2005 Single Family Housing Target Architecture

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Executive Summary

In conjunction with an ongoing effort by the U.S. Department of Housing and Urban Development's (HUD) Office of the Chief Information Officer (OCIO) to implement a Department-wide Enterprise Architecture (EA), Single Family Housing (SFH) has developed a proposed high-level target Information Technology (IT) architecture. SFH was deemed a high priority based on the rising maintenance costs of its outdated IT systems, coupled with the overall inability of these systems to support the field operations and emerging business requirements. An interdisciplinary work group comprised of staff from the Office of Single Family Housing, Office of Systems and Technology, and the OCIO collaboratively developed the new proposed SFH Serviced Oriented Architecture (SOA) to the target architecture[1].

Implementation of this new SFH Target Architecture (SFH TA) will significantly reduce the number of systems directly supporting Single Family's daily business activity. There are currently thirty-five official and ten unsupported systems. The SFH TA establishes five core modules as shown below in Table 1. This may result as much as a significant reduction in the number of SFH business systems. This projection is based on analysis of the "as-is" baseline system environment that identified numerous systems supporting common business functions and sharing similar data.

Table 1. SFH Core Modules

1. Loan Origination
2. Loan Insurance Management
3. Asset Management
4. Business Partner Approval & Monitoring
5. Business Intelligence

Business functions and processes for SFH were then reorganized according to similar functionality and data use. The SFH TA minimizes functional overlap, improves data quality, and increases flexibility. It also identifies opportunities to leverage systems that cut across SFH and/or the entire Department. The SFH TA accommodates both the present and future requirements identified by Single Family Housing in its target architecture document.

The TA accommodates both Headquarters and the Homeownership Centers (HOCs) by integrating current ad hoc systems such as the Underwriting Reports System, Lender Assessment Subsystem, and Nonprofit Approval Tracking System into the appropriate business module. However, the flexible design of the system mitigates the need for cuff systems. The TA parallels SFH's organizational divisions in all locations, which will minimize system disruption across SFH as new development efforts are initiated. Additionally, the TA will reduce total cost of ownership by modernizing the technology base and decreasing maintenance costs.

[1]See Appendix A of this document for more details on SOA.

Judging by the level of effort required to reach the target architecture, a set of coordinated projects are being used to supply overall integration design and project management support office functions, and to help acquire or build the various components of the TA. These artifacts produced by these efforts are being managed to be compliant with the HUD EA, bringing about the segment architecture for the SFH line of business.

1 Introduction

Single-Family Housing's Integration Project was initiated in 2005, with the goal of updating older existing technologies and platforms to streamline, safeguard and simplify access to mission-critical data. A vision has been formulated for this development, and an EA Migration Plan has been delivered to HUD. The information contained in this document comprises a combination of the 2005 HUD EA Plan and the SFIntegration Project documentation.

This Target Architecture (TA) document will serve as an updated version of the previous SFH TA Blueprint, dated September 9, 2002. This new Blueprint will focus on the current state of the SFIntegration Project and the current Target Architecture.

The SFH TA document is a living document, slated to undergo revision as the Project progresses. All tables and figures found within should be viewed as a representation of current best knowledge as of 1 September 2005; it is expected they will be updated as needed throughout the life-cycle of the Project.

1.1 Background

The Clinger-Cohen Act passed by Congress in 1996 gave the Department of Housing and Urban Development's (HUD) Chief Information Officer the responsibility for developing an integrated Enterprise Architecture (EA). HUD's Enterprise Architecture Team was charged with identifying strategic business objectives and aligning those objectives with appropriate information needs and IT solutions. The SFH TA identified and provided SFH's direction for investing in information technology. The target architecture shows how SFH operations can be improved through a streamlined system architecture for Single Family Housing's business lines.

SFH activities are supported by the current systems and cuff systems (databases) in Figure 1. At least 10 of those systems that are included within the scope of the Single Family Integration System Project were not in the original Single Family Housing EA Blueprint (dated September 2002).

Leveraging off of the SFH TA, the SFIntegration Project was initiated in October 2004. The scope of the project was to analyze thirty-five systems, their functionality and data, to develop an integrated system operating on a single database. Each module within the system will support a business function of SFH. The Modules are as follows:

Figure 1. Legacy Systems Mapped to SFIntegration System Modules

System Number	System Name	Loan Insurance	Servicing	Asset Mgmt	BPA&M	Business Intelligence
	Underwriting Reports System					
F17A	Automated Underwriting System/TOTAL Scorecard	X				
F57	Credit Alert Interactive Voice Response System (CAIVRS)	X				
F17	Computerized Homes Underwriting System (CHUMS)	X			X	
F17B	Case Binder Tracking System (CBTS)	X			X	
F17C	FHA Connection (FHAC)	X	X		X	
F12	Home Equity Conversion Mortgages (HECM)	X	X		X	
F51	Institution Master File (IMF)	X	X		X	
F11	Housing Counseling System	X		X	X	
F72	Title I Insurance and Claims	X	X			
A80R	Single Family Premium Collection Subsystem – Upfront (SFPCS-U)		X			
A43C	Single Family Claims Subsystem		X			
A80D	Distributed Shares and Refund Subsystem (DSRS)		X			
A80P	Single Family Premium Collection System – Periodic (SFPCS-P)		X			
F71	Title I Notes Servicing (Debt Collection and Asset Management)		X			
F42D	Single Family Default Monitoring System (SFDMS)		X			
A43	Single Family Insurance Subsystem or Insurance In Force (SFIS)		X	X		
A80S	Single Family Acquired Asset Management System (SAMS)			X		
A80H	Single Family Mortgage Notes Servicing System (SFMNS)			X		
	Non-Profit Approval Tracking			X		
P110	Single Family Appraisal Subsystem (SASS)			X	X	
F51A	Application, Recertification and Review Tracking System (ARRTS)				X	
F51B	Mortgagee Portfolio Assessment System (MPAS)				X	
F51Q	Quality Assurance Document Library System (QDLS)				X	
PO30	ILS/RESPA Tracking System				X	
PO96	Lender Assessment Subsystem (LASS)				X	
F42H	Home Mortgage Disclosure Act System (HMDA)				X	
A80W	Neighborhood Watch Early Warning				X	
A80Q	Public Inquiry Communication Subsystem (PICS)					X
F42	Consolidated Single Family Statistical System					X
D64A	Single Family Data Warehouse (SFDW)					X
A65	**Subsidized Housing Accounting System (SHAS)**					
A65A	**Section 235 Automated Validating and Editing System**					
	Manufactured Housing					
	Technical Suitability of Products					
	Total Systems Supporting Business Function/Sunset (SS)	10	11	6	14	3

The CIO manages most of these systems. According to the SFIntegration System Cost-Benefit Analysis Report, the operations and maintenance costs for these systems is approximately $40 million per year. The costs for the cuff applications are not apparent since they are informally maintained by HUD staff out of program funds (as opposed to Working Capital Funds). These run a risk of simply disappearing if the individuals providing the support should change jobs or leave the Department. For that reason, the cuff applications clearly document the incomplete functionality of the current system environment. Owners of the CIO-managed systems are distributed among Single Family Housing, the FHA Comptroller, and the Chief Financial Officer.

The CIO produced the updated *2005 HUD Target Enterprise Architecture Version 2.0,* dated June 27, 2005*,* which will be leveraged by the SFIntegration System Project in developing the SFH TA.

2 Current SFH Systems and Challenges

SFH is supported by a large number of systems which serve similar insurance-related functions. The systems are often faced with challenges such as:

- old technology
- disparate platforms
- fragmented data
- difficulty in adjusting to business needs
- GAO issues

Many of the major SFH systems were built in the 1980s (e.g., CHUMS, SFIS) and use proprietary software that makes it more difficult to reuse software code (e.g., SAMS). These high-volume systems were built for dedicated terminals rather than the modern network desktop where employees and partners use a Web browser to access a number of different systems.

New system or subsystems have been built by the Homeownership Centers (HOCs) to meet business needs that were otherwise not met. This tendency to build new systems rather than improve existing systems results in interoperability failures and created redundancies. These HOC systems are not connected to the HUD-managed system inventory, thus necessitating duplicate data entry and manual data update. Many of these systems exchange data with one another, which creates a complex and unwieldy architecture.

The United States General Accounting Office (GAO) has issued various reports over the past few years. These audits cited a number of issues with Single Family Housing's (SFH) information systems and called on HUD to delay SFH systems acquisition and development until a target architecture was defined. Government Accountability Office report GAO/RCED-00-112, *Stronger Oversight of FHA Lender's Could Reduce HUD's Insurance Risk,* cited the following:

- **Lack of Reliable Information** - Significant data integrity issues exist within the Single Family systems due to batch processing and the duplication of data.
- **Redundancy of System Functionality** - Numerous systems throughout Single Family are supporting the same business functions (e.g. Loan Insurance, Monitoring).
- **Need to Utilize Manual Processes -** Due to the age of systems and their outdated technology, personnel within Single Family are required to utilize manual processes in performing their daily tasks and meeting their reporting needs.

- **Lack of Integration Between Systems -** The lack of integration between Single Family systems requires extraordinary efforts by HUD personnel to accumulate date in generating reports.
- **Lack of Required Functionality -** The lack of required functionality in the core Single Family system causes users to create non-core systems to meet their business needs.
- **High Maintenance Cost -** The CIO manages the 35 legacy systems and the operation, maintenance, and development costs exceed $40 million per year. This cost does not include the cost associated with supporting the Homeowner Center (HOC) non-core applications since HOC staff informally maintains them.

In addition to the findings in the GAO reports, SFH realized that a critical review of SF systems was necessary to address the current problems, including a general lack of flexibility to meet future requirements. SFH and OCIO have determined the need to address this situation as an important driver behind the effort to upgrade HUD Target Architecture. Figure 2 below provides a partial list of the drivers:

Figure 2. HUD Target Architecture Drivers

- Clinger-Cohen Act of 1996
- GAO Report (GAO/RCED-00-112), Stronger Oversight of FHA Lenders Could Reduce HUD's Insurance Risk
- Scrutiny of SFH modernization efforts, including associated OMB 300
  - HUD IT Select Process and Ongoing PMRB Submission
  - OMB Major IT Project Review
- President's Management Agenda Initiatives and HUD Management and Performance Initiatives
- Various Enterprise Architecture Efforts
  - SFH TA
  - HUD EA
  - OMB EA

This SFH TA will ensure that new development efforts are properly aligned with the core business functions carried out by Single Family Housing.

3 HUD Enterprise Architecture (EA) and SFH Reference Models

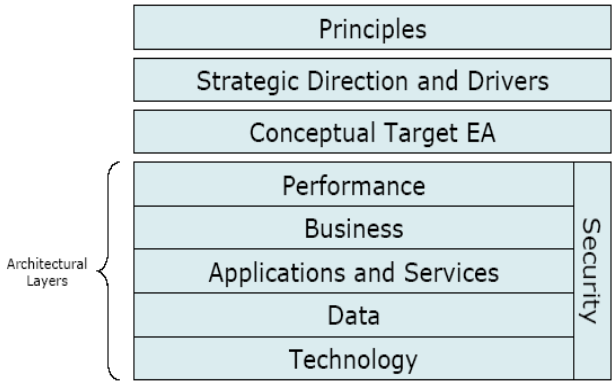
In FY 2005, the OCIO developed and updated a HUD Enterprise Architecture (EA) Framework that:

- supports mission performance
- avoids duplication of effort
- reduces costs
- promotes portability and interoperability
- encourages long-term stability.

The EA Framework presents an overview of current business and information systems, a strategy for the use of current technologies, and addresses the selection and deployment of technology to build toward the future. The EA Framework supports IT investment decisions based upon individual program functional business needs, as well as on how the new technology fits together with existing technology. The EA Framework allows HUD to structure its plan for department-wide future technology needs, while predicting the impacts to current architectures.

Figure 3 illustrates the HUD Target EA Framework as depicted in the 2005 HUD Target EA Framework document. The top three tiers represent the EA principles, the strategic drivers of the effort, and a conceptualized Target EA—the goal toward which the Department is working, and the philosophy and needs requirements that outline the benefits to be derived from such an undertaking. This tier frames the lower section containing the architectural layers: the performance goals and business rules that are served by the top tier, as well as the data and technology protocols that will be made accessible by the applications and services to be developed. Bracketing all of the architectural layers is the vital security layer that ensures safety of critical data and processes as mandated by Federal best practices. Together all these elements form a strong basis for development:

Figure 3. HUD Target EA Framework



Additionally, this Framework may be viewed as the HUD EA compliance with the Federal Enterprise Architecture Framework (FEAF), as set forth on the e.gov site (http://www.whitehouse.gov/omb/egov/a-2-EAModelsNEW2.html). At a very high level, the EA team provides the framework for categorizing the various aspects of the Department's daily activities. The EA Team developed a series of reference models to guide the process and products (such as baseline and target architectures) produced as a part of the process. The EA Team uses this information to identify redundant processes and those that might be better served by leveraging a technical solution across the entire Department. It also provides a framework to compare processes with similar names or appearance, and determine whether they are truly redundant.

The EA Team operates according to an established set of principles that help to shape the development of the EA and the implementation of information technologies. Among these principles, the following have had the most impact on the process:

- **Core Business Operations**. Development of the SFH TA began with identification of the current core business operations of the office. The EA Team was then able to focus on operations that must be supported by SFH systems versus those that could be supported either by systems in other areas of the Department or by enterprise wide solutions.
- **Enterprise Solution**. During this project, the EA Team sought ways to leverage technical solutions across the entire Department where appropriate. The core business of SFH dictates that this office performs certain processes. On the other hand, there are certain processes that SFH should not consider as part of its core business. For example all financial transactions are handled through the Federal Housing Agency Subsidiary Ledger system.
- **Reduce Complexity**. SFH uses approximately 35 systems and data bases to support its current operations. An examination of these systems and databases found that a considerable amount of overlap exists, with minimal flexibility to meet emerging requirements. One goal is to eliminate redundancy where possible and reduce the overall complexity of the systems.

Table 2 following illustrates the HUD EA's Business Reference Model (BRM) and its mapping to the SFIntegration System. This shows how HUD Business Areas, Functions, and Sub-Functions map to the new system's modules and the major business processes supported by those modules:

Table 2. Mapping of HUD BRM Elements To The SFIntegration System

HUD Business Area	HUD Function	HUD Sub-Function	Single Family Integration System	Major Processes Supported
Services for Citizens	Single Family Housing	N/A (Line Of Business)	All 5 Modules	• Each Module's corresponding major processes supported on a single set of platforms for executing all Modules: Database, Application Server, Messaging Middleware, Workflow/Business Process Management, Document/Record Management, and Data Warehouse/Business Intelligence Reporting • Each Module's corresponding major processes executed over new infrastructure: Services Registry, HUD-Wide Security System, Upgraded HUD Wide Area Network
Support Delivery of Services	Planning and Resource Allocation	Enterprise Architecture		
Management of Government Resources	IT Management	Lifecycle Change Management		
		Record Retention		
		Information Management		
		IT Security		
		System Development		
		System Maintenance		
		IT Infrastructure Maintenance		
Mode of Delivery	Loan Insurance	Issue Insurance	Loan Origination Module	• Close Loan Insurance (Application and Case Binder) • Evaluate Loan for Insurance (Pre-Endorsement Review and Reject/Endorse Loan for Insurance • Request Case Number • Submit Insurance Application • Evaluate Appraisal • Evaluate Credit • Approve/ Deny Loan
		Process Application		
		Perform Underwriting		
Mode of Delivery	Loan Insurance	Service Insurance	Loan Insurance Management Module	• Update Loan Insurance Information (Status and Servicer Changes) • Process Insurance Premium (Calculation and Application of Upfront and Periodic) • Process Claim • Verify Claim (Approve/Deny)
		Manage Claims		
Management of Government Resources	Financial Management	Asset and Liability Management		
		Reporting and Information		
Mode of Delivery	Loan Insurance	Manage Assets	Asset Management Module	• Acquire Asset (Conveyance and Recording) • Monitor Asset (Property Maintenance and Payments) • Dispose of Asset (Listing, Marketing, and Selling) • Service Assigned Loan (Status and Servicer Changes) • Sell Assigned Loan (Including Purchaser Monitoring) • Manage Single Family Housing Grants Programs (Housing Counseling Establishment, Execution, and Close-Out)
		Service Assigned Loans		
	Grants Management	Establish Program		
		Monitor Execution		
		Close-Out		
Support Delivery of Services	Revenue Collection	Federal Asset Sales		
Management of Government Resources	Financial Management	Asset and Liability Management		
		Reporting and Information		
Mode of Delivery	Business Participant Management	Participant Approval	Business Partner Approval and Monitoring	• Receive Application Package • Review Application Package • Approve/Reject Application Package (Including Partner
		Participant Monitoring		
	Enforcement	Program Evaluation		

HUD Business Area	HUD Function	HUD Sub-Function	Single Family Integration System	Major Processes Supported
		Program Monitoring	Module	Notification) • Monitor Lenders (Credit Watch, Neighborhood Watch, Field Reviews, etc.) • Monitor Servicers (Including Loss Mitigation Performance and Tier Ranking Analysis) • Monitor Appraisers (Watch Program) • Monitor Marketing and Management (M&M) Contractors (Reviews)
Support Delivery of Services	Controls and Oversight	Program Evaluation		
		Program Monitoring		
	Public Affairs	Customer Services		
Mode of Delivery	Loan Guarantees	Manage Risk	Business Intelligence Module	• Prepare Management Reporting Data (Extract, Load, Transform) • Store Management Reporting Data (Data Warehouse) • Provide Management Reporting and Analysis (Business Intelligence)
Support Delivery of Services	Market Research and Economic Analysis	Research and Development		
	Regulatory Development	Policy and Guidelines Development		

The Applications and Services Reference Model (ASRM) identifies core and cross-cutting capabilities to find system redundancies and areas where additional automation can be implemented. Table 3 illustrates how the various Service Domains map across Service Types and Components, and ultimately to features within SFIntegration for simplified tracking of which Modules are called or affected:

Table 3. HUD ASRM Mapped To SFIntegration System Features

Service Domain	Service Type	Service Component	Single Family Integration System Feature
Customer Services	Customer Relationship Management	Partner Relationship Management (framework for collaboration)	Business Partner Approval and Monitoring Module
Process Automation Services	Tracking and Workflow	Case/Issue Management	All Modules interacting with Workflow/Business Process Management System Component
		Process Tracking	
Business Management Services	Investment Management	Portfolio Management	Asset Management Module
		Performance Management	All Modules
	Management of Process	Business Rule Management	All Modules executing on an SOA orchestration platform
		Change Management	
Digital Asset Services	Document Management	Classification (of electronic documents)	All Modules Interacting with Electronic Document/Record Management System Component and with shared database
		Indexing (for quick retrieval of documents)	
		Library/Storage (for document and data warehousing and archiving)	
	Knowledge Management	Categorization (of data and information into specific sets)	
		Information Mapping/Taxonomy (for relationships between entities, standards, and categorization)	
		Information Sharing (for supporting the use of documents and data in a multi-user environment)	
		Smart Documents (for supporting the interaction of information and business logic between users)	
	Records Management	Document Classification (for categorization of electronic and physical	

Service Domain	Service Type	Service Component	Single Family Integration System Feature
		documents)	
		Document Retirement (for the retention or disposition of documents)	
		Record Linking/Association (for correlating logical data and information sets)	
Business Analytical Services	Analysis and Statistics	Mathematical (for algorithms used in analyzing data)	Business Intelligence Module supported with a Data Warehouse
		Predictive (for foretelling events in advance based on data)	
	Business Intelligence Reporting	Balanced Scorecard (for analyzing positive and negative impacts of a decision)	
		Decision Support and Planning (for the analysis of data and prediction of impacts of decisions)	
	Knowledge Discovery	Data Mining (for uncovering patterns and relationships in large sets of data)	
		Simulation (with models to simulate real-world processes)	
		Modeling (for describing data patterns and organization)	
	Reporting	Ad Hoc (for dynamic reports on an as needed basis)	
		Standardized/Canned (predefined reports and queries)	
		Online Analytical Processing (OLAP) (for summarizing data into multidimensional views)	
Back Office Services	Data Management	Data Classification (for classifying data)	Shared Database and Data Warehouse supporting the Business Intelligence Module
		Data Cleansing (for removing incorrect data)	
		Data Exchange (for data interchange between systems)	
		Data Warehouse (for the archiving and storage of large amounts of data)	
		Extraction and Transformation (for manipulating source data)	
		Loading and Archiving (for populating a database or data warehouse)	
	Development and Integration	Data Integration (for organizing data from separate sources into a single source)	All Modules executing on an SOA platform, using a shared database and Middleware
		Enterprise Application Integration (for moving disparate systems into a common data structure)	
	Financial Management	Billing and Accounting (for charging, collecting, and reporting on an organization's accounts	Interfacing with FHA Subsidiary Ledger for financial data
		Credit/Charge (for use of electronic funds transfers for payment and collection)	
		Debt Collection (for processing of accounts receivables)	
Support Services	Collaboration	Document Library (for grouping and archiving of files and records)	Electronic Document/Record Management System component
		Task Management (for supporting tasks assigned to employees)	Workflow/Business Process Management System component
	Search	Classification (for selecting and retrieving records)	Shared database and data warehouse
		Query (for retrieving records that satisfy specific criteria)	
	Security Management	Digital Signature (for guaranteeing the unaltered state of the file or transaction)	All Modules
		Encryption (for encoding data for security purposes)	
		Identification and Authentication (for obtaining and validating user information)	
		Verification (for confirming authority to enter/use a system)	

The Technical Reference Model (TRM) is used to classify standards and products into high-level categories to allow for better coordination of acquisition and support. Table 4 illustrates how Service Areas and categories map across such standards as web browsers, various databases, networks and the like, and further maps those items to specifications (e.g., programming languages and router protocols) and actual products in use on HUD's network—further indicating whether and where and impact or interaction may be felt by the SFIntegration System. The SFIntegration System will possess components to meet the particular services areas of the TRM:

Table 4. Mapping of HUD TRM to SFIntegration System

Service Area	Service Category	Service Standard	Service Specification	Product	Single Family Integration System Component
Service Access and Delivery	Access Channels	Web Browser	N/A	Internet Explorer v6.01, and Netscape Communicator v7.0	No change, but any needed portal plug-in must be compatible
		Other Electronic Channels	Extensible Markup Language (XML)	N/A	
	Delivery Channels	Internet	N/A	N/A	No change except ongoing updates to HUD VPN
		Extranet	Virtual Private Network (VPN	N/A	
	Service Requirements	Legislative/Compliance	Section 508	HUD-approved assistive technologies (e.g., JAWS)	No change expected unless dictated by TBD J2EE application server suite
		Authentication/Single Sign-On (SSO)	Lightweight Director Access Protocol (LDAP)	Pass Go for SSO	
	Service Transport	Supporting Network Services	Domain Name Service (DNS)	N/A	Addition of Web Services To HITS IT infrastructure may add to this list
		Transport Services	Internet Protocol (IPv6), File Transfer Protocol (FTP), Hyper Text Transfer Protocol (HTTP), HTTP Secure (HTTPS), and IP Security (IPSec)	N/A	
Service Platform and Infrastructure	Database Storage	Database	N/A	Oracle 9i or later	Oracle Database Suite accessed on a SAN or NAS arrangement
		Storage Services	Storage Area Network (SAN), and Network Attached Storage (NAS)	N/A	
	Delivery Servers	Web Servers	N/A	IIS, Apache, and SunOne	TBD J2EE application server suite may alter these choices given performance requirements of the new system
		Application Servers	N/A	SunOne Enterprise, Apache/ Tomcat, and BEA WebLogic	
		Portal Servers	N/A	N/A	
	Hardware/ Infrastructure	Servers/Computers	Unix	N/A	All Modules and Components accessed over the HITS IT hardware and network infrastructure
		Wide Area Network (WAN)	Special Purpose Router, General Purpose Router, and Special Purpose Gateway (for firewall)	N/A	
		Local Area Network (LAN)	Enterprise-level Managed Switch, Workgroup-level Switch, Network Bridge, Range Extender (network repeater)	N/A	
		Network Devices/Standards	N/A	Ethernet, T1/E1, ATM, OC3	
	Software Engineering	Integrated Development Environment (IDE)	Java 2 Enterprise Edition (J2EE)	TBD	TBD J2EE Application Server Suite may impact

Service Area	Service Category	Service Standard	Service Specification	Product	Single Family Integration System Component
		Software Configuration Management	N/A	PVCS	these; UML (Rational) used for functional modeling and data modeling done with ERWin, but both support standard export formats
		Test Management	N/A	Mercury	
		Modeling	UML	N/A	
Component Framework	Business Logic	Platform Independent	N/A	N/A	Modules execute and integrate in a TBD J2EE Application Server (both presentation and business logic); HUD-approved Electronic Document/ Record Management System Component provides document rendering
		Platform Independent	J2EE	N/A	
	Data Interchange	Data Exchange	XML, Simple Object Access Protocol (SOAP)	N/A	
	Data Management	Database Connectivity	Java Database Connectivity (JDBC)	N/A	
		Reporting and Analysis	N/A	Crystal Reports, SAS, SPSS	
	Presentation/ Interface	Static Display	XML, Portable Document Format (PDF)	PureEdge	
		Dynamic/Server-side Display	J2EE	Infragistics JSuite	
		Content Rendering	N/A	ESRI ArcExplorer	
	Security	Certificates/Digital Signature	X.500	N /A	TBD digital certificate and WS security solution
		Supporting Security Services	Secure Socket Layer (SSL), Web Services (WS) Security	N/A	
Service Interface and Integration	Integration	Middleware	NET 8, MQ Series, DCOM, Java Management Adapter (JMA)	N/A	TBD Middleware solution for data exchange and messaging
		Enterprise Application Integration	N/A	N/A	
	Interface	Service Discovery	Universal Description, Discovery, and Integration (UDDI)	N/A	TBD Service Registry Tool and UDDI Server
		Service Description Interface	WS Definition Language (WSDL)	N/A	
	Inter-operability	Data Format/Classification	XML	N/A	Reliance on XML in all modules to conduct data exchange and system-to-system dialogues
		Data Types/Validation	XML Schema	ESRI ArcGIS	
		Data Transformation	XSLT	N/A	

As this table will attest, many of the infrastructure components needed to support an SOA-based solution like the SFIntegration have yet to be identified by HUD. This information will be updated as it becomes available.

Table 5 illustrates how the Departmental Data Reference Model (DRM) maps to the SFIntegration System. It indicates how subject areas interact with the major entities of the system (e.g., services, requisitions, contractor organizations and the like), and then how those entities map to SFIntegration. All of the modules within SFIntegration will support one or more of the subject areas of the HUD DRM:

Table 5. Mapping of HUD DRM to SFIntegration System

Subject Area	Major Entities	Single Family Integration System
Acquisitions Management	Contractor Organization (for services or products received)	• Business Partner Approval Monitoring Module • Asset Module
	Procurement Plan (for obtaining the products or services)	
	Product or Service (being procured)	
	Requisition (for services to be acquired)	
	Service Contract (documenting the agreement to provide services or products)	
Financial Management	Participating Organization (participating entity with an obligation for the property)	• Loan Origination Module • Loan Insurance Management Module • Asset Management Module • Business Partner Approval and Monitoring Module
	Receivable (for monies due HUD)	
	Payable (for debt incurred by HUD that must be paid)	
Grants Management	Allocation Competition (that defines an annual program allocation that may be distributed to grantees)	• Loan Insurance Management Module (for Housing Counseling Program)
	Allocation Competition Score (that defines scores for allocation competition related to applications)	
	Fund Announcement (that defines public announcements by HUD that funds are available)	
	Funding Application (that defines a formal request for the grant	
	Grant Agreement (that defines a contract between HUD and the grantee)	
	Grantee (that defines the entity receiving the grant funds to carry out program objectives)	
	Project Activity (that defines a project service in which grants are provided)	
	Technical Assistance Need (that defines a type of training, counseling or assistance by grant program recipients or participants)	
Loan Management	Borrower (for an insured mortgage)	• Loan Origination Module • Loan Insurance Management Module • Business Partner Approval and Monitoring Module
	FHA Mortgage (the lien on the property)	
	Housing Asset Sale (for exchanging held notes or property for cash or a notes)	
	Insurance Contract (contract between HUD and mortagees/lenders)	
	Insurance Claim (request by lender for payment for defaulted loan)	
	Lender (provides FHA mortgages)	
	Lender Application (application for establishment as a partner with HUD)	
	Loan (to a borrower where a mortgage of the property is not involved)	
	Work Out Agreement (an agreement between a home buyer and a lender to make payments)	
Program Management	Legislation (for defining the governing statue or law)	• Loan Origination Module • Asset Management
	Management Control (for ensuring effectiveness and efficiency)	

Subject Area	Major Entities	Single Family Integration System
	Monitoring Strategy (for reviewing effectiveness and efficiency)	Module • Business Partner Approval and Monitoring Module • Business Intelligence Module
	Performance Measure (to gauge success or progress)	
	Program (that defines the plan of action statutorily mandated)	
	Program Need (that defines an issue, problem, or need requiring a revised or new program)	
	Resolution (that defines a principle or rule that is constraining)	
	Risk (that defines potential loss due to fraud, waste, and mismanagement)	
Properties, Locations, and Demographics	Community (that defines an interacting population living in a common area or location)	• Loan Origination Module • Asset Management Module • Business Intelligence Module
	Demographic (that defines a periodic enumeration of a population	
	Location (that defines a geographical area for the identification of a house)	
	Market Condition (that defines an external factor that has an impact on HUD)	
	Property (that defines an identifiable parcel of real estate, both land and buildings)	
Records Management	Official Record (for documents and generated transmissions/transactions)	• All Modules • Electronic Document/Record Management System Component
	Package Tracking (for tracking packages to/from HUD)	
	Record Disposition Schedule (that defines timetable for retention and purging)	

Later in this document there occurs a series of high-level process models (Figures 8 through 11), showing how the various modules step through their activities. These models show the basic actions performed at various levels within the module, and clarify the processes generic to user activity on a regular basis.

It is important to note that the SFIntegration System is required to map to these reference models—as is any subsequent system development effort within HUD. Compliance with these reference models is mandated by the FEAF document.

4 SF Target Architecture

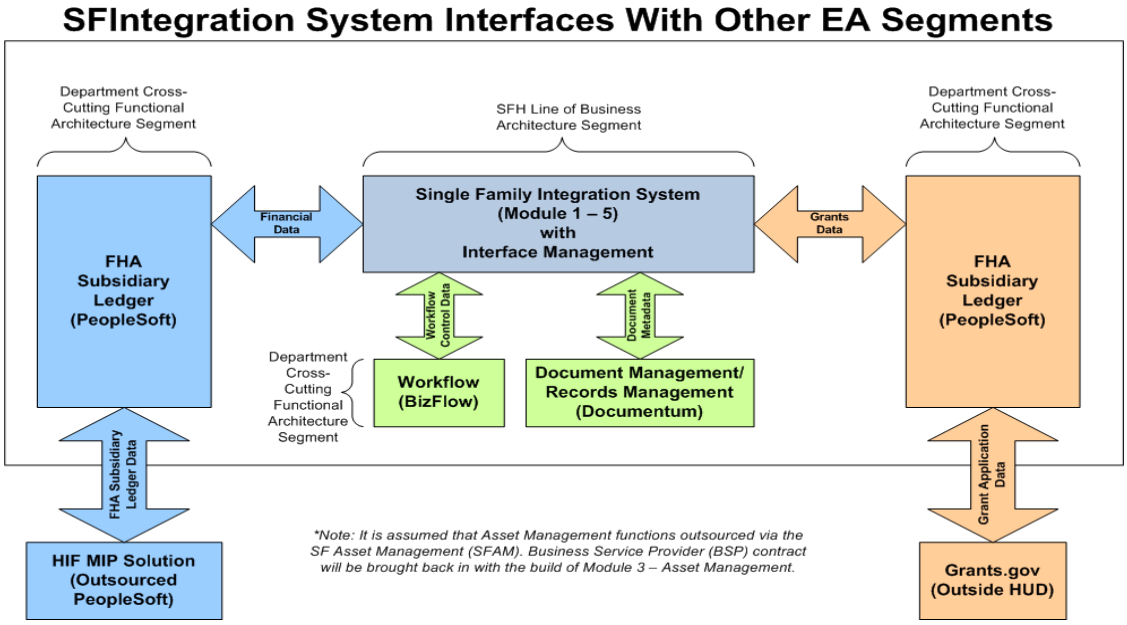
Target Architecture can be defined as an overall vision of what is to come in terms of system architecture. When formulating a TA for any system, it is important to take into consideration a number of issues: platforms, applications, security, interaction between system segments, and technological changes on the horizon, so that the result is both useful at present and forward-looking as new elements come into play. The following sections will look more deeply into the TA for Single Family.

4.1 Developing the SF TA

An important requirement that must be met in developing the SF TA is that is support segment architecture. Segment architecture is an IT architecture for a specific line of business (e.g., Multi Family Housing Finance) or a cross cutting service or technology (e.g., Tracking and Workflow, Grants Management). Figure 4 illustrates how various SFIntegration systems interact with one another by means of Segment Architecture. Within its own line of business or segment, each entity

manages data flow and other functional elements. When interacting with the SFIntegration System, the segments cross-cut over functional and technological lines (e.g., workflow or records management), ensuring interoperability and consistency of data. This is in conformance with the FEAF, as mandated by legislation.

Figure 4. Interfaces With Other EA Segments

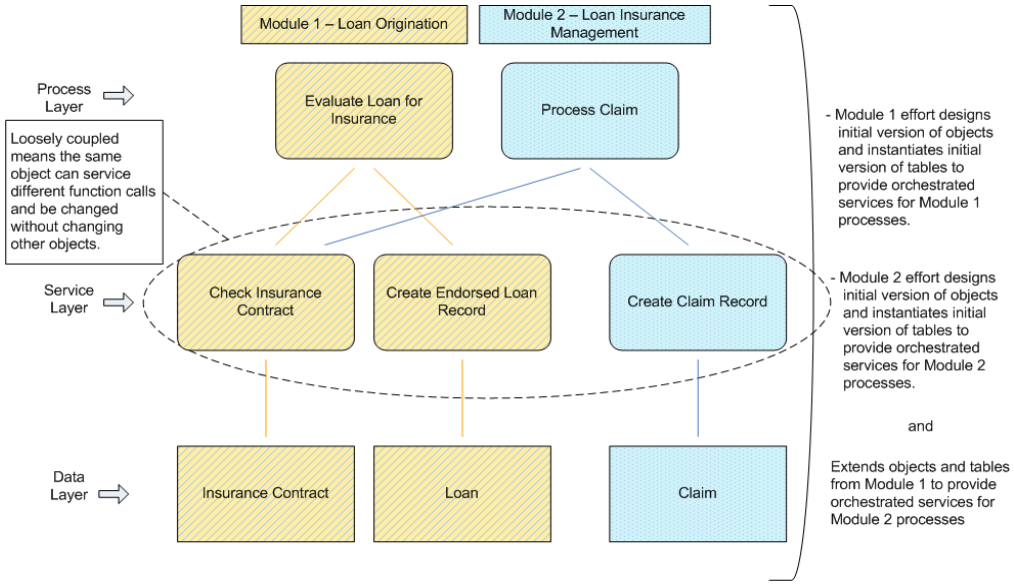


4.2 The SFIntegration System

The SFH TA goal is focused on addressing and rectifying the challenges identified in section 2 above. The EA Team and staff from SFH's Office of Housing Systems and Technology, working with the FHA Subsidiary Ledger Project Team, developed SOA—System-Oriented Architecture—as the TA solution for SFH using a proven evaluation methodology. In addition to drawing on the knowledge of subject matter experts who were part of the working group, information was obtained from the EA baseline captured in the Enterprise Architecture Management System (EAMS), the Information Technology Investment Portfolio (ITIP) system, and the Inventory of Automated Systems (IAS). For this task, the team also relied on information that was documented in the *EA Systems Analysis Document*, dated July 2005, and the EA Migration documents. Part of the process of building the target architecture was to reconcile the information in the various systems.

Figure 5 illustrates an example of the SOA approach required to obtain the above-mentioned improvements:

Figure 5. Example of an SOA Approach



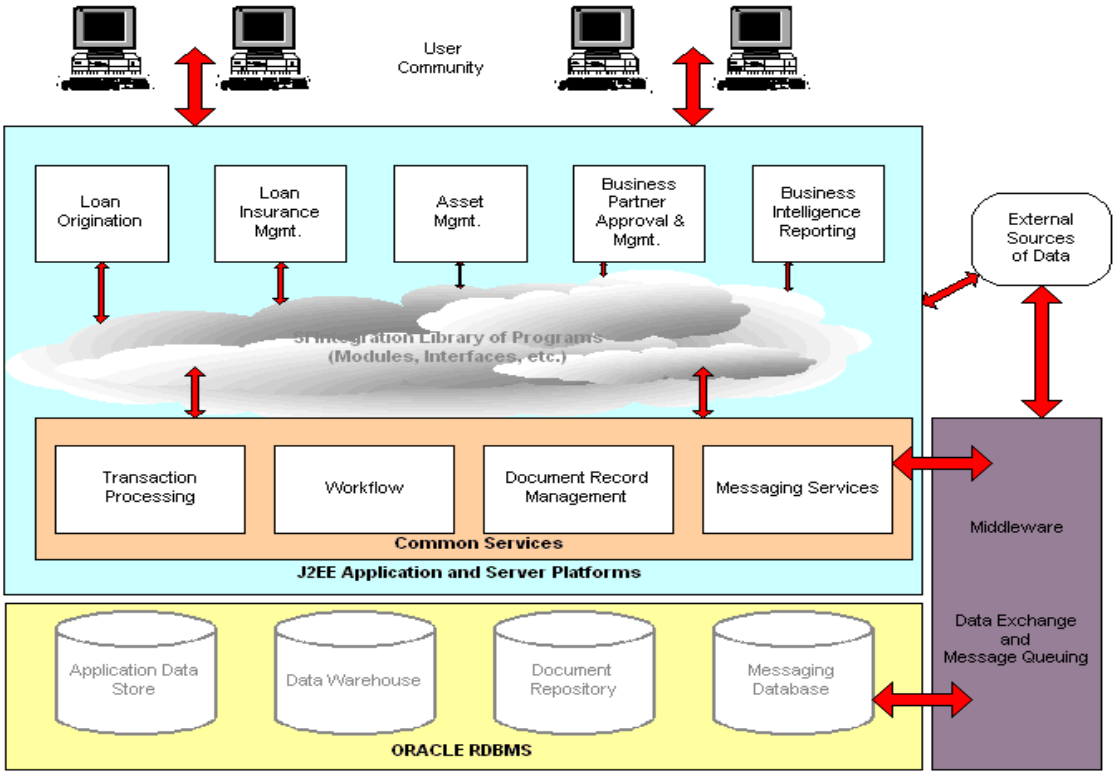
A more detailed discussion of SOA, explaining the current industry standards and explaining the technology involved, can be found in Appendix A of this document.

4.2.1 Software Environment

As has been described, the CIO chose the J2EE solution as ideal for the SFIntegration. Modern, secure, flexible, scalable, and easy to maintain, an environment designed at the outset to be integrated within the standardized Java web-application framework will yield cost savings and increased productivity over that offered by HUD's current landscape of aging disparate, stove-piped, legacy systems.

Figure 6 below illustrates the environment in which it is expected the SFIntegration System will operate. The user community interfaces with the various Modules through the applications; the Modules interact with the SFIntegration library of programs, and the Common Services (e.g., record management, messaging and transaction processing) pass data through that same library back to the users. All of this activity occurs on the J2EE application and server platforms, interacting with the layer in which the Oracle relational databases reside. Of special note is the Middleware layer, which in support of managing the various interfaces into and out of the new system can receive data from certain validated external sources (HOCs, etc.) while interacting with the Common Services as well as the database layer.

Figure 6. SFIntegration System's Target Architecture



In general, the SFH target environment may be described as multi-tiered, in which system elements are independently developed as follows:

- *Client Tier:* The Client Tier contains the means by which the user can access the functionality of the system. In the case of SFIntegration the system is accessed through dynamic and static HTML pages displayed in a web browser, such as Internet Explorer or Netscape Navigator.
- *Middle Tier:* The Middle Tier is the set of software components which performs the business functionality and manipulates the data. In this case, middleware is divided into:
    - *Business Functions:* These are the software components that do the work of the Functional Modules. The components implement the activities of the SFH Business Areas, Loan Origination being the first to be implemented.
    - *Business Objects:* These are the encapsulated data and functionality of the conceptualized actors (e.g. borrowers, lenders, M&Ms, assets, etc.) that are affected by and perform the business functionality.
    - *Web Application Service*: This service is the software application, directly accessed by the user through a browser, which executes the business functions to be performed on the business objects.

- *Business Object Access Service*: This is software which accesses the actual SFH Enterprise Shared Data store and allows the business functions to access enterprise data as business objects.
- *Enterprise Information System Tier*: The enterprise shared database is accessed as conceptual business objects by all functional modules via the middle tier.

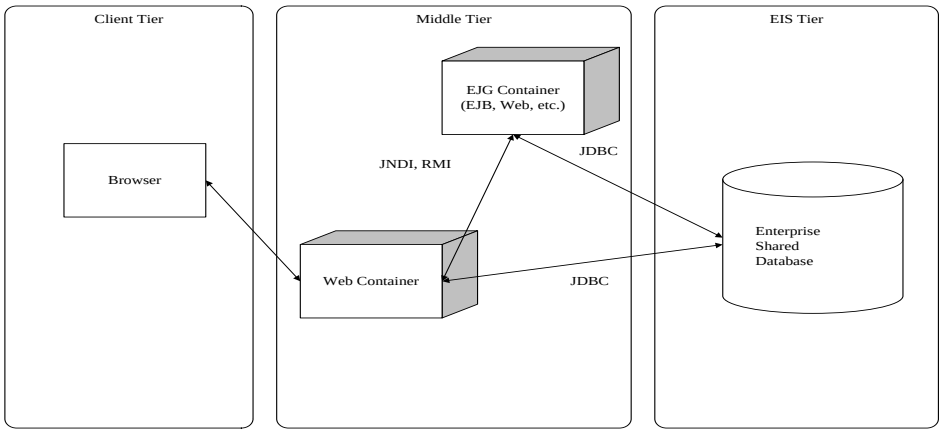
J2EE APIs (such as JSP, Servlets, JDBC, and optionally, EJB) represent component technology managed by containers. A web container provides the run-time environment for JSP and Servlet components, translating requests and responses into standard java objects. EJBs are similarly handled by an EJB container, and they partition data access details from the front-end and middleware development.

Both types of containers can be combined in a J2EE architecture to form the Middle Tier of an enterprise web application, with a Client Tier (browser) and an Enterprise Information System Tier (enterprise shared database), as shown below in Figure 7.

A typical sequence of execution, then, would proceed as follows:

- An authorized system user sends a request to the enterprise system through the browser interface.
- The web container receives the request, invokes the appropriate business components to accomplish the request, and sends an HTML-formatted response (either a static HTML file or a dynamically-created response generated by a JSP/Servlet).
- The enterprise shared database reads/writes are handled by the web container which passes the data/request to the database, either directly, invoking a functional component that uses the J2EE JDBC API, or via an EJB, which does the work for it and encapsulates the details.

Figure 7. Three-Tier View of the Target Architecture



4.2.2 System Modules

As shown in Figures 8 through 11 following, the SFIntegration System will be made up 4 transactional modules and a Business Intelligence component.

4.2.2.1 Transactional Modules

A transactional module is a part of the system to where transactions occur; such as, Loan Origination, Loan Insurance Management, etc.

The business functions supported by the four transactional modules have been decomposed and are illustrated in Figure 8 through Figure .

Figure 8 illustrates a high-level process model for Module 1, Loan Origination. All activities identified as typical to Loan Origination can be seen in sequence by following the trees through each level as shown below: for example, in order to process a loan application, the user would request a case number, submit an insurance application, and pre-qualify a borrower—then the activity moves to the next branch, Underwrite Loan:

Figure 8. High-Level Process Model—Module 1

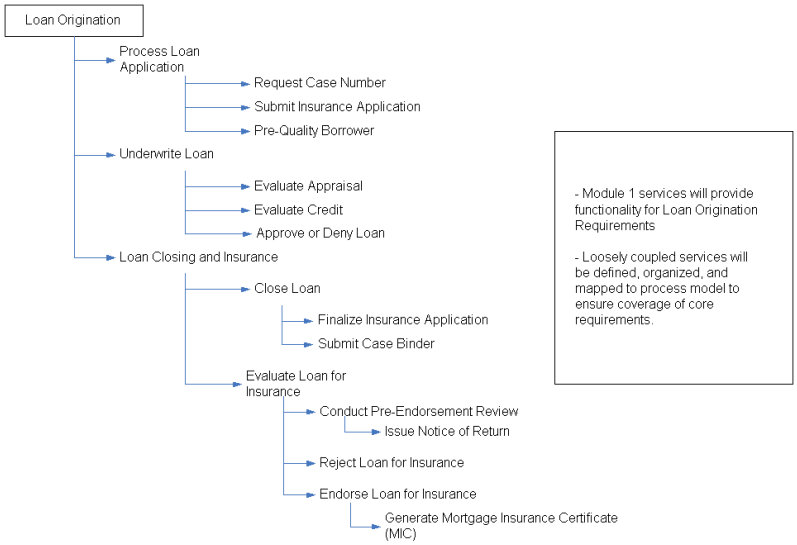


Figure 9 illustrates a high-level process model for Module 2, Loan Insurance Management. All activities identified as typical to Loan Insurance Management can be seen in sequence by following the trees through each level as shown below: for example, in order to service a loan, the user follow the steps to update loan information—then the activity moves to the next branch, Process Insurance Premium:

Figure 9. High-Level Process Model—Module 2

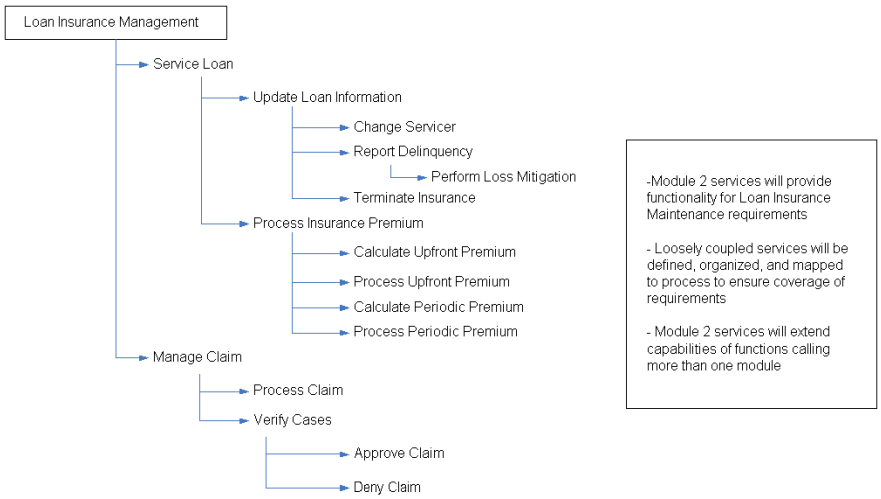


Figure 10 illustrates a high-level process model for Module 3, Asset Management. All activities identified as typical to Asset Management can be seen in sequence by following the trees through each level as shown below: for example, in order to manage an asset, the user follow the steps to Acquire Asset—then the activity moves to the next branch, Monitor, then Dispose of:

Figure 10. High-Level Process Model—Module 3

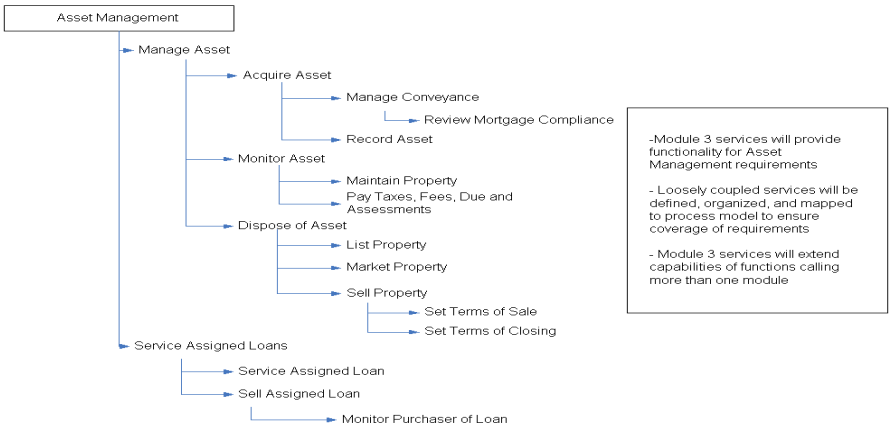
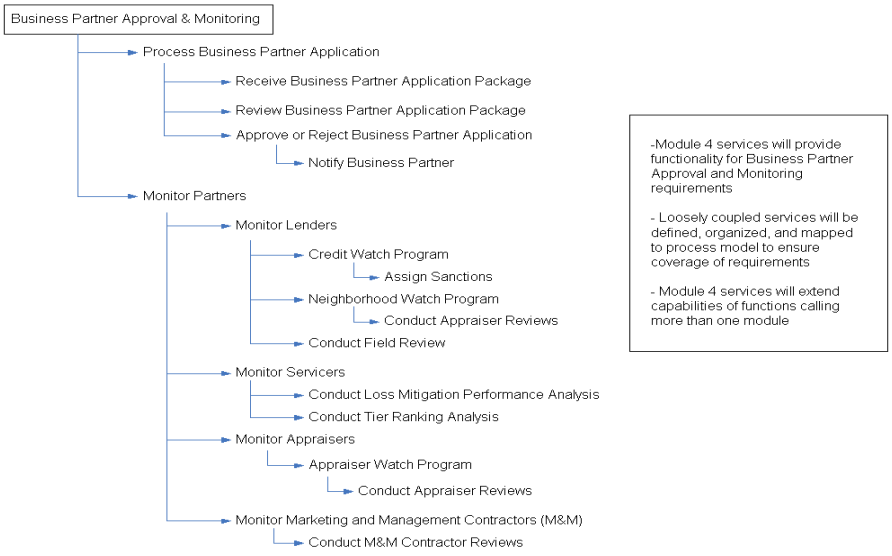


Figure 11 illustrates a high-level process model for Module 4, Business Partner Approval & Monitoring (BPA&M). All activities identified as typical to BPA&M can be seen in sequence by following the trees through each level as shown below: for example, in order to process a Business Partner application, the user follow the steps to apply—then the activity moves to the next branch, Monitor Partners:

Figure 11. High-Level Process Model—Module 4



4.2.2.2 Business Intelligence Module

A Business Intelligence Module is a compilation of data that comes out of the system to support business rules. Within the SFIntegration System, Business Intelligence will be utilized to meet the following lines of business:

- Reporting;
- Stakeholder Management; and
- Business Evaluation and Policy Management.

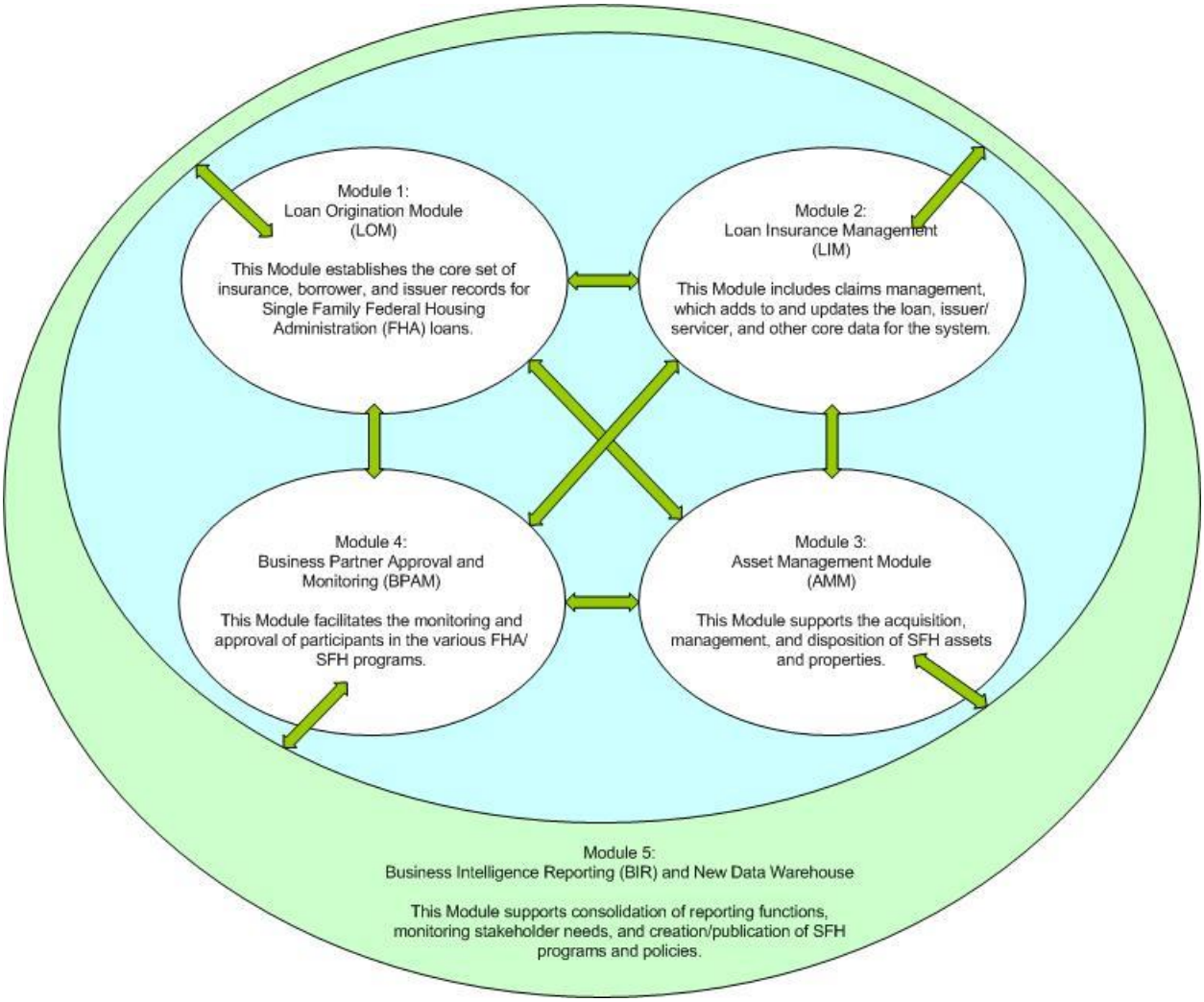
4.2.3 System Database

The database repository within an SOA is a vital part of the working whole. This is a centralized holding tank for all services that are available as defined by the SOA, and is based on the Universal Description, Discovery and Integration (UDDI) standard. In general, SOAs tap into this repository by means of a "composite Web service" integrated by UDDI to be available among defined groups (business partners, trade associations and the like). Some form of UDDI registry software is required to make this possible. Once implemented, however, this registry will add speed and reliability to the SOA and assist it to improve processing and data sharing across the entire project.

See Figure 12 below for graphical representation of the data relationships between each module. Please note that within each module each is matched by a corresponding "Subject Area" in the (new data warehouse) New SFIntegration System Database (Operational Data Store). Also note that each entity within each quadrant (module) consists of the corresponding core table and any needed ancillary tables. Also each arrow between the modules represents business rule relationships between one entity and another, representing business keys in related

tables between the modules. In the case of the Business Intelligence component, these relationships consist of the extract, load, and transform logic for populating the data warehouse from the operational database.

Figure 12. Data Relationships Between SFIntegration Modules



A data model for the SFIntegration System database is being developed pursuant to this high-level architecture. This will result in a data dictionary and an entity relationship diagram (ERD) for the operational datastore. This model will be developed in conjunction with the functional model of the objects, components, and services required by the new system.

5 Next Steps

The EA Team has analyzed the Single Family Housing operation and proposed a target architecture. This target is based on five identified core modules that will support the Single Family Housing core business. Accepting this target architecture will allow SFH to follow an approved plan for future system development. The actual number of systems or even system requirements may change, but the goals enumerated above should guide this effort toward a consolidation scheme for the existing systems. According to the *Cost Benefit Analysis Revision 1*, published in January of 2005, Single Family Housing devoted $80 million to maintenance of existing systems for fiscal years 2004 and 2005. An additional $35 million was slated for system development. This data indicates that Single Family Housing can and should reprioritize its development efforts and reprogram an appropriate amount of funds that are intended for existing projects into the development of the target modules. On the basis of the analysis completed and feedback from SFH, it is recommended that this effort address the loan insurance business function first, as it encompasses the majority of SFH's transactions and some of the other business functions as depicted in SFH next steps:

- **Select a Middleware Product**. Single Family Housing is currently putting together a middleware and SOA package for the HUD CCMB to review and approve. The middleware vendor has already been selected by the SFH Integrated Project Team (IPT) Working Group. The vendor chosen is considered a temporary and a quick-fix, because the vendor has already been listed by the HUD Information Technology Support (HITS) as a standard for HUD systems environment. The assumption is that the approval and acquisition will be expedited faster.
- **Implementation of Transactional Modules**. Certain modules of the SFIntegration System are primarily transactional in that they contain the core functionality for populating, updating and performing operational reporting from the operational database of the new system. These are Modules 1 - 4 (also known as Loan Origination, Loan Insurance Management, Asset Management, and Business Partner Approval and Monitoring). Implementation of these modules, including migration from the core legacy systems these modules are replacing, should take precedence over the implementation of Modules 5 (also known as Business Intelligence).

- **Implementation of Business Intelligent Module**. The business intelligence module consists of the following functional areas: Stakeholder Management, Business Evaluation & Policy Development (BE&PD) and Reporting. The BI module needs to be implemented after all the transactional modules, because those modules feed the necessary data for functionality that will be provided by the BI module. Unless the underlying data is available, the functionality of BI module cannot be implemented.

These are high-level steps that need to be undertaken in the next few months as the Project moves forward. Keeping in mind that this is a living document; all descriptions and temporary solutions are fairly fluid and likely to change. As each phase of the Project is completed, documentation and diagrams will be updated to reflect all changes in that phase.

APPENDIX A Service Oriented Architecture

This Study explains System-Oriented Architecture—SOA—to be used within the framework of the SFIntegration Project. It includes basic information concerning System-Oriented Architecture, a cutting-edge web application that is service-based, technology-neutral, modularized, and platform-independent. SOA has found rapid acceptance throughout the IT community because of its adaptability and relative ease of implementation, without negatively impacting existing systems—in fact, SOA can interface easily with other systems in a homogeneous manner that makes it an attractive alternative to more tightly-coupled and therefore less adaptable IT solutions.

A.1 Scope

The scope of SOA implementation on the SFIntegration Project is probably the easiest part of it to describe. Simply put, SOA will touch every part of the project, given its nature and usefulness. Exactly how this will be done has yet to be determined, however a Middleware evaluation has occurred and the results been reported. Solutions for the other parts of the proposed SOA are under consideration.

A.2 System Overview

System environment or special conditions: SFIntegration consists of thirty-five separate servers performing specific functions to fulfill Single-Family's mission. These systems are to be brought together into seven database systems, or modules, that will perform the same functions in a faster, more accurate and traceable manner. As many of these functions are web-enabled, SOA was determined to be the best solution to integrating and streamlining the process. One critical condition is that the entire process should result in as little down-time as possible during deployment, with little or no loss of data.

A.3 SOA Overview

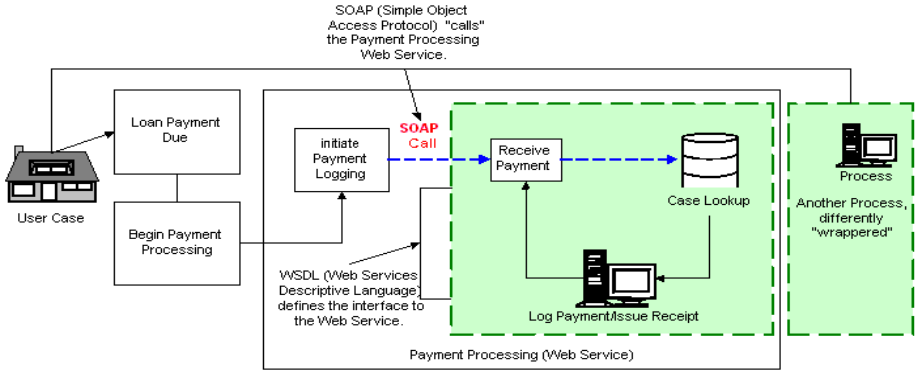
SOA is simply a new name for an established construct: the creation and implementation of a system based on shared resources that can be communicated across otherwise disparate platforms in a modular, loose-coupled manner that is framed in a reliable yet non-intrusive matrix. The basic building blocks of SOA have actually been around for several years—but now with the addition of the concept of Web Services, SOA is gaining swift acceptance as a networking choice.

Three basic standards are typical of an SOA:

- SOAP (Simple Object Access Protocol), the means by which a Web Service is "called" from an application to perform some action;
- WSDL (Web Services Description Language), a format based on XML that "defines" an interface to a Web Service; and
- UDDI (Universal Description, Discovery and Integration), a directory of Web Services available to applications.

Figure 13 below shows a simplified conceptual diagram of a generic SOA process, the "calling" of a typical Web Service. A call is initiated using SOAP to the Web Service known as Payment Processing; WSDL is the language that defines the interface to the Service, and UDDI makes available the address (like a URL on the generic World-Wide Web) at which the Service resides:

Figure 13. A Simple SOA Web Service Procedure



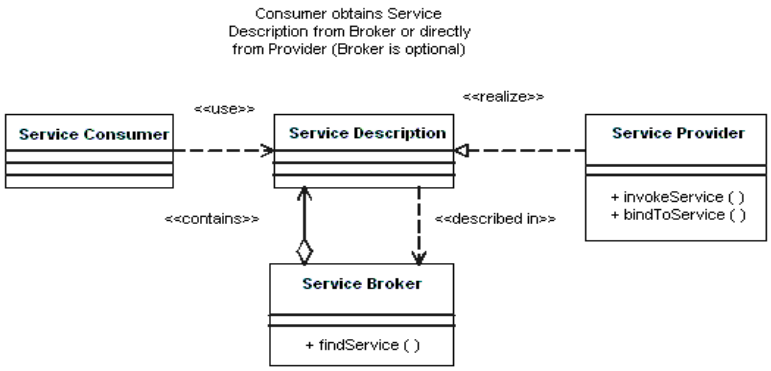
A Simple SOA Web Service Procedure

(N.B.: This is an example only, and should not be considered a design decision for SFIntegration; it is shown merely as one possible process and is not meant to reflect reality.)

A.4 How SOA Works

The key to a successful SOA is documenting available resources and knowing what the end result should be of the relationships between those resources. The basic concept of an SOA is that it be loose-coupled—that it allows for multi-platform, re-useable services that can be shared flexibly across many different applications and systems—and business aligned, that is, based on business requirements so that the appropriate services are available and can be called by those different elements as needed, in a comprehensible format. Figure 14 below shows a conceptual model of a very basic SOA:

Figure 14. Conceptual Model of an SOA Architectural Style



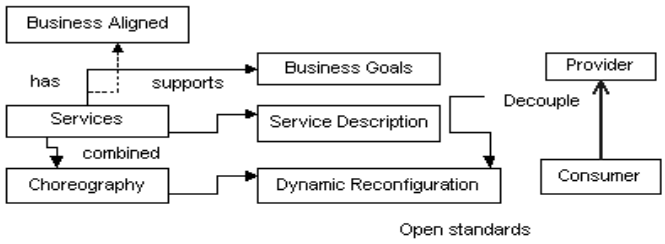
Conceptual Model of an SOA Architectural Style

(N.B.: This is an example only, and should not be considered a design decision for SFIntegration; it is shown merely as one possible process and is not meant to reflect reality.)

Note that interaction in SOA occurs between three basic entities: a service provider, a service consumer, and a service broker. The provider publishes a service description and provides implementation for that service; the consumer utilizes either a direct connect via Uniform Resource Identifiers (URIs) if known, or consults the broker for that information in a registry.

Figure 15 below outlines the so-called choreography between applications and requirements by means of standard protocols. SOA offers a great deal of flexibility in how the various portions respond to one another, linking resources on demand throughout an enterprise or sections thereof:

Figure 15. Attributes of an SOA



Attributes of an SOA

(N.B.: This is an example only, and should not be considered a design decision for SFIntegration; it is shown merely as one possible process and is not meant to reflect reality.)

Resources are made available to network participants by means of discoverable services that can be searching, bound, and invoked (called) on an as-needed basis by the service consumer. The service provider is responsible for implementing that called service and delivering it to the consumer; this is best facilitated by seeing to

it in the design phase that all services have declarative names for ease of searchability. For example, rather than naming a series of services A, B and C, names would reflect actual function (e.g., getcasebinder, findlender, savechange, and the like).

One of SOA's most useful protocols is that interfaces, implementations and bindings are kept separate, so that the moment of choice within the workflow of use is deferred until the actual point of service. A consumer designates which service it wishes to invoke at a given point in time, utilizes that service, then releases it, making all services re-usable across the architecture. Additionally, SOA possesses the capability of Fractal Realization Patterns: the architecture has the ability to apply in a composite manner the patterns and roles associated with its participants, locating the best possible match for a service call and allowing these entities to be applied across many regions, rather than becoming restricted to a single area. Within a closed architecture, these entities can be shared across a single tier; within an enterprise architecture, multiple tiers can re-use services between them. This gives SOA a unique scalability that can be valuable in terms of lowering response time and raising the incidence of quick, accurate calls throughout the system.

A.5 SOA Benefits Expected

Because of its reliability and adaptability, it is expected that implementing SOA on the SFIntegration Project will maximize data transfer and availability, as well as support the effort to keep HUD in general and SF in specific on the cutting edge of available technology. It is platform-independent, with many simple conventions built into the architecture that make for a wise business choice:

- intuitive naming conventions for web services
- strong reliability
- not hard-wired to a single technology or system
- loosely-coupled and therefore flexible
- modular in approach, thus easier to deploy and maintain
- non-intrusive
- broadly applicable across a wide range of needs.

An important design constraint when dealing with SOA is to deliberately and strategically design the system from the start to best maximize its potential for use within the environment for which it is being developed. This is a given in any design effort, of course, but with SOA it is critical in order to get out of it everything the organization hopes to achieve by its implementation. The following pieces are important parts of the whole:

- An application server suite,
- A service registry solution
- A UDDI server solution
- A middleware solution,

- A security solution for public key infrastructure (PKI) services for user authentication/verification and web services security for access to services
- A database repository, and
- A business process management or rules engine solution.

Understanding services and how they work within SOA is also of primary importance. Besides having intuitive naming structures, services should also be constructed such that during any business function, only one service can be authoritative. This makes it possible to re-use the service throughout multiple applications within the architecture, as explained above. An added benefit to this kind of configuration is that should changes to the service be necessary, they will all be made in one central location—no need to worry that an update was made in one location and not in another. Implementation of change is thus simplified and given an added level of security as well as speed.

Changes made to back-end infrastructure in an SOA remain transparent within the architecture—that is, only the services affected by the change are actually modified. Applications within the SOA only reference the services, thus changes should not affect the services at all—which means that any modifications made to other segments (for instance the middleware solution or the databases) will mean no interruption of activity among users, no "down-time" for the system as a whole.