SAMS Payment System Architecture Requirements

Purpose

This appendix describes the target architecture for the Payments Solution. This document will also provide additional technical requirements that must be adhered to by the Contractor.

Overview and Key Principles

NYSED, along with most State, Local and Education (SLED) organizations, is finding it increasingly difficult to find technical resources to develop and maintain custom application development. However, due to the unique business requirements required by New York State legislative mandates, turnkey Commercial-off-the-Shelf (COTS) and Software-as-a-Service (SaaS) solutions are often insufficient. This scenario applies to the Payments solution.

Furthermore, the Payments process must support volatile business rules and payment calculations. Much of these complexities cause manual testing and duplicative calculations.. NYSED is investing in Low-Code Development Platforms (LCDP) to mitigate the long-term staffing risks and to potentially enable "Citizen Development[1]". SAMS Payments will be the first major NYSED application to be primarily built on the OutSystems LCDP.

NYSED has made the determination that SAMS cannot be migrated to a LCDP with one megalithic project. Therefore, we are starting with the Payment process due to its urgency. Once the rest of the SAMS application portfolio is migrated, we do not want to make structural changes to the new Payment Solution. Therefore, it is critical that data interactions between the Payment Solution and external systems use an abstracted service interface that will be supported throughout the migration project and thereafter.

Key Principles:

- Out-of-the-box (OOTB) functionalities of OutSystems or any other technology enablers will be used over customized solutions. Pro-code (Java, C#, JavaScript, Python, etc.) must not be used unless absolutely necessary.
- All system integrations between the Payment Solution and external systems must use a formal service interface.

[1] Citizen Development refers to the practice of enabling non-professional developers to create or edit business applications.

Payments Business Process

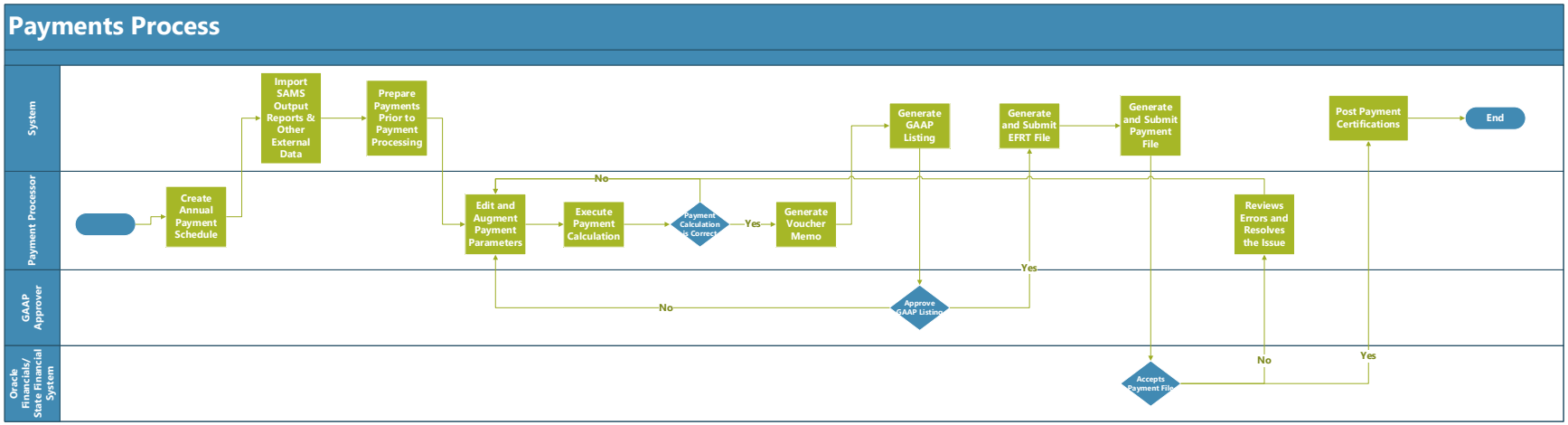

Figure 1: SAMS Payments Business Process

Note: GAAP stands for Generally Accepted Accounting Principles.

Actors

Actor	Type	Number of Users	Description
System	System	-	The new Payment Solution. This lane is a placeholder for fully automated tasks.
Payment Processor	NYSED Staff	3-10	The main users of the system. They are responsible for calculating and issuing payments to the local school districts and BOCES.
GAAP Approver	NYSED Staff	1-3	Staff that legally approves payment processing.
Oracle Financials and State Financial System (SFS)	System	-	The primary accounting systems for NYSED and the State of New York. Oracle Financials acts as a proxy to SFS.

Table 1: Payment Processing Actors

Process Flow

Name	Type	Description	Recurrence	Target Systems
Create Annual Payment Schedule	Input Form	The payment schedule is entered by a Payment Processor.	Annually	OutSystems
Import SAMS Output Reports & Other External Data	Automated	All the parameters required to calculate payments are ingested by the System.	Data is imported according to annual cycles	OutSystems, Java, Talend
Prepare Payments Prior to Payment Processing	Automated	Payment process tasks are created based on the Payment Schedule and other imported data.	Payments are prepared according to the Payment Schedule	OutSystems

Name	Type	Description	Recurrence	Target Systems
Edit and Augment Payment Parameters	Input Form	The Payment Processor will review and make edits to each potential payment.[2]	As Needed	OutSystems
Execute Payment Calculation	Input Form	Once the Payment Processor believes the payment parameters are correct, the payment is calculated based on Business Rules.	Per Payment Schedule	OutSystems
Payment Calculation is Correct	Web Report and Approval Task	Once a calculation is made, the Payment Processor reviews the calculation.	Per Payment Schedule	OutSystems
Generate Voucher Memo	Input Form	A payment that is formally registered.	Per Payment Schedule	OutSystems
Generate GAAP Listing	Automated	The system aggregates payment information from the Voucher Memo.	Per Payment Schedule	OutSystems, Adobe Sign
Approve GAAP Listing	E-Signature	The GAAP Approver legally approves the payments listed on the GAAP listing.	Per Payment Schedule	Adobe Sign
Generate and Submit EFRT File	Automated	The EFRT file is generated and submitted to EFRT.	Per Payment Schedule	OutSystems, Talend, GoAnywhere

[2] Payment Parameters are edited for the payment, but the data in the system of record remains the same.

Name	Type	Description	Recurrence	Target Systems
Generate and Submit Payment File	Automated	The payments are requested through a payment file that is submitted to Oracle Financials and SFS.	Per Payment Schedule	OutSystems, Telend, GoAnywhere
Accept Payment File	Third Party/External	The payment file is processed.	Per Payment Schedule	Not Applicable
Review Errors and Resolve Issues	Manual Task	Payment Processors may need to adjust payments. If necessary, ITS may be notified for assistance.	Per Payment Schedule	OutSystems, JIRA
Post Payment Certifications	Automated	The payment certification reports are posted to the NYSED public web site.	Annually	OutSystems, GoAnywhere

Table 2: Payment Process Flow Description

Conceptual Data Architecture

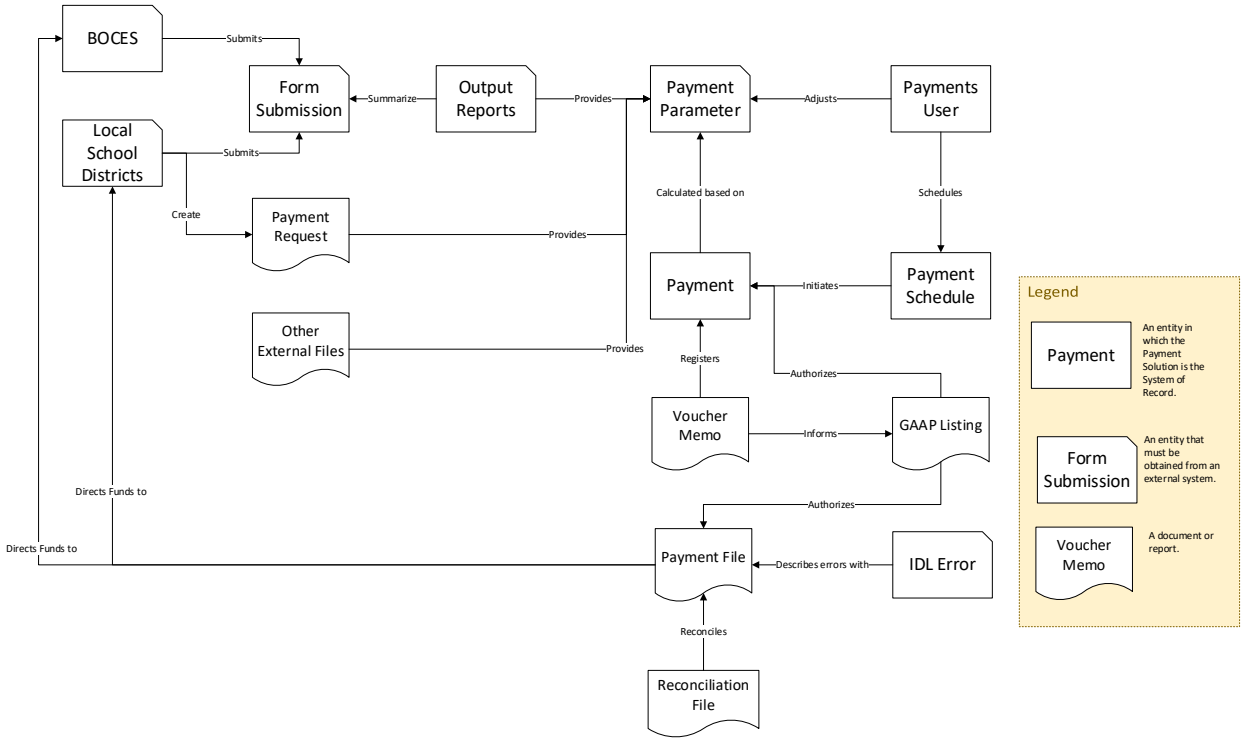

Figure 2: SAMS Payments Conceptual Model

Entity	Description	Target System of Record	Relationships
BOCES	Boards of Cooperative Educational Services (BOCES) are specialized districts that provide services that are created when two or more school districts have similar needs that can be met through a shared program.	SEDREF	• BOCES districts submit annual Form Submissions. • The Payment File directs funds to BOCES through SFS.
Form Submission	A set of forms that list a set of facts and financial information about a school district. These are similar to an annual financial statement or an annual disclosure.	Legacy SAMS	• BOCES submits Forms Submissions annually. • Local School Districts submit Form Submissions annually. • Form submissions contain many Payment parameters, which are aggregated by Output Reports.
GAAP Listing	A listing of payments that are authorized by NYSED. This document is legally binding.	Adobe Sign	• GAAP Listings authorizes the Payment File and the Reconciliation File.
IDL Error	Interface Description Language (IDL) Errors are issues that occurred during the processing of Payments by SFS.	SFS	• IDL Errors describe issues with the Payment File.
Local School District	A local school district within New York State.	SEDREF	• Local School Districts submit annual Form Submissions. • The Payment File directs funds to Local School Districts through SFS.

Entity	Description	Target System of Record	Relationships
Other External Reports	Various external parties provide data files that provide Payment Parameters.	Various External Parties	• External Reports provide many Payment Parameters.
Output Reports	An aggregate report of Form Submission data with additional calculated fields.	Legacy SAMS	• Output Reports summarize Form Submissions • Output Reports provide Payment Parameters.
Payment	A calculated payment that should be directed to a school district.	OutSystems	• Payments are calculated based on many Payment Parameters. • A Payment Schedule initiates a Payment and sets the deadline for the Payment.
Payment File	A file that is sent to Oracle Financials and SFS to authorize Payments.	OutSystems	• A Payment File directs funds to school districts (local and BOCES). • Issues with a Payment File are described by an IDL Error. • Payment files list payments that are authorized by the GAAP Listing.
Payment Parameter	A value that is collected from one or more Form Submissions.	Legacy SAMS	• Output Reports list multiple Payment Parameters. • Payments are calculated based on Payment Parameters

Entity	Description	Target System of Record	Relationships
Payment Request	A document that is created by a Local School District. It requests NYSED to authorize a one-time payment. The document will list the parameters that are required to authorize the payment.	OutSystems	• A Local School District creates and submits a Payment Request Document. • A Payment Request document contains Payment Parameters.
Payment Schedule	A list of key dates in which Payments must be calculated, reviewed, authorized and submitted.	OutSystems	• Payment Schedules initiate Payments. • Payments Users schedule Payment Schedules.
Payments User	The NYSED staff that calculate, review and authorize Payments.	OutSystems User Modules	• Payment Users schedule Payment Schedules. • Payment Users adjust Payment Parameters The following are not pictured due to brevity: • Payment Users initiate Voucher Memos • Payment Users initiate and authorize GAAP Listings. • Payment Users analyze IDL Errors.
Reconciliation File	A file that lists all the payments for a year. This file is sent to the EFRT systems, which performs the reconciliation.	OutSystems	• The Reconciliation File reconciles the Payment File.

Entity	Description	Target System of Record	Relationships
Voucher Memo	A review document that allows supervisors to approve Payments.	OutSystems	• Voucher Memos registers Payments. • Voucher Memos inform GAAP Listings. • Voucher Memos are aggregated by Payment Files.

Table 3: Payment Entities

Application Context Architecture

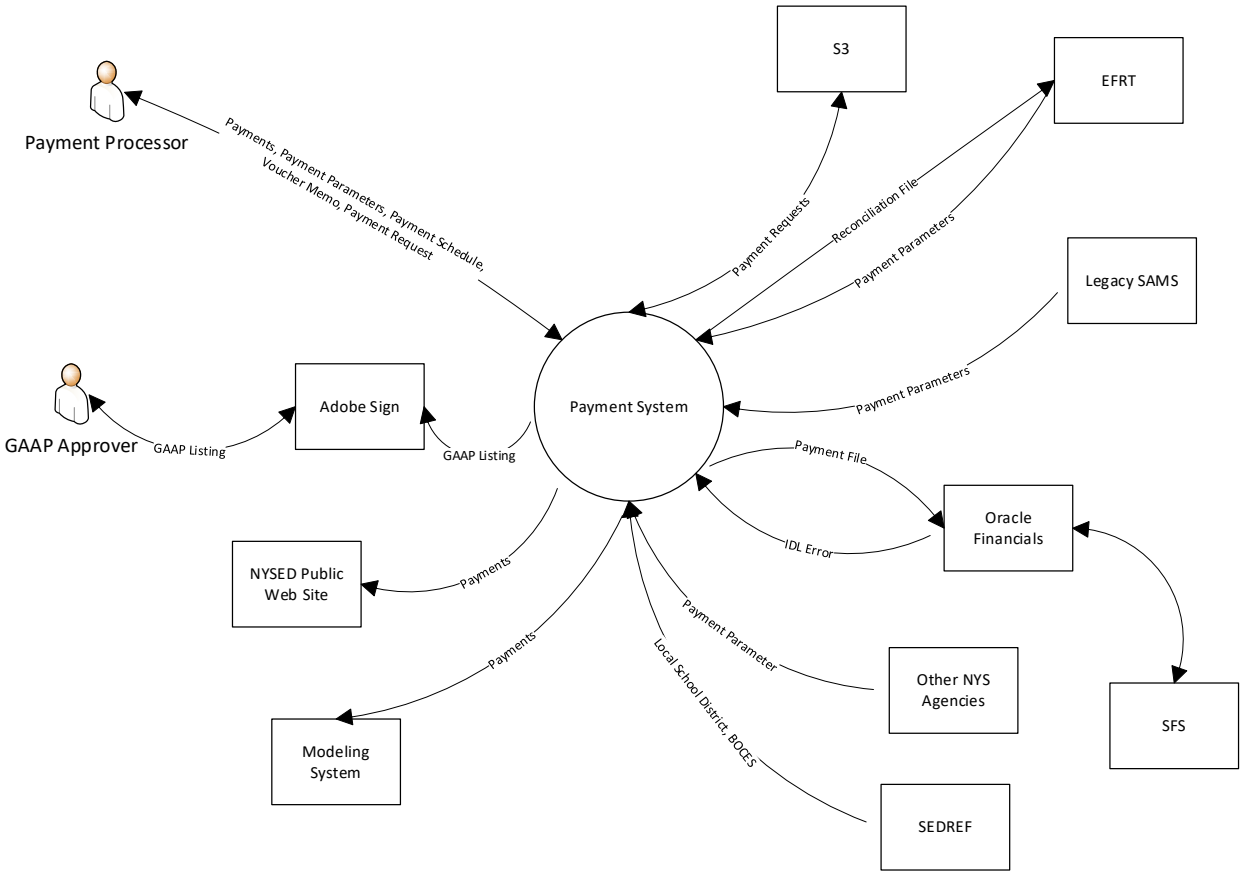

Figure 3: Payments Application Context Diagram

Application Descriptions

Application Name	Owner	Purpose
Adobe Sign	Adobe (vendor)	GAAP Listings will be exported to Adobe Sign for e-signature. The GAAP Listing will be stored in Adobe cloud. A link to the signed document will be stored in the Payments system.
EFRT	NYSED	EFRT is an accounting system maintained by NYSED. It provides the payment system with additional payment parameters. EFRT also reconciles payments made by SFS and what was authorized by the Payments System.
Legacy SAMS	NYSED	The core financial system for NYSED. Legacy SAMS provides most of the Payment Parameters used to calculate Payments.
Modeling System	NYSED	The Modeling system is used by the Fiscal Analysis and Research Unit (FARU) to develop financial models. These models are used by elected officials to determine upcoming budgets. The Payment System provides Payment information to the Modeling System.
NYSED Public Web Site	NYSED	Payment certifications and other documents are posted to the NYSED Web Site for public review.
Oracle Financials	NYSED	Acts as a proxy to SFS.
S3	AWS (vendor)	Hosts Payment Request documents and other static documents and files. S3 is used due to its affinity to the OutSystems managed platform.
SEDREF	NYSED	SEDREF hosts the core information relating to BOCES and Local School Districts.
SFS	SFS	Statewide Enterprise Resource Planning (ERP) system. Payments to school districts are directly issued by SFS.
Other NYS Agencies	TRS	Various NYS agencies, including the Department of Budget (DOB), Department of Tax and Finance (TAX) and Teachers' Retirement System (TRS), provide multiple flat files that provide information required for calculating payments.

Table 4: Payment Application Dependencies

System Interactions

Service Name	Consumer	Provider	Description	Key Data Elements	Service Protocol or SDK[3]
AWS S3	Payments (OutSystems)	AWS S3	Content management utility for Payment Requests and other related documents.	Payment Request, Other Non-Structured Files	Amazon S3 Connector
Reconciliation Exchange	EFRT	Payments (OutSystems, Talend)	Payments provides a Payment history file. EFRT uses this file to reconcile payments made by SFS with the payments authorized by the Payments System.	Reconciliation File	JSON over SFTP
SAMS Service	Payments (OutSystems)	Legacy SAMS (SpringBoot Proxy Service)	Provides an abstraction to the Output Reports and Form Status provided by SAMS. All Payment Parameters provides by SAMS are obtained through this service.	Payment Parameters	REST (JSON over HTTPS)

[3] Software Development Kit

Service Name	Consumer	Provider	Description	Key Data Elements	Service Protocol or SDK[3]
Parameter Repository	Payments (OutSystems)	EFRT, TAX, TRS, RSU (Talend & GoAnywhere as a proxy)	All flat files that are provided by other NYS agencies or NYSED applications will be transformed to a standardized JSON format. The JSON file will be consumed by OutSystems for payment processing.	Payment Parameter	JSON over SFTP
Payment File Exchange	Oracle Financials	Payments (OutSystems)	The authorized payments are sent to Oracle Financials for processing. Oracle Financials acts as a proxy to SFS.	Payment File	JSON over SFTP
IDL Error Exchange	Payments (OutSystems)	Oracle Financials (Talend & GoAnywhere as a proxy)	Returns a set of errors that result from SFS processing the Payment File.	IDL Error	JSON over SFTP
SEDREF Service	Payments (OutSystems)	SEDREF	This service provides the core information of Local School Districts and BOCES.	Local School Districts, BOCES.	REST (JSON over HTTPS)
Modeling Data Pipeline	Modeling System	Payments (OutSystems)	Payments System provides payment data to the Modeling system for budget and financial analysis.	Payments	TBD
Payment Certification Exchange	NYSED Public Web Site	Payments (OutSystems)	Payment certification reports are released to the public.	Payments	TBD

Service Name	Consumer	Provider	Description	Key Data Elements	Service Protocol or SDK[3]
Adobe Sign API	Payments (OutSystems)	Adobe Sign	Adobe Sign is used to create and authorize a GAAP Listing using an e-signature.	GAAP Listing	Adobe Sign Connector

Table 5: Payment Service Interfaces

Service Model

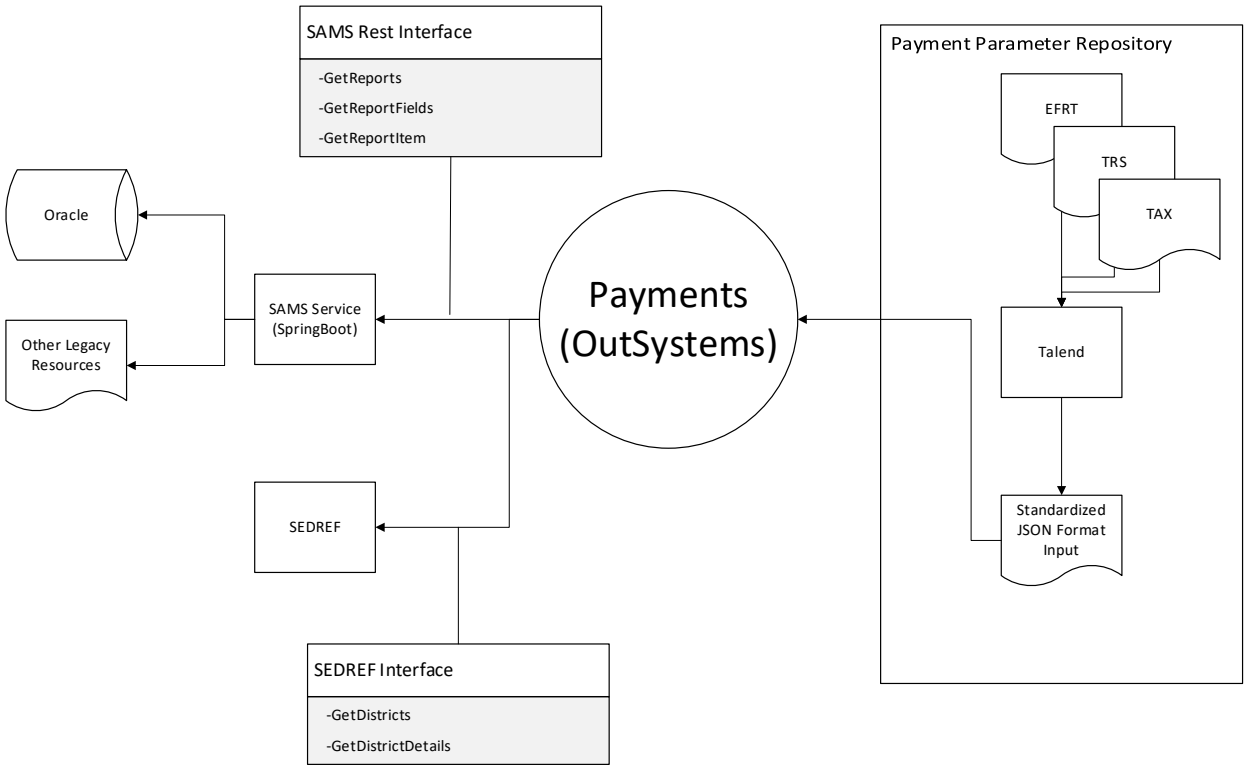

Figure 4: Logical Service Model

Note: This model does not contain all the service interfaces required by the Payments System.

OutSystems modules will only obtain data through standardized interfaces. There are three (3) interfaces that will be maintained by NYSED: SAMS Service, Payment Parameter Repository and the SEDREF API.

The SAMS Service will provide all the information that is available on Output Reports and the corresponding Form Submission status. This REST API that will probably be written in Java SpringBoot. The interface information model will provide a standardized data model that will format all form data into a consistent structure. A draft design of this structure is found in Figure 5.

The Payment Parameter Repository provides all Payment Parameters that are not provided by the SAMS Service. OutSystems will obtain highly standardized JSON files from our Go Anywhere SFTP server. The JSON files will follow an information model very similar to the one provided by the SAMS Service. NYSED will develop a series of data transformations to convert the flat files to the standardized JSON format.

The SEDREF API will provide data relating to school districts and BOCES.

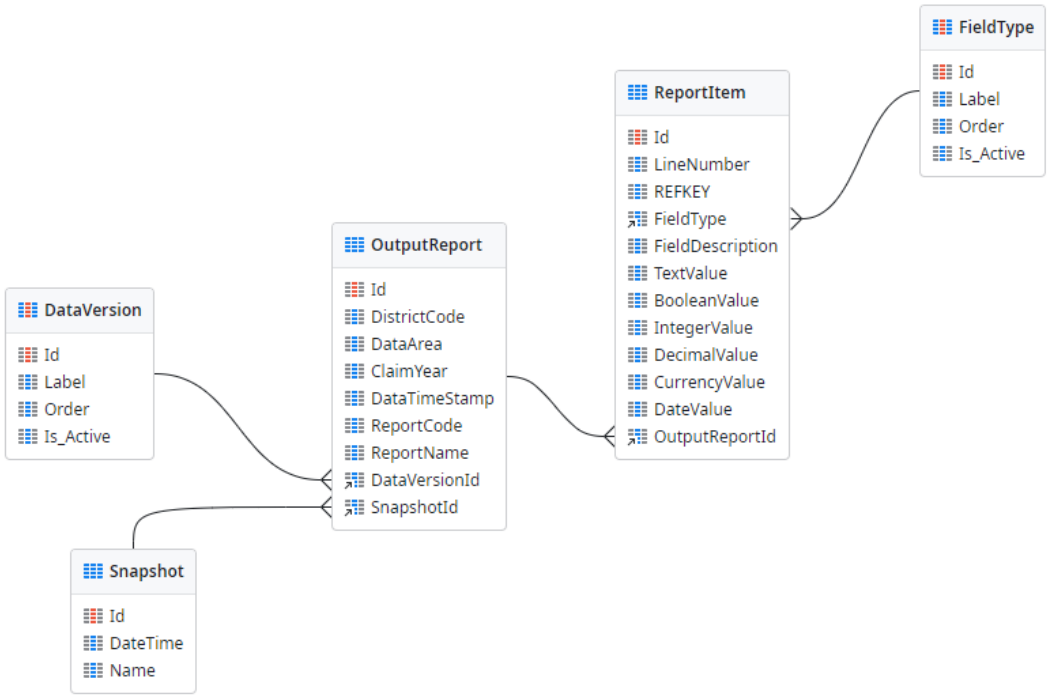

Figure 5: Draft information model that will used by the SAMS Service and the Payment Parameter Repository. The model is subject to minor changes.

Conceptual Deployment Architecture

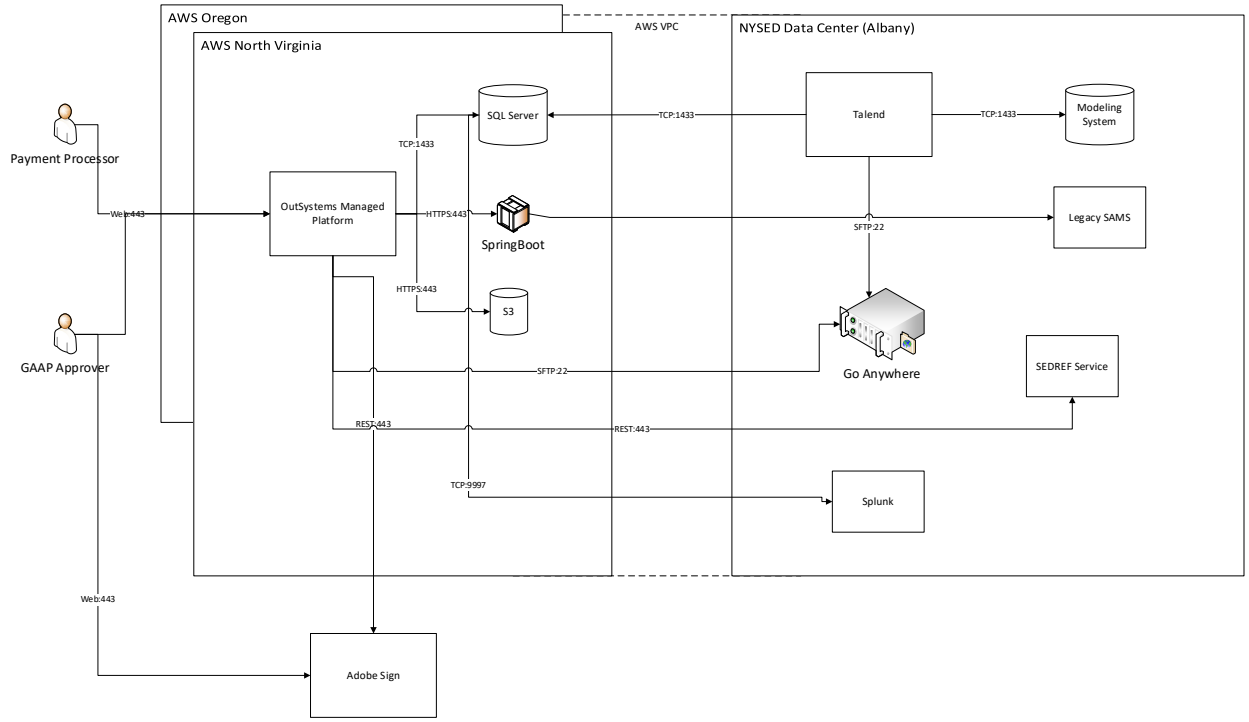

Figure 6: Payments Conceptual Deployment Architecture

The Payment solution will be primarily developed and hosted on the managed OutSystems platform that is hosted on AWS. There are multiple external services that must also be utilized by the Payments application hosted on OutSystems. Table 6: Payment System Components and Dependencies describes each dependency.

The Payment solution will be deployed on two AWS Regions: Oregon and North Virginia. The Lifetime, DEV, QA, STAGING and PROD environments of OutSystems will be hosted in North Virginia. The Disaster Recovery (DR) environment will be hosted in Oregon.

Connectivity to the NYSED Data Center in Albany, NY will be protected using an AWS Virtual Private Cloud (VPC), which is included with our OutSystems subscription.

Component	Purpose	Description	Associated Services	Deployment
Adobe Sign	E-Signature Platform	Used to officially authorize GAAP Listings.	Adobe Sign API	Adobe Cloud
GoAnywhere	Managed File Transfer and SFTP Server	Hosts various files for data exchanges.	• Parameter Repository • Reconciliation Exchange • Payment File Exchange • IDL Error Exchange • Payment Certification Exchange	NYSED Data Center
Legacy SAMS	Legacy System of Record	SAMS is the system of record for most Payment Parameters required by the Payment solution. SAMS can be accessed through a SpringBoot REST façade.	SAMS Output Service	NYSED Data Center
Modeling System	Data Warehouse and Analytics	The Modeling System is a data warehousing application that is used to project future budgets and other analysis. Data from the Payment Systems must be provided to the Modeling system.	Modeling Data Pipeline	NYSED Data Center
OutSystems Managed Platform	LCDP	The primary development platform for the Payment System. All user interactions for the Payments system will be developed on OutSystems (except for GAAP Listing approvals). We will be using the OOTB managed architecture provided by OutSystems.	All services	AWS
S3	Storage Bucket	Used to store Payment Requests and other documents.	AWS S3	AWS

Component	Purpose	Description	Associated Services	Deployment
SEDREF	System of Record	This application provides the core information of Local School Districts and BOCES.	SEDREF Service	NYSED Data Center
Splunk	Log Consolidation	All security and audit logs that are generated by OutSystems will be forwarded to Splunk. This will enable log analysis and provide a segregated location for security logs.		NYSED Data Center
SpringBoot	REST Service Proxy	This containerized Java application provides a REST interface for the Output Reports provided by SAMS Legacy.	SAMS Output Service	TBD (AWS or NYSED Data Center)
SQL Server	Staging Database	This is a near real-time replicate of the OutSystems database. All Extract Transform & Load (ETL) and data streaming consumers will use this database as a source. The online transactional database managed by OutSystems may not be directly accessed.	Modeling Data Pipeline	AWS
Talend	ETL Platform	Performs data transformations for the Payment Repository SFTP service.	Payment Repository	NYSED Data Center

Table 6: Payment System Components and Dependencies

OutSystems Module Architecture

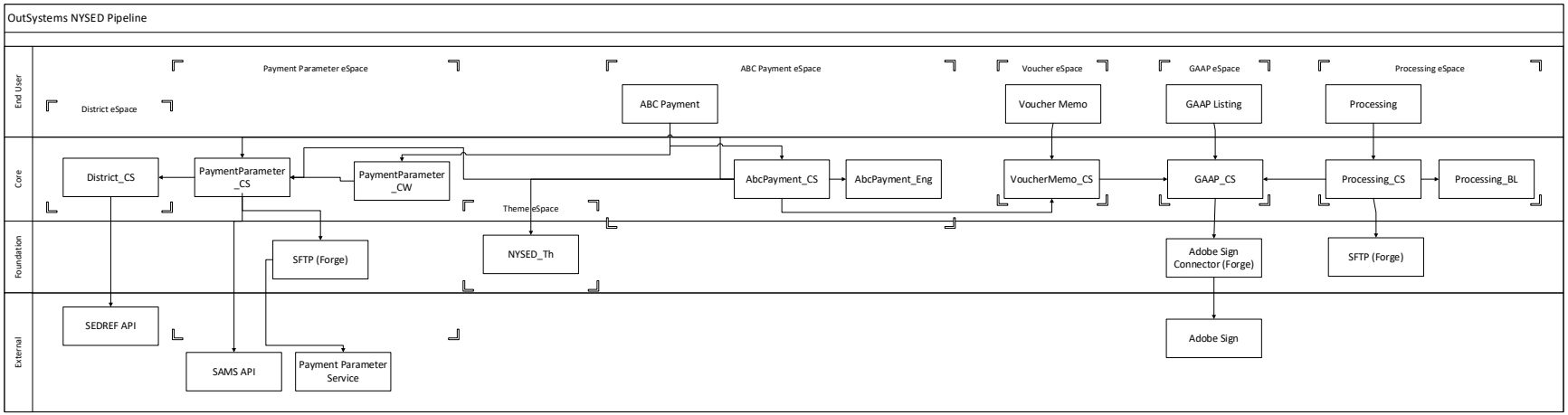

Figure 7: Draft Payments Module Architecture

Notes:

- Wrapper modules at the Foundational layer are omitted for brevity.
- All End User modules have a dependency on the NYSED_Th core theme.
- All End User modules will utilize the Business Process Technology (BPT) features of the OutSystems platform.
- This architecture is subject to change.

The Payment Solution will use a micro-service architecture. There are seven (7) core eSpace[4] components that will be required for the Payment System:

- NYSED Theme (NYSED_Th): The core user experience theme used by all End User modules.
- Payment Parameter (PaymentParameter_CS, PaymentParameter_CW): These are modules that enable Payment services and end users to find and select Payment Parameters.
- District_CS: Used by the Payment Parameter modules to look up district data. A data synchronization module will also be needed (not pictured).
- Voucher (Voucher Memo, VoucherMemo_CS): Modules that manage the Voucher Memo entities.

[4] An eSpace is an OutSystems term for a collection of interdependent OutSystems modules.

- GAAP (GAAP Listing, GaapListing_CS): Modules that manage the GAAP Listing Process.
- Processing (Processing, Processing_CS, Processing_BL[5]): Manages the submission of the Payment File and other file submissions to external systems. This eSpace also manages the IDL Errors that are returned by SFS.
- Schedule (not pictured): Manages the annual payment schedule.

The system will also require multiple (approximately 30) Payment eSpaces. For illustrative purposes, one fictitious Payment eSpace is included in Figure 7 (ABC Payment). Each Payment eSpace will include a process flow, entities, user interface, and business rules associated with the payment. These modules will be highly volatile due to churn associated with the business rules. Due to the churn of these modules, no modules should reference any Payment module.

[5] Required if necessary.