studio is an advanced analytics application that supercharges anti-financial crime programs for better customer due diligence, transaction monitoring, and investigations by leveraging the latest innovations in artificial intelligence, open-source technologies, and data management.

It combines Oracle's Parallel Graph Analytics (PGX), Machine Learning for AML, Entity Resolution, notebook-based code development, and enabling Contextual Investigations in one platform with complete and robust model management and governance functionality.

2.2 Architecture Overview

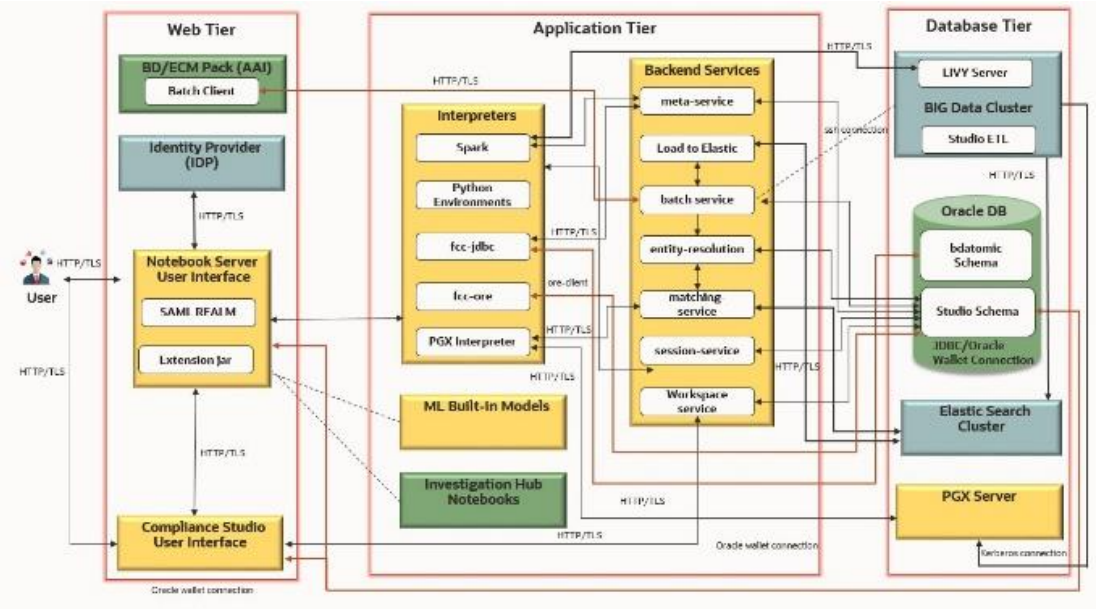
This topic provides the architecture details.

Topic:

2.2.1 Native Architecture

The following diagram exhibits the complete architecture of OFS Compliance Studio.

Figure 1: OFS Compliance Studio Complete Architecture



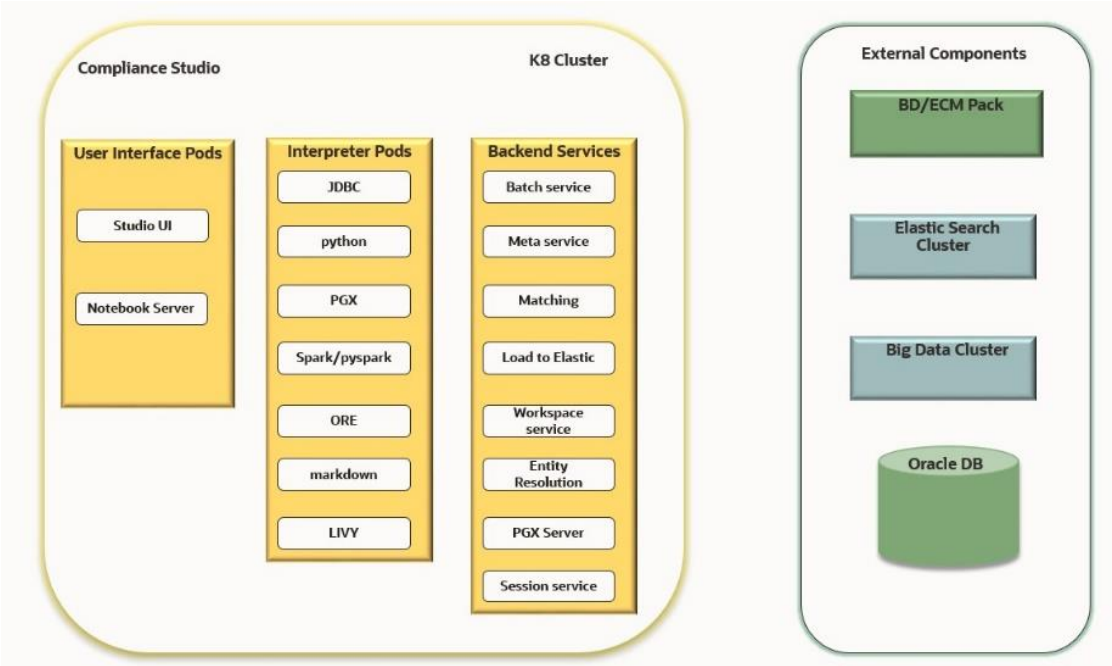
NOTE:

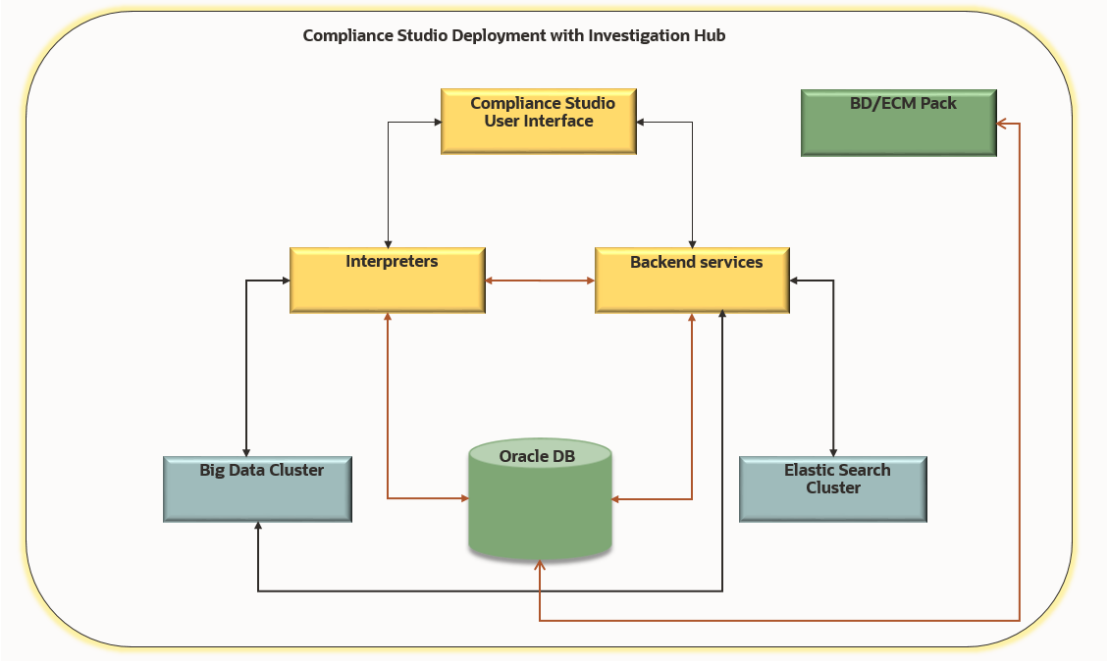
- Compliance Studio components (indicated in the yellow color) are deployed on the same server.
- PGX Server can be deployed on the same server or other server based on Graph Sizing requirement.

2.2.2 Containerized Architecture

- The following diagram exhibits the Kubernetes and Helm architecture of OFS Compliance Studio.

Figure 2: Cloud Architecture





2.3 Components

This topic provides the list of key compentes and third-party components.

Topic:

2.3.1 Key Components

The following components are bundled in the OFS Compliance Studio installer:

- OFS Compliance Studio Front End Service
  - Compliance Studio UI
  - Notebook Server UI
- OFS Compliance Studio Back End Service
  - Interpreters
  - Backend Services
  - Workspace Service
- Machine Learning Built-in Models
- Python Environments
- Parallel Graph Analytics Server

2.3.2 Other Oracle Components

- Behavior Detection (DB) Pack
- Enterprise Case Management (ECM) Pack
- Investigation Hub
- Oracle DB

2.3.3 Third-party Components

- Elastic Search Cluster
- Big Data Cluster
- Identity Provider (IDP)

2.4 Component Details

Table 3: Component Details

Component/Service	Details
OFS Compliance Studio Front End Service	
Compliance Studio UI	You can access the Compliance Studio UI via browser and enter the login credentials along with the language. For valid login credentials, it navigates to the Workspace Summary page.

Notebook Server UI	You can access Notebook Server UI directly or through the Compliance Studio UI. It is recommended to log in to Notebook Server through Compliance Studio UI.
OFS Compliance Studio Back End Service - Interpreters	
Spark Interpreter	You can connect to a big data cluster and create the models to perform analytics on data present in the big data clusters.
Python Interpreter	You can create/execute the Python models using this interpreter. Analytics can be done with any python library. By default, python interpreters are configured with the following Virtual Environment: • fcc-python • fcc-python-ml4aml • fcc-python-sane For more information, see the OFS Compliance Studio Installation Guide.
JDBC Interpreter	You can create/execute the SQL models using this interpreter. By default, this is connecting to Oracle Studio schema. You can connect to any schema by changing the interpreter configuration. For example, BD or ECM schemas
ORE Interpreter	You can create/execute the ORE models using this interpreter. By default, it connects to Oracle Studio Schema. You can connect to any schema by changing the interpreter configuration. For example, BD or ECM schemas
PGX Interpreter	• **PGX Java**: Java-based interpreter, you can create/execute Java-based models and interact with PGX server for graph analytics • **PGQL**: SQL like an interpreter to query on the graph • **PGX-algorithm**: Graph toolkit that provides a graph query language, optimized analytics algorithms. For more information, see the website.
OFS Compliance Studio Back End Service	
Meta Service	This service is responsible for setting up metadata related to Compliance Studio in Studio schema.
Load to Elastic	This service manages Elastic Search indexes used to resolve the entity based on the matching rules.
Batch Service	This service is responsible for executing some of the batch jobs of Compliance Studio. For example, ETL for graph analytics or entity resolution
Entity Resolution	It is responsible for resolving entities using matching and merging rules. • **Graph ER**: It creates Similarity Edges between nodes by comparing the attributes of the nodes and identifying where the similarity is significant enough to create an edge so the nodes are linked with the graph model and can be analyzed as a single entity. • **Global Party ER**; It creates a Global Party of similar entities by comparing multiple attributes of entities using matching and merging rules.

	For more information on merging and matching rules, see *OFS Compliance Studio Matching Guide*.
Matching Service	It is responsible for scoring in ER based on matching rules. It has the following scoring methods: • Jaro-Winkler • ML-Boosted Name • ML-Boosted Address • Levenshtein • Individual Name • Entity Name • Default For more information on merging and matching rules, see the OFS Compliance Studio Matching Guide.
Session Service	It is responsible for managing the spark session in the spark LIVY interpreter.
ML4AML	
ML Model Templates	The prepackaged Model templates allow you to perform the following: • Model segmentation (model grouping) • Load and Preview data • User-defined transformation (deriving additional features) • EDA • Feature selections • Model training and evaluation • Model Agnostics (Explainability) • On-going validations
Python Environments	Python environment contains all packages required to execute ML4AML models. For example, scikit-learn pandas
Workspace Service	
Workspace Service	This service is used to manage the following functions: • Workspaces and sandbox • Data sources (external, local file, relational, and distributed) • Model complete lifecycle, governance, and execution • Batch and Scheduler services • User roles and accesses • User Provisioning and authentication
Other Oracle Components	
Parallel Graph Analytics Server	Graph analysis lets you reveal latent information that is not directly apparent from fields in your data but is encoded as direct and indirect relationships - metadata - between elements of your data. This connectivity-related information is not apparent to the naked eye but can have tremendous value when uncovered. PGX is a toolkit.

	For graph analysis, It supports both efficient graph algorithms and fast SQL-like graph pattern matching queries. FCGM is loaded into the PGX server for analytics.
BD PACK	In Compliance Studio, the graph model is based on the BD Pack's FCDM model and ML4AML using the same data model. For more information, see the Behavior Detection Application Pack.
ECM PACK	In Compliance Studio, the graph model is based on the ECM Pack's FCDM model. ECM is also used to correlate events generated via Compliance Studio and for case investigation. For more information, see the Enterprise Case Management Application Pack.
Oracle DB	Compliance Studio stores the metadata in the Oracle DB.
Investigation Hub	OFS Investigation Hub is an application built on Compliance Studio, allowing investigators to view the case and adhoc information within then cerates case narratives and insights, highlights risk factors and red flags meaningful to the investigation, and recommends actions based on graph scoring algorithms. For more information, see the Investigation Hub Application Pack.
Third-party Components	
Identity Provider	Identity Provider (IdP or IDP) is required for SSO/SAML authentication.
Big Data Cluster	Big Data Clusters allow you to deploy scalable clusters of SQL Server, Spark, and HDFS. These components run side-by-side to enable you to read, write, and process big data from Transact-SQL or Spark, allowing you to easily combine and analyze your high-value relational data with high-volume big data. It is used for ETL, a job that is converting our FCDM to FCGM. For more information on Technology Stack Matrices, see Oracle Financial Services Analytical Applications 8.1.1.0.0 Technology Matrix.
Elastic Search Cluster	An Elastic Search cluster is a group of nodes that have the same cluster name attribute. As nodes join or leave a cluster, they reorganize to distribute the data across the available nodes evenly. If you are running a single instance of Elastic Search, you have a cluster of one node. It is used for a matching service engine used for Entity Resolution and Similarity Edge for Graph Nodes.

2.5 Communication Details

Table 4: Communication Details

Connection/Interface	Details
HTTP	Hypertext Transfer Protocol (HTTP) is a communication protocol in the application.
HTTPS	HTTPS (HTTP over SSL or HTTP Secure) uses Secure Socket Layer (SSL), a secure protocol that works on top of HTTP to provide security. That means SSL encrypted data will be routed using protocols like HTTP for communication.
TLS	Transport Layer Security (TLS) encrypts data for private and sensitive information such as passwords, credit card numbers, and personal correspondence in the application.
ETL	Extract Transfer and Load (ETL) is the procedure of copying data from one or more sources into a destination system that represents the data differently from the source or in a different context. Data movement and graph loading is performed using ETL.
Thrift connection	Thrift supports clean abstractions and implementations for data transport, data serialization, and application-level processing.
Oracle Wallet connection	Oracle Wallet is a file that stores database authentication and signing credentials. It allows users to securely access databases without providing credentials to third-party software and quickly connect to Oracle products.
SSH connection	Secure Shell Protocol (SSH) hosts multiple channels simultaneously and transfers data in both directions.

2.6 Application Deployment

The separate installer is provided for the On-premise deployment.

For more installation information, you can see the respective OFS Compliance Studio Installation Guides.

2.7 Application Authentication

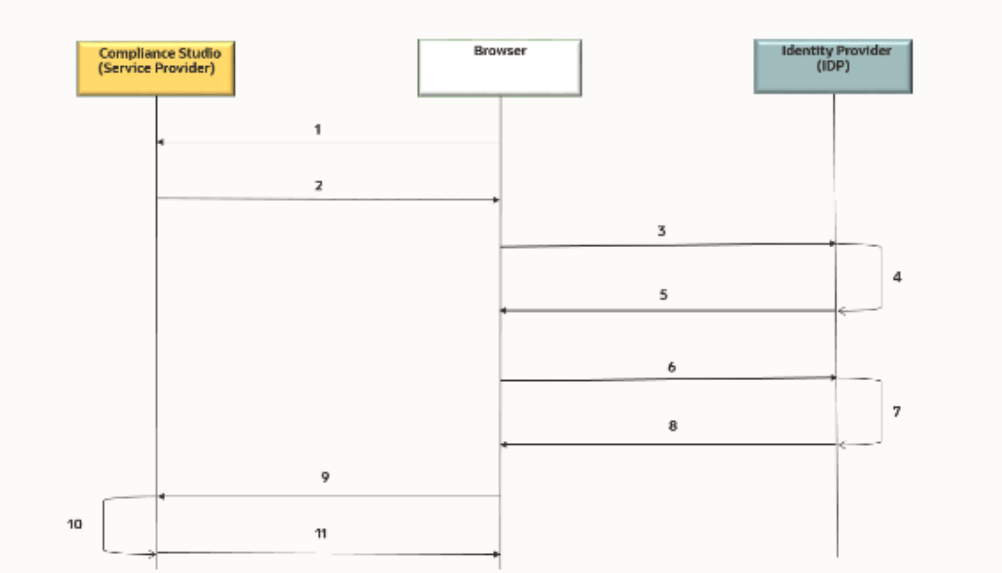
This topic provides the authentication details.

Topic:

2.7.1 SSO/SAML

Single Sign-On (SS0)/Security Assertion Markup Language (SAML) is a type of authentication supporting the OFS Compliance Studio. It is an open standard for exchanging authentication and authorization between the user and Compliance Studio application, such as logins, authentication state, identifiers, and other relevant attributes.

Figure 3: SAML Authentication Process



The entities are as follows:

- End-User
- OFS Compliance Studio application
- SAML

The SMAL authentication process is as follows:

1. A user sends a request to access the OFS Compliance Studio application.
2. The application redirects the request to IDP for authentication with SAML request:
3. The application sends the request to IDP for the SSO login page.
4. IDP validates the SAML request for the login page.
5. IDP sends the response to the user with the SSO login page.
6. The user enters the credentials on the SSO login page.

7. IDP validates the credentials and generates the SAML response.
8. IDP sends the SAML response is as follows:
    - For valid credentials, it sends the response to the application for validating the SAML response.
    - For invalid credentials, it displays the authentication error.
9. It posts SAML response to Assertion Consumer URL for valid credentials.
10. The application verifies the user signature in the SAML response.
11. The application displays the OFS Compliance Studio home page to the user.

2.7.2 OFSAAI

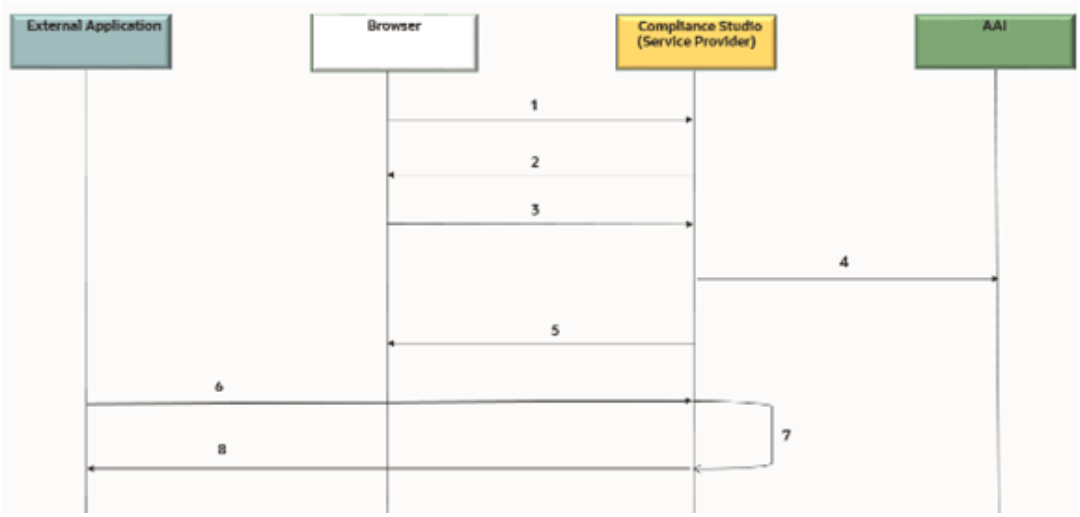
Oracle Financial Services Analytical Applications Infrastructure (OFSAAI) authenticates users using any web browser with a username/password to login into the application. It is also possible to restrict access to content and services based on user attributes or, conversely, make them accessible internationally.

You can authenticate the OFS Compliance Studio with the following:

- Existing OFSAAI
- Install OFSAAI and authenticate

OFSAAI is available with a pre-installed BD Pack or ECM Pack.

Figure 4: OFSAAI Authentication Process



The entities are as follows:

- End-User
- OFS Compliance Studio application
- AAI
- External Application

The AAI authentication process is as follows:

1. A user sends a request to access the OFS Compliance Studio application.
2. The application displays the OFS Compliance Studio application login page:
3. The user enters the credentials on the login page.
4. The application sends the request to AAI for validation.
5. AAI validates the credentials:
   a. For valid credentials, it displays the OFS Compliance Studio home page to the user.
   b. For invalid credentials, it displays the authentication error.
6. The External Application sends the request with Bearer/Basic token to access the application through REST API.
7. The application validates the Authorization Header using Pre-Filters.
8. The application sends the response to the External Application.

   REST API: Representational State Transfer (REST) is a software architectural style that defines a set of constraints to create Web services. Web services that conform to the REST architectural style, called RESTful Web services, provide interoperability between computer systems on the internet.

2.8 Use Cases

This topic provides different use cases.

Topic:

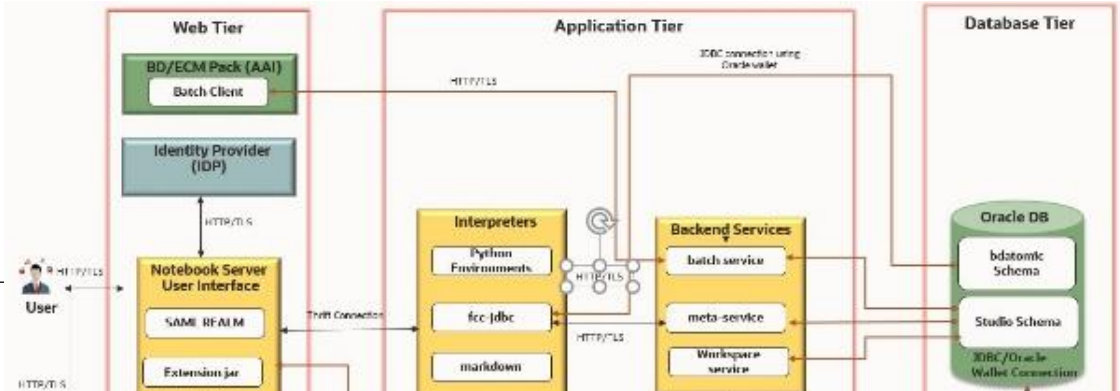
- Scenario Authoring
- Machine Learning for AML
- Entity Resolution
- Investigation Hub

2.8.1 Scenario Authoring

OFS Compliance Studio supports Polyglot Scenario Authoring to author new scenarios in various languages like SQL, Scala, Python, and R.

It is used with Oracle's Behavior Detection or other FCC product. There are pre-built integrations for Scenario Authoring and creating events, posting them into our Enterprise Case Management system, and further creating cases for investigation. However, Compliance Studio can be used with any financial crime platform for Scenario Authoring.

Figure 5: Scenario Authoring



The following components are involved in this use case:

- OFS Compliance Front End Service
- OFS Compliance Back End Service
- IDP
- ECM/BD Pack
- Oracle DB

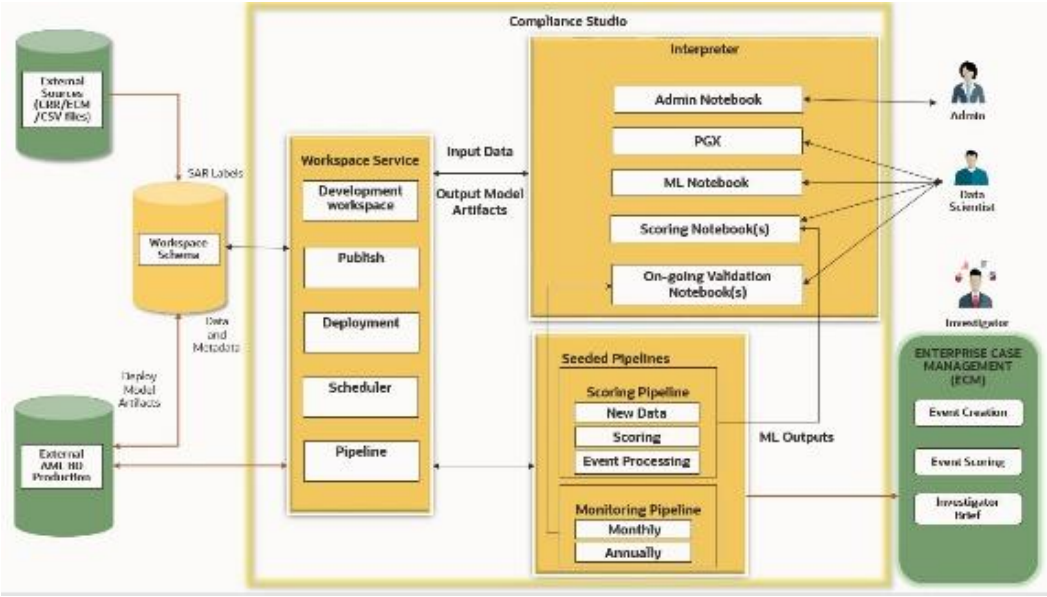
For more information on each component, see the Component Details section.

2.8.2 Machine Learning for AML

OFS Compliance Studio supports Machine Learning for AML (ML4AML). It is a foundation with building blocks for the Machine Learning (ML) lifecycle, tailored for the AML domain. It uses the familiar notebook environment to train, test, and validate ML models rapidly.

It has a predefined dataset with more than 300 attributes ready for variable analysis. You can execute models with multiple techniques and compare the results side-by-side.

Figure 6: ML4AML



The following components are involved in this use case:

- OFS Compliance Front End Service
- OFS Compliance Back End Service

- Database -External sources (ECM/CRR CSV file)/AML BD production
- ECM

For more information on each component, see the Component Details section.

2.8.2.1 Customer Risk Scoring

OFS Compliance Studio supports building the customer risk scoring models from available customer and KYC attributes and behavioral attributes. It uses a set of out-of-the-box behavioral and non-behavioral attributes and Time Series transformations to accelerate feature engineering. You can incorporate AML related behavioral attributes directly into the model to better assess AML risk.

2.8.2.2 AML Event Scoring

OFS Compliance Studio supports creating an event scoring model that can determine the risk associated with an event. The risk score can be utilized to prioritize events for review or be used as input for case correlation. Leverage alert highlights that are made available OOB besides custom-designed features.

2.8.2.3 Detection Models

OFS Compliance Studio supports building a supervised machine-learning model at an account or customer level to detect the behavior of interest.

2.8.2.4 Customer Segmentation

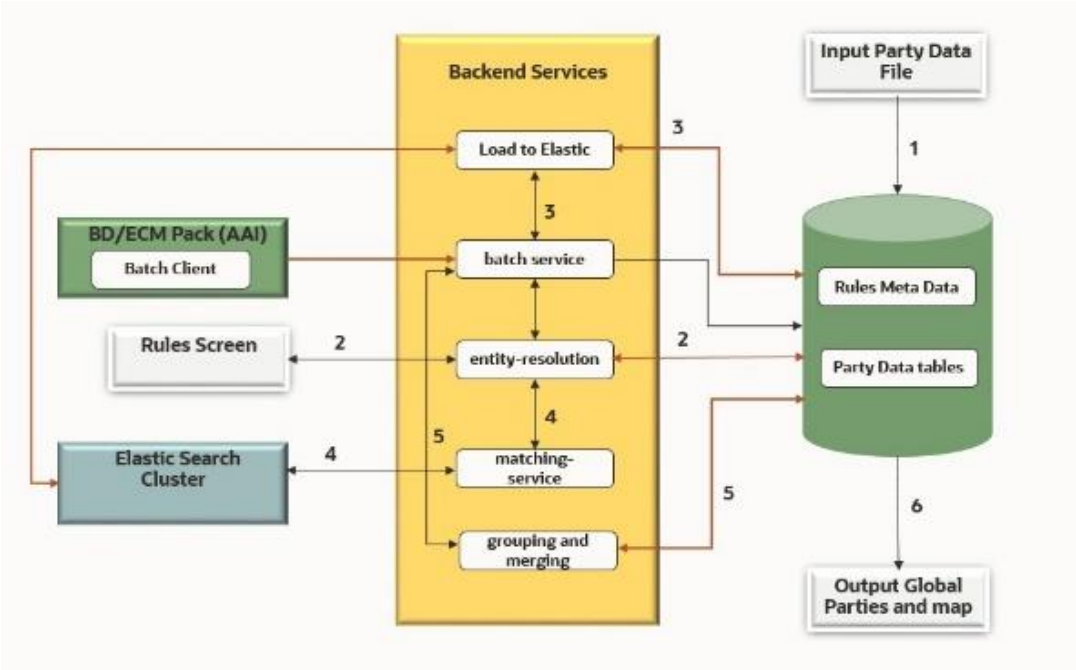
OFS Compliance Studio supports building a top-down customer segmentation framework using the institution's understanding of its risk profile, product portfolio, and customer base. Use unsupervised methods to create bottom-up segments under these higher-level segments. Use anomaly detection techniques to determine if a customer's behavior is inconsistent with that of its segment.

2.8.3 Entity Resolution

OFS Compliance Studio supports Entity Resolution. It allows firms to break through barriers in their data by gaining single views of their customers, their external entities and have the choice of monitoring them both under one consolidated Global Party.

Entity Resolution leverages ideas and concepts from entity resolution, machine learning, and graph analytics to resolve parties across vast datasets where customers to avoid detection may misidentify parties due to segmented business processes or malicious attempts. The new features allow firms to have rich visualization around complex networks and truly gain an entity view across varied datasets. This new clear customer view also can be weaponized within AML detection systems by using this resolved data to drive down false positives and ensure entities are being monitored holistically.

Figure 7: Entity Resolution



The following are reference points for Figure 7:

1. Load input data
2. Input rules
3. Create and load Index
4. Match and generate similarities
5. Group and merge based on similarities
6. Persist Global parties in the file system

The following components are involved in this use case:

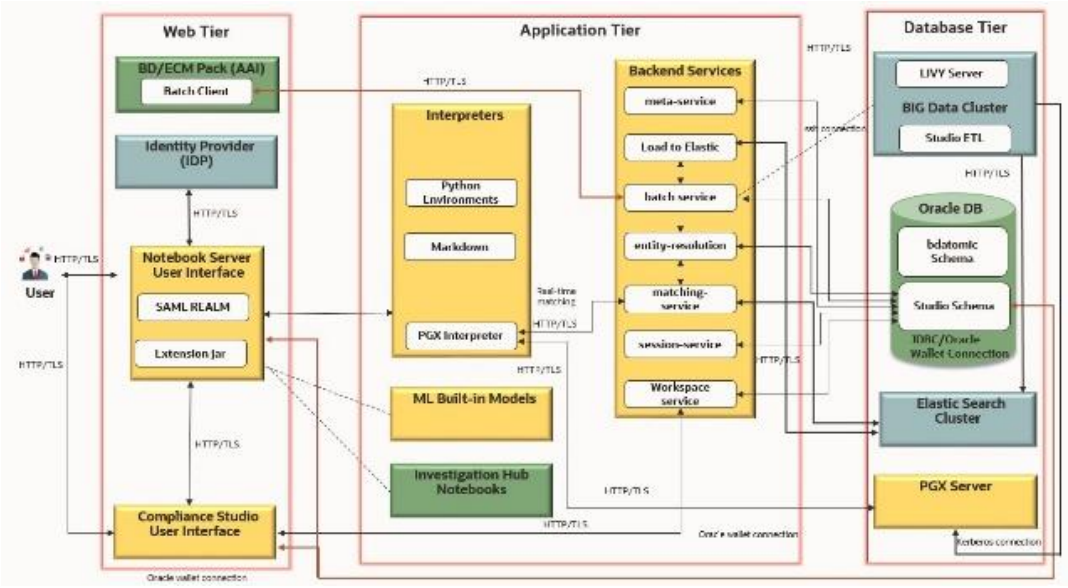
- OFS Compliance Back End Service
- ECM/BD Pack
- Oracle DB
- Elastic Search

For more information on each component, see the Component Details section.

2.8.4 Investigation Hub

OFS Investigation Hub is an application built on Compliance Studio, allowing investigators to rapidly view the case and adhoc information within the FCGM. The in-built scoring, matching, and correlation engines create meaningful investigation units, and pre-configured red flags and risk factors target investigative effort effectively. The FCGM on which it is built accelerates investigations by bringing relevant information sources together, preventing the need for the manual collation of information from disparate sources for adhoc investigations. OFS IH automatically generates case narratives and insights, highlights risk factors, red flags meaningful to the investigation, and recommends actions based on graph scoring algorithms.

Figure 8: Investigation Hub



The following components are involved in this use case:

- OFS Compliance Front End Service
- OFS Compliance Back End Service
- IDP
- ECM/BD Pack
- Oracle DB
- Elastic Search
- PGX
- BIG Data Cluster
- Investigation Hub

For more information on each component, see the Component Details section.

OFSAA Support

Raise a Service Request (S.R.) in My Oracle Support (MOS) for queries related to the OFSAA applications.

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