

Technology Standards and Products Guide

Version 7.8 • 9/17/2020

Final

Revision History

VERSION	DATE	DESCRIPTION
1.0	November 2, 2001	<ul style="list-style-type: none"> • Provided general updates under TO 55.
2.0	January 25, 2002	<ul style="list-style-type: none"> • Reformatted document to align with the Department of Education Policy document. • Updated document to reflect new standards and products.
2.1	February 12, 2002	<ul style="list-style-type: none"> • Updated document with client feedback. • Renamed document title.
2.2	March 29, 2002	<ul style="list-style-type: none"> • Included updates from 1/15/2002 to 3/15/2002 in Federal Student Aid standards, products, and policies. • Added an Application Development section.
2.3	June 30, 2002	<ul style="list-style-type: none"> • Incorporated planned ITA upgrades • Added an Executive Summary. • Added Mobile Devices to Network Services section. • Added External Connections to External Environment section. • Updated several version numbers.
3.0	September 27, 2002	<ul style="list-style-type: none"> • Updated to include minor version number changes and other architectural changes. Reflects all updates through revision date.
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4.2	May 2005	<ul style="list-style-type: none"> • Introduced the Metadata management category, added products to be provided with Advance and CSB contracts.
5.0	December 2005	<ul style="list-style-type: none"> • Populated the Metadata management category. Revised and added the software for ADvance and CSB contracts. • Removed the Data Strategy section and all references to it. • Updated the EDM text as well as Data Modeling. • Removed the minimum PC Specifications and all references to it. • Added a new Appendix A – Reusable Common Services (RCS) and Portlets. Reflects all updates through revision date.
5.1	February 2006	<ul style="list-style-type: none"> • Added “FileNet” as the Document Management Standard. • Changed “WebSphere Application Server 6.0” to “WebSphere Process Server 6.0”.
5.2	June 2006	<ul style="list-style-type: none"> • Updated DRM information. • Updated web sites. • Added in Common Operating Environment (COE) Diagrams, updated language.

VERSION	DATE	DESCRIPTION
6.0	July 2007	<ul style="list-style-type: none"> • Document renamed to Technology Standards and Products Guide and re-organized to facilitate architecture understanding, re-categorized products and standards to align with FEA TRM. • Removed version numbers from product listing to facilitate maintenance. • Evergreen process will provide the current version of products in the environment.
7.0 Draft	April 2012	<ul style="list-style-type: none"> • Updated draft document to incorporate the new Federal Student Aid Technology Classification Framework. • Updated document based on stakeholder feedback.
7.0 Draft	August 2012	<ul style="list-style-type: none"> • Incorporated feedback received through ECCB members.
7.0 Final	September 2012	<ul style="list-style-type: none"> • Incorporated feedback received through ERB members.
7.1 Draft	April 2015	<ul style="list-style-type: none"> • Updated References and Related Documents. • Updated the following Technology Capabilities: <ul style="list-style-type: none"> ○ Table 3: Desktop and Productivity Technology Domain Standards (Personal Productivity, Collaboration Software and, Business Intelligence and Data Warehouse Platforms) ○ Table 4: Application Environment Technology Domain Standards (Application Delivery Platform, Software Engines, Integration Software and, Database Management Systems) ○ Table 5: Hardware Devices and Systems Software Technology Domain Standards (Operating Systems and Utilities, and Storage) ○ Table 6: Network and Computer Accommodation Technology Domain Standards (Network) • Table 7: Management and Control Technology Domain Standards (Systems Management and Security Management)

VERSION	DATE	DESCRIPTION
7.2	September 2016	<ul style="list-style-type: none"> • Updated subsections 1.3 Intended Audience, 1.4 Document Organization and 1.5 References and Related Documents. • Updated the following Technology Capabilities: <ul style="list-style-type: none"> ○ Table 3: Desktop and Productivity Technology Domain Standards (Collaboration Software and, Business Intelligence and Data Warehouse Platforms) ○ Table 4: Application Environment Technology Domain Standards (Application Development Software, Application Delivery Platform, Software Engines, Integration Software and, Database Management Systems) ○ Table 5: Hardware Devices and Systems Software Technology Domain Standards (Servers, and Storage) ○ Table 6: Network and Computer Accommodation Technology Domain Standards (Network, and Bandwidth and Connectivity) ○ Table 7: Management and Control Technology Domain Standards (Systems Management and Security Management) • Added Section 3 FSA Technology Standards that profiles the technology standards used to support the FSA enterprise architecture.
7.3	September 2017	<ul style="list-style-type: none"> • Updated draft document to incorporate stakeholder feedback. • Incorporated new classification of “Target Elective” to document technology standards in use by the Target ED infrastructure service providers. • Created an acronyms reference in Appendix A.
7.4	September 2018	<ul style="list-style-type: none"> • Updated draft document to incorporate stakeholder feedback. • Refined the definition of Target Elective. • Updated definition for Non-Relational DBMS.
7.5	April 2019	<ul style="list-style-type: none"> • Updated draft document to incorporate stakeholder feedback. • Made standard and target updates based on DCC Award Technologies Recommended Mappings Workbook.
7.6	October 2019	<ul style="list-style-type: none"> • Updated draft document to incorporate stakeholder feedback.
7.7	March 2020	<ul style="list-style-type: none"> • Updated document to incorporate stakeholder feedback. • Updated technology class definitions with current examples.
7.8	September 2020	<ul style="list-style-type: none"> • Updated document to incorporate stakeholder feedback.

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Section 1. Introduction

1.1. Purpose

The TSPG is a guide for Federal Student Aid architects, business stakeholders, project managers, system administrators, application developers, procurement personnel, and others who require guidance on implementing Federal Student Aid technology standards.

The primary purpose of the TSPG is to enable architects to identify opportunities to leverage technology, alleviate redundancy, and highlight instances in which technology overlaps limit the value of IT investments.

This guide addresses the fundamental technologies comprising FSA's infrastructure, and it focuses on standards and products that promote managed services within a reliable and secure environment. The TSPG is a critical component of a comprehensive effort to align government-wide investments in information technology with the needs of Federal Student Aid.

The TSPG is not intended to serve as a comprehensive list of all products in use within Federal Student Aid. Rather, it is the set of identifiable current and target technology standards, aimed at supporting FSA's Modernization Plan.

1.2. Scope

The TSPG lists the preferred technologies and products that promote transition from the current technical architecture to the envisioned technical architecture as described in the Federal Student Aid Modernization Plan.

The adoption of enterprise-wide standards promotes interoperability, scalability, and enables cost effective acquisition and development of systems and applications to meet Federal Student Aid's business needs. The TSPG is intended to promote a smooth transition from current to future technologies, but it does not attempt to provide a prioritized, scheduled transition plan for moving toward a desired future state.

1.3. Intended Audience

This guide is intended for all FSA personnel, including current and potential vendors, who are involved in the management, development, and support of Federal Student Aid's general support systems and, major and minor applications. This guide is intended to assist those individuals in understanding and applying relevant technology standards to their respective systems and applications.

The table below lists the intended users for the Federal Student Aid Technology Standards and Products Guide, the document sections most relevant for each type of user, and the purpose for which the users may use the information in this Guide.

Table 1. Intended Audience

USERS	USES
Federal Student Aid Executives / Federal Student Aid Business Owners & Technology Directorate Staff	Facilitates and communicates an organized, systematic way of classifying the information technology infrastructure
Federal Student Aid Architects	Facilitates understanding of Federal Student Aid's technology infrastructure and promotes reuse by identification of standards
Vendors	Communicates the technology infrastructure and identifies standards, and technologies that support the construction, delivery, and maintenance of Federal Student Aid IT applications

1.4. Reference Documents

Federal Student Aid's Technology Standards and Products Guide was developed to support Federal Student Aid's business operations in compliance with the laws, regulations, and guidance listed below:

Table 2. Reference Documents

DOCUMENT TITLE	DOCUMENT VERSION
Clinger-Cohen Act of 1996; Requires agencies to implement IT management processes, integrate management and budget processes, inventory IT investments, and designate a Chief Information Officer	
OMB Circular A-11; Requires agencies to submit plans and progress on their enterprise architectures	
OMB Circular A-130; Requires that Federal agencies create Enterprise Architecture and update OMB as significant changes are made	
Paperwork Reduction Act of 1995; Requires Federal agencies to be more responsible and publicly accountable for reducing the burden of Federal paperwork	
The Government Paperwork Elimination Act (GPEA); Requires agencies to leverage improved network technologies by improving electronic transactions	
The E-Government Act of 2002 (P.L. 107-347); Requires agencies to support e-Government projects and to leverage cross-agency initiatives to further e-Government. It also requires agencies to submit privacy impact assessments for all new IT investments using personally identifiable data from or about members of the public	
The Federal Records Act of 1950; Requires Federal agencies to establish and maintain a continuing program for the economical and efficient management of agency records. Electronic records created or received by the Federal Government must be managed as Federal records	
Government Performance Results Act of 2010; Requires that Federal agencies accurately employ performance metrics to measure and report performance results related to IT investments.	
Federal Information Security Management Act (44 U.S.C. 3544): Specifies standards and requirements for securely managing information and information systems, with guidance provided by the Department of Commerce's National Institute of Standards and Technology (NIST).	
The Common Approach to Federal Enterprise Architecture: Requires Agency Heads to develop and maintain an agency-wide enterprise architecture that integrates strategic drivers, business requirements, and technology solutions.	
OMB Circular A-119: Requires agencies to participate in the development and use of voluntary consensus standards and in the conformity Assessment Activities	
Lifecycle Management Methodology: Federal Student Aid's comprehensive end-to-end process for managing information technology projects from vision to retirement	V2.1

DOCUMENT TITLE	DOCUMENT VERSION
<u>Queensland Department of Public Works, ICT Policy and Coordination Office and Queensland Government Chief Technology Office: Queensland Government Technology Classification Framework, Final</u>	April 2015, V4.0.1
Clinger-Cohen Act of 1996: Requires agencies to implement IT management processes, integrate management and budget processes, inventory IT investments, and designate a Chief Information Officer	
OMB Circular A-11: Requires agencies to submit plans and progress on their enterprise architectures	
OMB Circular A-130: Requires that Federal agencies create Enterprise Architecture and update OMB as significant changes are made	
Paperwork Reduction Act of 1995: Requires Federal agencies to be more responsible and publicly accountable for reducing the burden of Federal paperwork	

The classification methodology utilized by the Technology Standards and Products Guide is based on the Technology Classification Framework developed by the Queensland, Australia Government. This technology framework was selected in order to classify the Federal Student Aid standards and specifications in an industry standard manner, by organizing them into Technology Domains, consisting of Technology Capabilities and broken down further into Technology Classes. Additional details are included in Section 2.

Section 2. Executive Summary

The Federal Student Aid (FSA) Technology Standards and Products Guide (TSPG) provides an organized, systematic way of classifying technologies employed by Federal Student Aid and provides a basis for understanding the technologies supporting the development and maintenance of Federal Student Aid's information technology (IT) infrastructure.

The TSPG identifies FSA technologies through a classification framework that categorizes FSA software, services, and hardware according to their primary capabilities.

The TSPG further augments its classification framework by denoting the products and services that will help Federal Student Aid achieve its Modernization Plan. The scheme identifies the status of each technology in the classification framework as follows:

- **Standard** -Technologies/products mandated and in use by FSA or the Department of Education.
- **Elective** - Technologies/products in use by infrastructure service providers.
- **Target** -Technologies/products planned for use by FSA or the Department of Education.
- **Target Elective** -Technologies/products planned for use by infrastructure service providers.
- **Phase Out** -Technologies/products that will be discontinued by FSA or the Department of Education.

The adoption of enterprise-wide standards promotes interoperability, scalability, and enables cost effective acquisition and development of systems and applications to meet Federal Student Aid's business needs. The TSPG is intended to promote a smooth transition from current to future technologies, but it does not attempt to provide a prioritized, scheduled transition plan for moving toward a desired future state.

Section 3. Technology Classification Framework

The objective of defining a Technology Classification Framework is to identify and classify standards and technologies that support the construction, delivery, and exchange of Federal Student Aid business and application components at a level of abstraction that allows principles and rules to be developed and/or followed without being confused by physical implementation details. The following graphic in Figure 3-1 illustrates the FSA Technology Classification Framework:

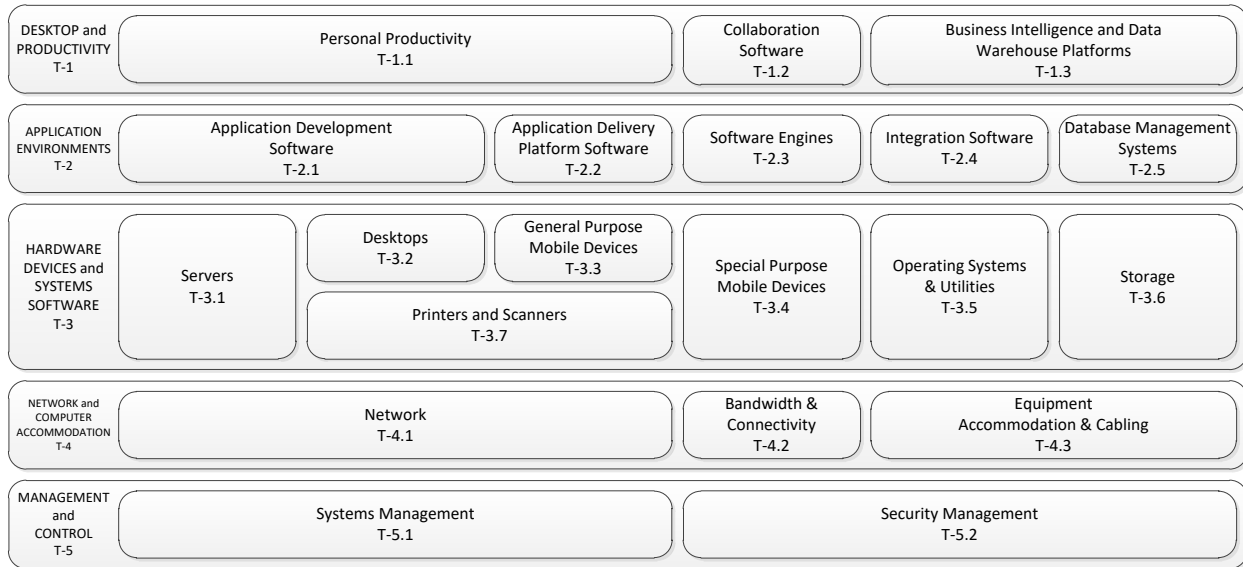


Figure 1. FSA Technology Classification Framework

Technology Domains are the topmost and define a coarse segmentation of technologies. Each of the Technology Domains is further segmented into several Technology Capabilities, which define a more focused set of technology functionalities. Technology Capabilities are further refined into finer classifications of Technology Classes.

Figure 3-2, below, illustrates how the FSA Technology Classification Framework categorizes Federal Student Aid’s technologies through the following hierarchy:

- Technology Domains, which are comprised of:
 - Technology Capabilities, which are comprised of:
 - Technology Classes, which are comprised of:
 - Technology Products and Services¹

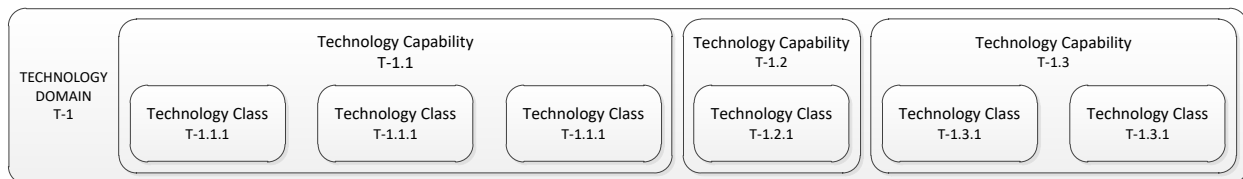


Figure 2. FSA Technology Classification Framework Hierarchy Example

¹ Technology Products and Services are intentionally not depicted in the FSA Technology Classification Framework in order to preserve legibility of the diagram. These items are listed in their respective Domain Standards tables throughout this document.

The TSPG further refines the Technology Classification Framework through the use of a Standards Classification scheme to help the reader identify FSA's standards. This scheme identifies the status of technology products and services as follows:

Table 3. FSA Technology Usage Classifications

DOCUMENT TITLE	DOCUMENT VERSION
Standard	Technologies/products mandated and in use by FSA or the Department of Education.
Elective	Technologies/products in use by infrastructure service providers.
Target	Technologies/products planned for use by FSA or the Department of Education.
Target Elective	Technologies/products planned for use by infrastructure service providers.
Phase Out	Technologies/products that will be discontinued by FSA or the Department of Education.

3.1. Desktop and Productivity Technology Domain

The Desktop and Productivity Technology Domain covers those elements that are directly used by business users. This tier provides the structure and guidance for all Desktop and Productivity technologies and is composed of the following Technology Capabilities and Classes as depicted in Figure 3. Desktop and Productivity Technology Domain Figure 3 below.

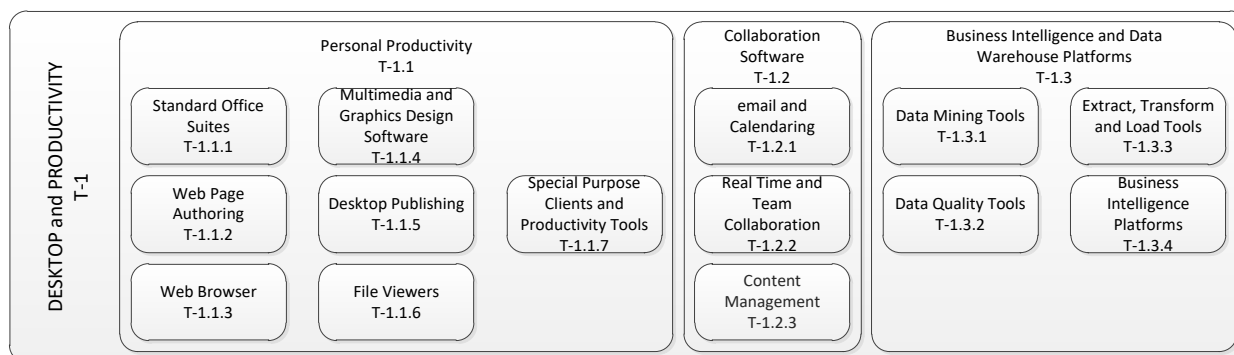


Figure 3. Desktop and Productivity Technology Domain

- **Personal Productivity (T-1.1):** This capability comprises all technology elements that support personal productivity including office suites, multimedia graphics and design suites, web page authoring packages, publishing packages and file viewers throughout Federal Student Aid.
 - **Standard Office Suites (T-1.1.1):** This class describes a core desktop productivity system, which is made up of a number of tools such as a word processor and a spreadsheet. Some degree of integration usually exists between the separate tools. An example of a standard office suite is Microsoft Office, which contains the word processor Microsoft Word and the spreadsheet Microsoft Excel. The database tool MS Access, for organizing, accessing and sharing information, is included under another capability 'Desktop DBMS'.
 - **Web Page Authoring (T-1.1.2):** This class includes technologies that allow a document creator to mark up (that is, annotate in a machine-readable way) a document to allow the document content to be presented in a format suitable for the Internet. This class typically refers to standalone authoring suites. Authoring suites integrated into content management systems would normally appear in the content management class. The most common

- example is the marking up of a plain text document, using HTML, so that it can be displayed on a screen as hypertext (that is, a web page in HTML format). An example of a web page authoring tool is First Page (for HTML).
- **Web Browser (T-1.1.3):** This class includes software programs used to locate and display information on the Internet or on an intranet. Most browsers can display graphics, photographs and text; multimedia information (such as sound and video) may require additional software, known as plug-ins. Examples include Google Chrome, Microsoft Edge, and Firefox.
 - **Multimedia and Graphics Design Software (T-1.1.4):** This class includes products that enable users to produce and edit content in a variety of presentation formats including sound, still images, video images and, animations. Examples include Adobe Photoshop and PhoXo.
 - **Desktop Publishing (T-1.1.5):** This class includes software that creates high-quality publications combining text and graphics in a sophisticated layout following design standards. Desktop publishing often allows a single individual to create publications that would have previously required expensive printing equipment and a full team of publishing staff. An examples of desktop publishing tool is Adobe InDesign.
 - **File Viewers (T-1.1.6):** This class includes software products that enable users to open and display contents of files originally stored in a variety of formats including text as well as multimedia file formats such as sound, video images, photographic images, still images or animations. Examples of a file viewer is Adobe Acrobat Reader.
 - **Special Purpose Clients and Productivity Tools (T-1.1.7):** This class includes out-of-the-box desktop productivity tools deployed to specific users to perform specific functions not already covered in the other desktop productivity categories. Examples include mind-mapping tools such as Mind Map. This class also includes special purpose clients, such as front-end GIS products.
- **Collaboration Software (T-1.2):** This capability comprises all technology elements within Federal Student Aid that support group productivity and interaction between participants such as email, content management, file sharing, instant messaging and team collaboration environments.
 - **Email and Calendaring (T-1.2.1):** This class includes email tools to support electronic mail, including composing, sending and receiving messages, managing messages and managing electronic mail address lists. Calendaring tools provide support for the managing of calendars (diaries), creating appointments and events, and organizing and scheduling of meetings. Examples include Microsoft Outlook and Google Gmail. This class also includes server components, for example, Microsoft Exchange.
 - **Real Time and Team Collaboration (T-1.2.2):** This class includes tools to support people working together even though they may be separated physically and geographically. Workers can work with each other, with clients, or with partners from their desktop, swapping ideas, resolving ideas, sharing information, marking up files or collaborating with whiteboards. Examples of real time collaboration tools include Microsoft Teams, a web conferencing tool for meeting with large or small groups in different locations, with each participant working from her or his desktop. Videoconferencing software such as Zoom, is another example of real time collaboration tools. An example of a team support tool is Microsoft Windows SharePoint Services.
 - **Content Management (T-1.2.3):** This class generally refers to applications for managing content intended to be published, typically over the Web or to the processes and workflows involved in organizing, categorizing and structuring information resources so that they can be stored, published and reused in multiple ways. A Content Management System (CMS) is used to collect, manage and publish content, storing the content either as components or whole documents, while maintaining the links between components. A CMS may include integrated authoring tools that support the design, creation, capture, editing, and integration of information from discrete multi-media components, often to produce a website. Examples of content management systems are SharePoint and Interwoven product suite.
 - **Business Intelligence and Data Warehouse Platforms (T-1.3):** This capability includes software tools that allow the storage, access and analysis of data in a data warehouse. They

include online analytical processing tools (OLAP), data mining tools, executive information systems, data extraction, query and reporting tools, multidimensional tools and decision support systems.

- **Data Mining Tools (T-1.3.1):** This class includes tools to support the process of extracting patterns and trends from data. Often it refers specifically to the processing of large amounts of data stored in specific data mining repositories or data warehouses. SAS Enterprise Miner is an example.
- **Data Quality Tools (T-1.3.2):** This class includes tools to support the analysis, cleansing and standardization of data to improve its utility for data mining by identifying and rectifying problems such as duplicate records, erroneous data, redundant data, inconsistent data and different instances of names and addresses for the same data entity. Examples of data quality tools are IBM Quality Stage and SAS Data Quality Solution.
- **Extract, Transform, and Load Tools (T-1.3.3):** This class includes tools which support the conversion and transformation of data and its associated metadata from one source to another. Often used for migrations from an old system to a new one, or for moving data from an operational system to a data warehouse or other analysis repository. SAS Enterprise ETL Server and IBM DataStage are examples of an Extract, Transform and Load (ETL) tool.
- **Business Intelligence Platforms (T-1.3.4):** This class includes software that provides an integrated set of enhanced query, reporting, and possibly, OLAP tools. This includes the platforms on which the enterprise Business Intelligence (BI) capability is built. Examples of BI software includes SAS BI Suite, Cognos, Power BI, and MicroStrategy.

Table 4, below, identifies the products and services that comprise FSA's current Desktop and Productivity Technology Domain.

Table 4. Desktop and Productivity Technology Domain Standards

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Personal Productivity	Standard Office Suites	Microsoft Excel for Office 365	Standard	
Personal Productivity	Standard Office Suites	Microsoft OneDrive for Office 365	Standard	
Personal Productivity	Standard Office Suites	Microsoft OneNote for Office 365	Standard	
Personal Productivity	Standard Office Suites	Microsoft Outlook for Office 365	Standard	
Personal Productivity	Standard Office Suites	Microsoft PowerPoint for Office 365	Standard	
Personal Productivity	Standard Office Suites	Microsoft Project 2019	Standard	
Personal Productivity	Standard Office Suites	Microsoft Publisher for Office 365	Standard	
Personal Productivity	Standard Office Suites	Microsoft Visio 2019	Standard	
Personal Productivity	Standard Office Suites	Microsoft Word for Office 365	Standard	

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Personal Productivity	Web Page Authoring	Adobe Dreamweaver 2020	Standard	
Personal Productivity	Web Browser	Google Chrome	Standard	
Personal Productivity	Web Browser	Microsoft Edge	Standard	Default Browser with Windows 10
Personal Productivity	Web Browser	Safari	Standard	Mobile Device Browser/Mac Desktop Browser
Personal Productivity	Web Browser	Microsoft Internet Explorer	Phase Out	
Personal Productivity	Multimedia and Graphics Design Software	Adobe Creative Cloud	Standard	
Personal Productivity	Desktop Publishing			
Personal Productivity	File Viewers	Adobe Acrobat for Mac	Standard	
Personal Productivity	File Viewers	Adobe Acrobat Professional 2017	Standard	
Personal Productivity	File Viewers	Adobe Acrobat Reader DC	Standard	
Personal Productivity	File Viewers	Adobe Acrobat Standard 2017	Standard	
Personal Productivity	File Viewers	Adobe Digital Editions	Standard	
Personal Productivity	Special Purpose Clients and Productivity Tools	Adobe Captive	Standard	eLearning Authoring Tool
Personal Productivity	Special Purpose Clients and Productivity Tools	Colour Contrast Analyser	Standard	
Personal Productivity	Special Purpose Clients and Productivity Tools	SureID	Standard	
Personal Productivity	Special Purpose Clients and Productivity Tools	iSpring Suite	Phase Out	Command Center
Personal Productivity	Special Purpose Clients and Productivity Tools	Oracle Taleo Learning Management System	Phase Out	Command Center
Collaboration Software	Email and Calendaring	Adobe Campaign Classic	Standard	High Volume Email Solution (~ 1.3B Emails/Annum)

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Collaboration Software	Email and Calendaring	Microsoft Outlook Exchange	Standard	
Collaboration Software	Email and Calendaring	Postfix	Standard	
Collaboration Software	Email and Calendaring	SendGrid	Phase Out	High Volume Email Solution. (~125M Emails/Month)
Collaboration Software	Real Time and Team Collaboration	Microsoft Project Server	Standard	
Collaboration Software	Real Time and Team Collaboration	Microsoft SharePoint	Standard	
Collaboration Software	Real Time and Team Collaboration	Microsoft SharePoint Online	Standard	
Collaboration Software	Real Time and Team Collaboration	Microsoft Teams	Standard	Audio Visual
Collaboration Software	Real Time and Team Collaboration	Zoom for Government	Target	Audio Visual
Collaboration Software	Real Time and Team Collaboration	Microsoft Skype for Business	Phase Out	Audio Visual
Collaboration Software	Content Management	Automattic WordPress	Standard	Blog Only
Collaboration Software	Content Management	Drupal	Standard	Public Facing
Collaboration Software	Content Management	Microsoft SharePoint	Standard	Internal/Employee Facing
Collaboration Software	Content Management	Microsoft SharePoint Online	Standard	
Collaboration Software	Content Management	TeamSite	Phase Out	
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	Cognos Query	Standard	Access and Query Activity
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	Crazy Egg	Standard	Web Analytics
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	Google Analytics Premium	Standard	Web Analytics

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	Python	Standard	Enterprise Data Warehouse
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	Microsoft R	Standard	Data Mining and Analysis
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	R	Standard	Enterprise Data Warehouse
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	Salesforce Einstein Analytics	Standard	Predictive Analytics
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	SAS	Standard	Enterprise Data Warehouse
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	Tealium	Standard	Web Analytics
Business Intelligence and Data Warehouse Platforms	Data Mining Tools	Vanguard Software	Elective	Business and Predictive Analytics
Business Intelligence and Data Warehouse Platforms	Data Quality Tools	IBM IIS Information Analyzer	Standard	Data Management
Business Intelligence and Data Warehouse Platforms	Data Quality Tools	IBM Information Governance Catalog (IGC)	Standard	Master Data Management and Data Dictionary
Business Intelligence and Data Warehouse Platforms	Data Quality Tools	IBM Quality Stage	Standard	Data Management / Data Quality Control
Business Intelligence and Data Warehouse Platforms	Data Quality Tools	SmartyStreets	Standard	Address Validation
Business Intelligence and Data Warehouse Platforms	Extract, Transform and Load Tools	IBM DataStage	Standard	Data Management / Data Quality Control

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Business Intelligence and Data Warehouse Platforms	Extract, Transform and Load Tools	Oracle Golden Gate	Standard	Replication and Data Migration
Business Intelligence and Data Warehouse Platforms	Business Intelligence Platforms	Business Objects	Standard	Advanced Analytics
Business Intelligence and Data Warehouse Platforms	Business Intelligence Platforms	Cognos Suite	Standard	Advanced Analytics
Business Intelligence and Data Warehouse Platforms	Business Intelligence Platforms	Microsoft Power BI Desktop	Standard	
Business Intelligence and Data Warehouse Platforms	Business Intelligence Platforms	Microsoft Power BI Online	Standard	
Business Intelligence and Data Warehouse Platforms	Business Intelligence Platforms	Microsoft Power BI Report Builder	Standard	
Business Intelligence and Data Warehouse Platforms	Business Intelligence Platforms	Pivotal Greenplum	Standard	RDBMS-Enterprise Data Warehouse
Business Intelligence and Data Warehouse Platforms	Business Intelligence Platforms	RedAsh	Standard	
Business Intelligence and Data Warehouse Platforms	Business Intelligence Platforms	Alation	Target	
Business Intelligence and Data Warehouse Platforms	Business Intelligence Platforms	ACL Robotics Pro	Elective	Report and Data Extraction Automation

3.2. Application Environment Technology Domain

The Application Environment Technology Domain covers framework and other supporting software for the development and deployment of application software within Federal Student Aid. Products that service this domain typically offer significant bundled functionality but are not used directly by business end-users.

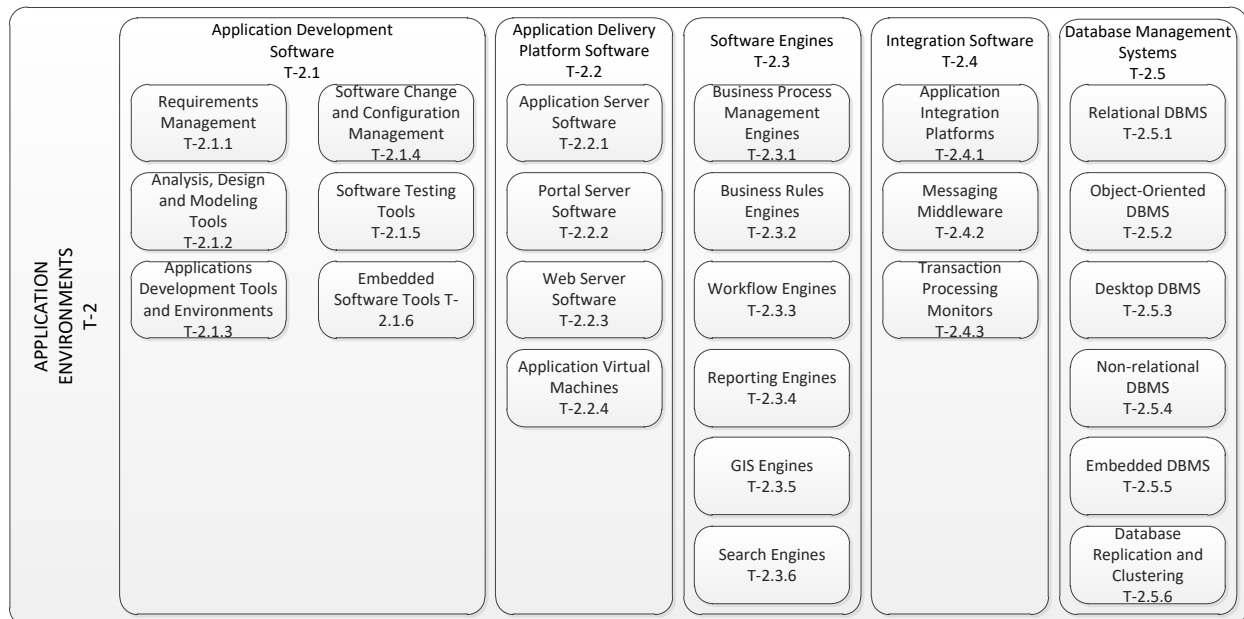


Figure 4. Application Environment Technology Domain

The Application Environment Technology Domain is composed of the following Technology Capabilities and Classes:

- **Application Development Software (T-2.1):** This capability comprises all those elements within the Federal Student Aid that relate to the specification, design, construction, implementation and lifecycle management of software applications.
 - **Requirements Management (T-2.1.1):** This class includes tools that support the requirements gathering phase of the application development life cycle, the purpose of which is to record the stakeholders' requirements for the system which is to be developed. Tools may assist with the capture of requirements, management of requirements changes, tracing of the initial requirements to individual pieces of functionality in the final system, and management of the document lifecycle for requirements generally. IBM Rational DOORS is a requirements management tool.
 - **Analysis, Design and Modeling Tools (T-2.1.2):** This class includes tools that support the analysis and design phases of the traditional software development life cycle. An example is SAP Power.
 - **Applications Development Tools and Environments (T-2.1.3):** This class includes integrated sets of tools that enable software programming, packaging, testing, and distribution. These tools are used by software developers in building software applications in an integrated development environment. Examples include Borland's Jbuilder, Microsoft's Visual Studio, and Oracle Developer Suite.
 - **Software Change and Configuration Management (T-2.1.4):** This class includes tools that provide automated support for managed change, configuration or version control of software assets. An example is IBM's Rational ClearCase.
 - **Software Testing Tools (T-2.1.5):** This class includes tools that provide automated support for the software testing cycle and include such facilities as the management of the overall test

- process, test development, capture/development of test scripts, replay of test scripts and test case generation for various kinds of testing including unit testing, system testing, regression testing, and integration testing. An example is HP's Business Process Testing, and Functional Testing software.
- **Embedded Software Tools (T-2.1.6):** This class includes software development tools that manage the embedded software development lifecycle: analyzing, designing, documenting, writing, compiling, debugging, testing, optimizing and verifying software. An example is the multi-embedded software development environment from Green Hills Software Inc.
 - **Application Delivery Platform Software (T-2.2):** This capability includes the essential software infrastructure products that enable the running of business applications. Types of application delivery platform software include application server software, portal server software and web portal software.
 - **Application Server Software (T-2.2.1):** This class includes system software used to host the business logic tier of applications, or to host application services. BEA WebLogic Server and IBM WebSphere Application Servers are examples.
 - **Portal Server Software (T-2.2.2):** This class includes software to support the development, deployment and operation of a portal environment, supplying aggregation and presentation capabilities that enable users to see relevant information and personalize their environments to best meet their needs and facilitate ease of use. It provides such capabilities as centralized identity services that manage users, roles, policies, and aggregation and presentation capabilities. IBM WebSphere Portal and Microsoft SharePoint are examples of portal server software.
 - **Web Server Software (T-2.2.3):** This class includes servers that centrally host and serve web pages. The web server software uses the client/server model and the Hypertext Transfer Protocol (HTTP) and serves the files that form web pages to web users (whose computers contain HTTP clients that forward their requests). An example is the Apache HTTP Server.
 - **Application Virtual Machines (T-2.2.4):** A process Virtual Machine (VM), sometimes called an application virtual machine, runs as a normal application inside an Operating System (OS) and supports a single process. It is created when that process is started and destroyed when it exits. Its purpose is to provide a platform-independent programming environment that abstracts away details of the underlying hardware or operating system and allows a program to execute in the same way on any platform. A process VM provides a high-level abstraction – that of a high-level programming language. This type of VM has become popular with the Java programming language, which is implemented using the Java virtual machine. Another example is the .NET Framework, which runs on a VM called the Common Language Runtime.
 - **Software Engines (T-2.3):** This capability includes software that enables the delivery of components of an application system through a software engine that interprets configuration information (sometimes created through an associated development tool like a business process modeling tool associated with a business process engine) in order to provide the functionality required for the application.
 - **Business Process Management Engines (T-2.3.1):** This class includes servers that centrally host and serve web pages. The web server software uses the client/server model and the Hypertext Transfer Protocol (HTTP) and serves the files that form web pages to web users (whose computers contain HTTP clients that forward their requests). An example is the Apache HTTP Server.
 - **Business Rules Engines (T-2.3.2):** This class includes software engines used to record, track, manage and revise enterprise business processes, without having to modify the software application itself. Rules are set to stipulate and outline processes and the Business Rule Engine (BRE) externalizes these rules for quick and easy modification.
 - BREs (also known simply as rule engines) are tools that manage the rules that define processes. BREs can be used in conjunction with other business-oriented tools such as Business Activity Monitoring (BAM), workflow engines and Business Process Management (BPM) tools.

- Examples include ILOG's Business Rule Management System (BRMS) and Blaze Advisor.
- **Workflow Engines (T-2.3.3):** This capability includes software engines that support workflow management which can be of two types:
 - Internal and external process integration – a workflow approach that allows for the definition of business processes that span applications, including those that come from different vendors. This usually requires a standards-based commercial workflow development environment.
 - Workflow engines automate, manage and execute business tasks and processes and events by executing a defined sequence of tasks which can include saving, modifying or generating files, sending, responding and receiving emails, and escalating or progressing approvals.
 - Enhydra Shark is an example of Open Source workflow engines written in Java.
- **Reporting Engines (T-2.3.4):** This class includes software engines for the generation of reports. Reports are usually defined through a report modeling tool and their execution can be triggered either through direct interaction with the reporting tool or through an Application Programming Interface (API) call from other software in which the engine is embedded. An example of a reporting engine is Crystal Reports.
- **GIS Engines (T-2.3.5):** This class includes server and desktop engines that combine relational databases with spatial interpretation and produce outputs in the form of maps. Geographic Information System (GIS) engines capture, store, integrate, analyze and display data that is spatially referenced.
- **Search Engines (T-2.3.6):** This class includes tools to support both searching and indexing capabilities. A search engine is a tool used to help find information on the Internet, intranet or in databases and file servers. Each search engine has its own way of gathering, classifying, and displaying information to the user. Examples of indexing search engines are Google Search and SharePoint Search.
- **Integration Software (T-2.4):** This capability includes platforms and other software for integrating the Federal Student Aid applications and systems.
 - **Application Integration Platforms (T-2.4.1):** This class includes middleware products (also known as an Integration Broker Suite or IBS) that combine the core functionality of an integration broker (an engine that provides message transformation and intelligent routing services) with additional features to deliver comprehensive integration capabilities. These additional features may include various interface and integration adapters, communication middleware, orchestration, choreography, business process management and message warehousing. This class also includes adaptors and connectors that combine design tools and runtime software that link applications to the enterprise messaging infrastructure, and ORBs (Object Request Broker) that allow objects to communicate with other software. An example is the Oracle/BEA WebLogic Integration Suite.
 - **Messaging Middleware (T-2.4.2):** This class includes integrated Message-Oriented Middleware (MOM) that covers applications that manage the asynchronous delivery of messages and message replies. This differs from other forms of program-to-program middleware, which are connection oriented and synchronous in nature. MOM receives messages and then ensures the delivery to the appropriate receivers independently of the message originator. IBM WebSphere MQ is an example.
 - **Transaction Processing Monitors (T-2.4.3):** This class includes applications that manage transactions end to end, ensuring integrity and performance usually in complex distributed environments. They are often used to monitor information processing that must occur within a defined, predictable and near real time manner. Examples include Oracle/BEA's Tuxedo and IBM's CICS.
- **Database Management Systems (T-2.5):** This capability includes different types of database management systems and related technologies within the Federal Student Aid.

- **Relational DBMS (T-2.5.1):** This class includes Database Management Systems (DBMS) in which the data is organized according to relationships between data entities as defined in a relational data model. Relational DBMS systems normally support a Structured Query Language (SQL) application programming interface. Examples are Oracle's 11g and Oracle 19c.
- **Object-Oriented DBMS (T-2.5.2):** This class includes DBMS that apply an Object-Oriented (OO) paradigm to the storage, retrieval and management of data and are usually used to support object-oriented programming languages. ObjectDB is an example.
- **Desktop DBMS (T-2.5.3):** This class includes DBMS that run on a desktop operating system such as Microsoft Windows. To be classified as a desktop DBMS, a product would need to be designed for single-user access only and not for remote access. An example is Microsoft Access.
- **Non-Relational DBMS (T-2.5.4):** This class includes any DBMS that is not a relational DBMS as defined above including noSQL. It may, for example follow the hierarchical or network database models. Examples are Cassandra and MongoDB.
- **Embedded DBMS (T-2.5.5):** This class includes software that is embedded within an application or a device and acts as a component of that application or device. Typically, embedded DBMSs are high-performance, have a small footprint and require no administration. The DBMS is transparent to the user, and customers for the embedding application or device do not have to purchase a separate DBMS license. An example is Oracle Berkeley DB.
- **Database Replication and Clustering (T-2.5.6):** This class includes DBMS architectures that support high-availability and fault-tolerant systems. In general, clustering means that multiple servers are arranged to access a single copy of the database. Each server is able to carry part of the application workload – if one fails, the workload is shared across the remaining servers. Replication achieves similar objectives by implementing multiple instances of the database; database objects are copied and maintained in multiple databases that make up a distributed database system. An example of a system that implements replication and clustering is Oracle Real Application Cluster (RAC).

Table 5, below, identifies the products and services that comprise FSA's current Application Environment Technology Domain.

Table 5. Application Environment Technology Domain

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Application Development Software	Requirements Management	IBM Rational DOORS	Standard	
Application Development Software	Analysis, Design and Modeling Tools	Oracle SQL Developer	Standard	
Application Development Software	Analysis, Design and Modeling Tools	TOAD (Query)	Standard	
Application Development Software	Analysis, Design and Modeling Tools	ERWin	Target	Data Modeling
Application Development Software	Analysis, Design and Modeling Tools	Embarcadero ER/Studio	Phase Out	Data Modeling
Application Development Software	Application Development	IBM Rational Application Developer	Standard	

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
	Tools and Environments			
Application Development Software	Application Development Tools and Environments	Jupyter	Standard	Advanced Analytics
Application Development Software	Application Development Tools and Environments	Microsoft R	Standard	Data Mining and Analysis
Application Development Software	Application Development Tools and Environments	Microsoft Visual Studio	Standard	Windows Development
Application Development Software	Application Development Tools and Environments	Microsoft Visual Studio Code	Standard	Windows/Linux/Mac Development
Application Development Software	Application Development Tools and Environments	Oracle Developer Suite	Standard	
Application Development Software	Application Development Tools and Environments	Python	Standard	Enterprise Data Warehouse
Application Development Software	Application Development Tools and Environments	R	Standard	Data Mining and Analysis
Application Development Software	Application Development Tools and Environments	GT Ivory	Elective	API Creation and Integration
Application Development Software	Software Change and Configuration Management	GIT	Standard	Version Control
Application Development Software	Software Change and Configuration Management	GitHub	Standard	Enterprise Data Warehouse Version Control
Application Development Software	Software Change and Configuration Management	IBM Rational ClearCase	Standard	
Application Development Software	Software Change and Configuration Management	IBM Rational ClearQuest	Standard	
Application Development Software	Software Change and Configuration Management	IBM Rational Team Concert	Standard	

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Application Development Software	Software Change and Configuration Management	IBM uDeploy	Standard	Version Control
Application Development Software	Software Change and Configuration Management	Red Hat Ansible	Standard	DevOps
Application Development Software	Software Change and Configuration Management	IBM SMART / RESTART	Elective	Checkpoint / Restat for z/OS Batch Application Recovery
Application Development Software	Software Testing Tools	HP LoadRunner	Standard	Performance Testing
Application Development Software	Software Testing Tools	IBM Rational Functional Tester	Standard	
Application Development Software	Software Testing Tools	IBM Rational Performance Tester	Standard	Performance Testing
Application Development Software	Software Testing Tools	IBM Rational Quality Manager	Standard	
Application Development Software	Software Testing Tools	JMeter	Standard	Performance Testing
Application Development Software	Software Testing Tools	JUnit	Standard	
Application Development Software	Software Testing Tools	SeeTest.io	Standard	Virtual Mobile Device Simulator
Application Development Software	Embedded Software Tools			
Application Delivery Platform	Application Server Software	IBM WebSphere Application Server	Standard	
Application Delivery Platform	Application Server Software	Micro Focus Solutions Business Manager (SBM)	Standard	Custom Workflow Development
Application Delivery Platform	Application Server Software	Microsoft Project Server	Standard	EBC Microsoft SharePoint Environment
Application Delivery Platform	Application Server Software	Microsoft SharePoint	Standard	
Application Delivery Platform	Application Server Software	Microsoft SharePoint Online	Standard	
Application Delivery Platform	Application Server Software	Red Hat JBoss Enterprise Application Platform (EAP)	Standard	Digital Platform

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Application Delivery Platform	Portal Server Software	Microsoft SharePoint	Standard	EBC Microsoft SharePoint Environment
Application Delivery Platform	Portal Server Software	Microsoft SharePoint Online	Standard	EBC Microsoft SharePoint Environment
Application Delivery Platform	Web Server Software	Apache Web Server	Standard	
Application Delivery Platform	Web Server Software	IBM HTTP Server	Standard	
Application Delivery Platform	Web Server Software	Microsoft Internet Information Server (IIS)	Standard	
Application Delivery Platform	Web Server Software	Microsoft SharePoint	Standard	
Application Delivery Platform	Web Server Software	Microsoft SharePoint Online	Standard	
Application Delivery Platform	Application Virtual Machines	Java Virtual Machine (JVM)	Standard	
Application Delivery Platform	Application Virtual Machines	VMWare EXS1	Standard	
Software Engines	Business Process Management Engines			
Software Engines	Business Rules Engines			
Software Engines	Workflow Engines	Micro Focus Solutions Business Manager (SBM)	Standard	Custom Workflow Development
Software Engines	Workflow Engines	Microsoft SharePoint	Standard	EBC Microsoft SharePoint Environment
Software Engines	Workflow Engines	Microsoft SharePoint Online	Standard	EBC Microsoft SharePoint Environment
Software Engines	Workflow Engines	Appian	Target	Correspondence Management
Software Engines	Reporting Engines	IBM Information Server (IIS)	Standard	
Software Engines	Reporting Engines	Rational CLM (Collaborative Lifecycle Management)	Standard	
Software Engines	Reporting Engines	SQL Server Analytical Services (SSAS)	Standard	EBC Microsoft SharePoint Environment
Software Engines	Reporting Engines	SQL Server Reporting Services (SSRS)	Standard	EBC Microsoft SharePoint Environment

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Software Engines	Reporting Engines	Tableau Suite	Standard	Data Mining, Analysis Visualization
Software Engines	Reporting Engines	MicroStrategy	Phase Out	
Software Engines	GIS Engines			
Software Engines	Search Engines	Search.gov	Standard	
Software Engines	Search Engines	SearchBlox	Standard	
Software Engines	Search Engines	SharePoint 2013 Search	Standard	EBC Microsoft SharePoint Environment
Integration Software	Application Integration Platforms	bTrade TDAccess	Standard	
Integration Software	Application Integration Platforms	IBM DataPower Gateway	Standard	
Integration Software	Application Integration Platforms	IBM Information Server	Standard	
Integration Software	Application Integration Platforms	IBM WebSphere Adapters	Standard	
Integration Software	Application Integration Platforms	IBM WebSphere MQ FTE	Standard	
Integration Software	Messaging Middleware	IBM Integration Bus	Standard	
Integration Software	Messaging Middleware	IBM WebSphere MQ	Standard	
Integration Software	Transaction Processing Monitors	CICS	Standard	Application and Data Access Method
Database Management Systems	Relational DBMS	DB2	Standard	Mainframe and mid-tier
Database Management Systems	Relational DBMS	MS SQL Server	Standard	Mid-tier Application Use
Database Management Systems	Relational DBMS	MySQL	Standard	Mainframe and Mid-Tier
Database Management Systems	Relational DBMS	Oracle	Standard	Mid-tier Application Use
Database Management Systems	Relational DBMS	PostgreSQL	Standard	Data Warehouse Framework
Database Management Systems	Object-Oriented DBMS			
Database Management Systems	Desktop DBMS	Microsoft Access 365	Standard	

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Database Management Systems	Non-Relational DBMS			
Database Management Systems	Embedded DBMS			
Database Management Systems	Database Replication and Clustering			
Database Management Systems	Desktop DBMS	Microsoft Access 365	Standard	

3.3. Hardware Devices and Systems Software Technology Domain

The Hardware Devices and Systems Software Technology Domain comprises base level system functionality across Federal Student Aid. Business applications may run directly on technology elements from this domain, or they may run on technology elements from the Application Environments domain which in turn run on technology elements from this domain.

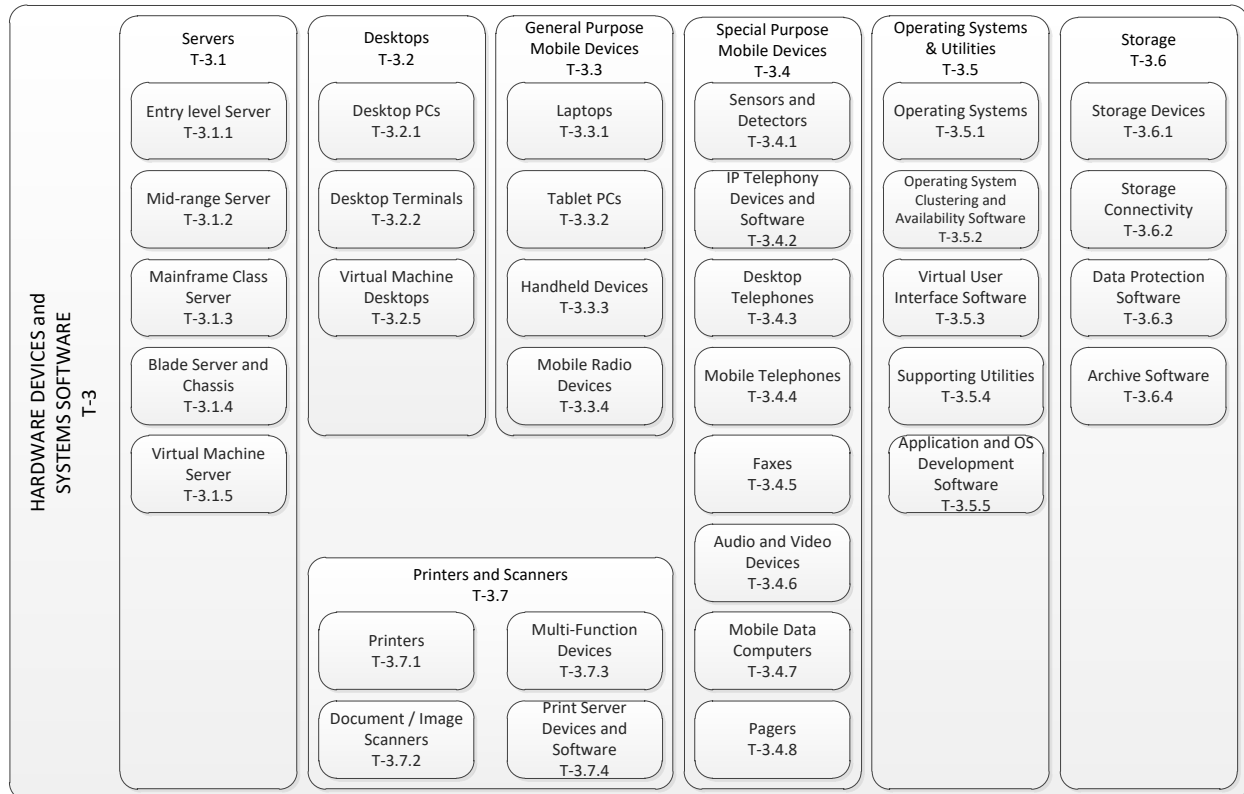


Figure 5. Hardware Devices and Systems Software Technology Domain

The Hardware Devices and Systems Software Technology Domain is composed of the following Technology Capabilities and Classes:

- **Servers (T-3.1):** This capability includes server hardware including entry-level server, mid-range server, mainframe class server and blade servers, as well as virtual servers.
 - **Entry Level/Development Server (T-3.1.1):** These are desktop or workgroup servers that provide services to desktop workstations including the hosting of email, hosting of directories and authentication mechanisms, provision of application and operating system development infrastructure, provision of file storage services and provision of print services. These are server class machines that typically feature multiple high-throughput processors, large memory capacity, large capacity high-speed storage, redundant components for high availability, fast bus speeds and high transfer rates. Examples include IBM Intel based xSeries servers.
 - **Mid-range Server (T-3.1.2):** This class includes computers or servers that fall into the range above entry-level servers on the low end and below mainframe servers at the high end. Mid-range systems may or may not run proprietary operating systems. Examples include IBM's pSeries P7-740. Blade servers and chassis are not considered to be midrange servers.
 - **Mainframe Class Server (T-3.1.3):** This class includes large-capacity computer systems designed to serve large numbers of multiple users, and are typically deployed in a centralized

- manner to handle enterprise-wide applications. They may require specialized and specific cooling and power. Mainframe servers will be defined as such by the manufacturer. Examples include IBM's zEnterprise 114.
- Blade Server and Chassis (T-3.1.4): Blade servers are self-contained all-inclusive computer servers with a design optimized to minimize physical space. A blade enclosure, which can hold multiple blade servers, provides services such as power, cooling, networking, various interconnects and management.
 - Virtual Machine Server (T-3.1.5): Virtual machines (sometimes called hardware virtual machines) allow the sharing of the underlying physical machine resources between different virtual machines, each running its own operating system. The software layer providing the virtualization is called a virtual machine monitor or hypervisor. A hypervisor can run on bare hardware or on top of an operating system. Examples include VMware's ESXi.
- **Desktops (T-3.2):** This capability includes desktop PC and alternative technologies that provide a similar capability within the Federal Student Aid.
 - **Desktop PCs (T-3.2.1):** This class includes microcomputers designed primarily for individual use, which remain more or less permanently on an office worker's desk; sharing resources with another computer is optional. It is not designed for portability and is usually permanently linked to the enterprise network.
 - **Desktop Terminals (T-3.2.2):** This class includes terminals with little or no software of their own that rely on a mainframe or another computer (such as a PC server) for its intelligence. This class includes dumb terminals and thin client network computers.
 - **Virtual Machine Desktops (T-3.2.3):** A virtual desktop is a running instance of a desktop operating system that has its own BIOS, chipset, disk drives and network. Although these devices are all virtual devices, they look, act and function just like their real counterparts. The operating system running on a virtual desktop has no idea what sort of machine it is running on www.sarcom.com. Examples include VMware's Workstation product.
 - **General Purpose Mobile Devices (T-3.3):** This capability includes portable and mobile generic computing devices. These generally have some capability to install applications to provide specialist functions.
 - **Laptops (T-3.3.1):** A laptop computer, also known as a notebook computer, is a small personal computer designed for mobile use. A laptop integrates all of the typical components of a desktop computer, including a display, a keyboard, a pointing device (a touchpad, also known as a trackpad, or a pointing stick) and a battery into a single portable unit. The rechargeable battery is charged from an AC/DC adapter and has enough capacity to power the laptop for several hours. A netbook is a lightweight, low-cost, energy-efficient, highly portable laptop suitable for web browsing, email and general-purpose applications. To achieve its small form factor, low weight and affordability, netbooks offer fewer features, less processing power and a reduced ability to run resource-intensive operating systems.
 - **Tablet PCs (T-3.3.2):** This class includes computing devices that are operated by direct screen contact via a pen or touch interface. An example is the Apple iPad.
 - **Handheld Devices (T-3.3.3):** This class also includes computing devices that can be held in the palm of the hand and that offer advanced capabilities, often with PC-like functionality. They typically use a touch screen or stylus device for data entry and navigation. Examples include the iPhone series of smart phones, or TomTom GPS navigation systems.
 - Modern mobile phones may also be considered a handheld device if they incorporate networking capability and support mobile productivity applications, email, and Internet access. Classification of the asset should be based on its dominant use.
 - **Mobile Radio Devices (T.3.3.4):** This class includes two-way radio devices that are manufactured to be installed in vehicles. They may be analog or digital radio devices that can communicate via a radio repeater or directly between devices on select licensed frequencies. Mobile radios are also often installed in a fixed site location such as a building.

- **Special Purpose Devices (T-3.4):** This capability includes various other special purpose devices that don't fit under the other more generic classes. These include remote sensors, dedicated IP telephony video devices, desktop telephones, mobile telephones, faxes and other audio and video devices.
 - **Sensors and Detectors (T-3.4.1):** This class includes dedicated devices that are used for the measurement of some phenomena such as temperature, precipitation or water level. In general, as well as a data capture facility, the device has some means of storage to allow the recording of data, and a telecommunications capability for reporting the captured data back to either a central location or data capture device. This class would also include Radio Frequency Identification tags and detectors (scanners), as well as GPS based tracking systems.
 - **IP Telephony Devices and Software (T-3.4.2):** This class includes devices that support voice and video communications by means of the Internet Protocol (IP), bypassing the public switched telephone network (PSTN) and its associated charges. Examples include various softphones, the Cisco 7900 series IP phones and Cisco's Unified Video Advantage software.
 - **Desktop Telephones (T-3.4.3):** This class relates to the familiar everyday stand-alone telephone handset that is used for voice communications. It is stand-alone in the sense that it is not incorporated into another device such as a personal computer.
 - **Mobile Telephones (T-3.4.4):** This class includes portable wireless telephones that allow voice communication via radio signals through special ground stations that cover areas known as cells and are linked with the public telephone system. Most mobile telephones offer Short Messaging Service (SMS) for sending and receiving brief text messages.
 - Modern mobile phones may also be considered a 'handheld device' if they incorporate networking capability and support mobile productivity applications, email, and Internet access. Classification of the asset should be based on its dominant use.
 - This class also includes SMS gateways that transform messages to mobile network traffic. Typical use of a gateway would be to forward simple email to a mobile phone recipient.
 - **Faxes (T-3.4.5):** This class includes devices for the telephonic transmission of scanned-in printed material (text or images), usually to a telephone number associated with a printer or other output device.
 - This class also includes fax gateways that transform messages to faxes and transmit them over fax-capable modems. Fax gateways also receive faxes, and transmit them as attachments to emails over the IP network. Examples include Kofax Communication Server.
 - **Audio and Video Devices (T-3.4.6):** This class includes devices not captured by the above headings including projectors, cameras, and teleconferencing equipment.
 - **Mobile Data Computers (T-3.4.7):** The Mobile Data Computer or terminal is a vehicle-mounted device that facilitates messaging, electronic dispatching, vehicle monitoring, and GPS-based vehicle tracking.
 - **Pagers (T-3.4.7):** This class relates to pagers, which are a simple personal telecommunications device for receiving (and sometimes sending) short messages. Pagers mainly support the critical messaging markets, such as emergency service personnel, medical personnel, and information technology support staff. Examples include the Apollo range of paging devices and systems.
- **Operating Systems and Utilities (T-3.5):** This capability includes operating systems and related software.
 - **Operating Systems (T-3.5.1):** This class includes the main control programs that manage the operation of the computer hardware including memory, storage, networking and input and output, and interfaces the hardware to the applications and users.
 - This class is primarily focused on general or multi-purpose operating systems, such as IBM's AIX mid-range server operating system, Novell Netware, and Microsoft Windows for personal computers.
 - **Operating System Clustering and Availability Software (T-3.5.2):** This class refers to software systems that manage a group of loosely coupled servers so as to maximize availability or up time and/or share the workload; the clustered servers often share common disk storage. Cluster Manager from Red Hat is an example.

- **Virtual User Interface Software (T-3.5.3):** This class includes software that enables an enterprise to provide application access for many desktops from one centralized location, reducing the cost of provisioning desktops individually and allowing configuration and management from the central site, under the thin client model. An example is the Citrix MetaFrame Access Suite.
- **Supporting Utilities (T-3.5.4):** This class includes tools that work together with the core operating system to provide certain functions to users of a computer. Examples include WinZip, a file compression utility, and terminal emulation software such as PuTTY, or Reflections.
- **Application and OS Deployment Software (T-3.5.5):** This class includes facilities that are designed to allow the distribution and deployment of software and the associated upgrades, from a central site to a number of remote installations. This is done in a managed way so that the central site has tight control over the software configurations and versions loaded onto the remote machines. An example is Microsoft's System Center Configuration Manager.
- **Storage (T-3.6):** This capability includes storage devices and related connectivity and software.
 - **Storage Devices (T-3.6.1):** This class includes physical storage resources and devices that are part of storage architecture and are attached to a storage interconnection network. Physical storage resources often have a high degree of redundancy, including multiple network connections and data redundancy functions (via RAID), all aimed at delivering highly available storage services. The devices typically provide a means to persistently retain data over a long time period. Examples include disk drives, disk arrays, storage controllers, array controllers, tape drives, tape libraries and a wide range of storage appliances such as Network Attached Storage (NAS) appliances. This class should also include firmware and similar operating software, such as the Brocade Fabric OS.
 - **Storage Connectivity (T-3.6.2):** This class includes the infrastructure and embedded software that connects elements of the storage environment. These technologies may be primarily used for access to storage devices or shared with other functions. The important characteristic is that they provide rich, high-performance, scalable connectivity upon which a storage environment can be based. The Storage Connectivity class often provides the ability to implement multiple connections from a host, thus providing another element of redundancy for high availability environments by enabling the use of multi-path I/O software on the host, which may also provide load balancing among the redundant paths. The physical-layer network technologies that are typically (or have been) used to provide this capability include Fiber Channel, Fast and Gigabit Ethernet, InfiniBand and VAX CI network.
 - **Data Protection Software (T-3.6.3):** Data protection software will produce, through some method, a collection of data stored on (usually removable) non-volatile storage media for purposes of recovery, in case the original copy of data is lost or becomes inaccessible. This is often called a backup copy. To be useful for recovery, a backup must be made by copying the source data image when it is in a consistent state. Software in This class can support methods such as: tape backup, restore; disk backup, restore; snapshots, search and retrieval; synthetic backup, roll back; real time replication; instant recovery. Enabling technologies can assist in the above methods and include de-duplication software, virtual tape libraries and continuous data protection technology.
 - **Archive Software (T-3.6.4):** This is software to automate the migration, storage and retention of both structured and unstructured information in accordance with business policies. The software supports the primary purposes of archiving, which are the long-term preservation, retention and retrieval of that data. The differentiator between archive and data protection rests in a number of attributes, including:
 - The length of retention
 - Granularity of retention: the retention and control is more granular acting on objects or entities specifically identified by the business, compared with data protection which acts at a higher level of aggregation on the same objects without concern for filtering any of those objects

- Associating metadata with the objects, which among other things will authenticate its originality verifying that no change has occurred
 - The ability to search on the data stored in a richer context than typically achievable in the data protection class.
- **Printers and Scanners (T-3.7):** This capability includes printers, scanners and hybrid multi-function devices.
 - **Printers (T-3.7.1):** This class includes devices that provide dedicated printing services. Typically, these include large laser printers, shared by many people, but may also include personal desktop printers such as ink-jets.
 - **Document/Image Scanners (T-3.7.2):** This class includes dedicated scanning devices, often small enough to sit on the desk of an office worker. Its purpose is to scan paper documents, producing a digitized facsimile of the document on the personal computer to which it is connected.
 - **Multi-Function Devices (T-3.7.3):** This class includes peripheral devices that perform a variety of functions that would otherwise be carried out by separate peripheral devices. Multi-function devices include at least two of the following: a printer, a scanner, a copier and a fax machine. Common examples include:
 - Digital copy machine: Creates copies digitally, by scanning and printing. In addition to scanning and printing, may include fax, sorter and office hardware, such as a stapler.
 - Fax machine: Looks like a normal fax but connects to a PC for data input/output, printing, scanning and copying.
 - Printer/Scanner/Copier MFP: Performs all three functions and sometimes faxing as well.
 - **Print Server Devices and Software (T-3.7.4):** This class includes software that manages and controls network printing. Examples include the Levi Ray and Shoup Enterprise Output Management suite for the IBM z/OS. Also included are dedicated devices that connect one or more printers to a local area network. Such devices typically have a single LAN connector, such as an RJ-45 socket, and one or more physical ports (e.g. serial, parallel or USB) to provide connections to printers. An example is Hewlett Packard Print Server Appliance 4200.

Table 6, below, identifies the products and services that comprise FSA's current Hardware Devices and Systems Software Technology Domain.

Table 6. Hardware Devices and Systems Software Technology Domain Standards

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Servers	Entry Level Server	HPE DL380	Elective	
Servers	Mid-range Server	HPE DL380	Elective	
Servers	Mid-range Server	HP rp7440	Elective	
Servers	Mid-range Server	HPE BL460c Gen7	Phase Out	
Servers	Mid-range Server	HPE BL460c Gen9	Elective	
Servers	Mainframe Class Server	IBM zEnterprise Z13	Elective	
Servers	Blade Server and Chassis	HPE C7000	Elective	
Servers	Virtual Machine Server	VMware vSphere	Standard	
Servers	Virtual Machine Server	HPE BL460c Gen9	Elective	
Desktops	Desktop PCs			
Desktops	Desktop Terminals			
Desktops	Virtual Machine Desktops			
General Purpose Mobile Devices	Laptops	Dell Latitude 5470	Standard	
General Purpose Mobile Devices	Laptops	Dell Latitude 5480	Standard	
General Purpose Mobile Devices	Laptops	Dell Latitude 5490	Standard	
General Purpose Mobile Devices	Tablet PCs	Microsoft Surface 3	Phase Out	
General Purpose Mobile Devices	Handheld Devices			
General Purpose Mobile Devices	Mobile Radio Devices			
General Purpose Mobile Devices	Sensors and Detectors			
Special Purpose Devices	IP Telephony Devices and Software	Cisco UCCE Suite	Standard	
General Purpose Mobile Devices	Desktop Telephones			
Special Purpose Devices	Mobile Telephones	Amazon SNS	Standard	or High Volume SMS (~ 125M SMS/Day)
Special Purpose Devices	Mobile Telephones	iPhone 8	Standard	
Special Purpose Devices	Mobile Telephones	iPhone 10	Standard	

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Special Purpose Devices	Mobile Telephones	SUMOTEXT	Phase Out	For High Volume SMS (~ 10M SMS/Month)
Special Purpose Devices	Faxes			
Special Purpose Devices	Audio and Video Devices	ATUC-50DU Speaker	Standard	
Special Purpose Devices	Audio and Video Devices	Planar LX55X-L 55" Television	Standard	
Special Purpose Devices	Mobile Data Computers			
Special Purpose Devices	Pagers			
Operating Systems and Utilities	Operating Systems	Android	Standard	Mobile Application on Play Store
Operating Systems and Utilities	Operating Systems	HP-UX 11.23	Standard	
Operating Systems and Utilities	Operating Systems	iOS	Standard	Mobile Application on App Store
Operating Systems and Utilities	Operating Systems	Linux Red Hat v7.x	Standard	
Operating Systems and Utilities	Operating Systems	Linux Red Hat v6.x	Phase Out	
Operating Systems and Utilities	Operating Systems	Linux Red Hat v5.x	Phase Out	
Operating Systems and Utilities	Operating Systems	Windows 10	Standard	
Operating Systems and Utilities	Operating Systems	Windows 2016	Standard	
Operating Systems and Utilities	Operating Systems	Windows 2012	Phase Out	
Operating Systems and Utilities	Operating Systems	Windows 2008 R2 Standard	Phase Out	
Operating Systems and Utilities	Operating Systems	Windows 2008 R2 Enterprise	Phase Out	
Operating Systems and Utilities	Operating Systems	zOS 2.1	Standard	

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Operating Systems and Utilities	Operating Systems	zOS 2.2	Target	
Operating Systems and Utilities	Operating System Clustering and Availability Software	HP Clustering	Elective	
Operating Systems and Utilities	Virtual User Interface Software	Citrix XenApp	Standard	
Operating Systems and Utilities	Virtual User Interface Software	VMWare	Standard	
Operating Systems and Utilities	Supporting Utilities	Rocket BlueZone	Standard	
Operating Systems and Utilities	Supporting Utilities	WinZip	Standard	
Operating Systems and Utilities	Application and OS Deployment Software	Red Hat OpenShift	Standard	Digital Platform
Storage	Storage Devices	EMC DLm 8100 (VTL)	Elective	
Storage	Storage Devices	EMC VMAX 40K	Elective	
Storage	Storage Devices	HPE XP7	Elective	Mainframe
Storage	Storage Devices	Netgear ReadyNAS 4360S	Elective	
Storage	Storage Devices	HPE 6600 StoreOnce (VTL)	Target Elective	Midrange
Storage	Storage Devices	HPE 7440-4	Target Elective	Midrange
Storage	Storage Devices	HPE 8450-4	Target Elective	Midrange
Storage	Storage Devices	IBM 7760	Target Elective	Mainframe
Storage	Storage Devices	DataDomain DD4500 (VTL)	Phase Out	
Storage	Storage Connectivity	ESCON	Elective	
Storage	Storage Connectivity	FICON for Mainframe	Elective	
Storage	Data Protection Software	Fast Dump Restore (FDR) for Mainframe	Elective	
Storage	Data Protection Software	Innovation Data Processing FDR	Elective	
Storage	Data Protection Software	Metalogix StoragePoint	Elective	

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Storage	Data Protection Software	HPE Snap/Business Copy	Target Elective	
Storage	Archive Software	Symantec Backup Exec 15	Standard	
Storage	Archive Software	CA DMS for Mainframe	Elective	
Storage	Archive Software	IBM Content Manager OnDemand	Elective	Static Document Management, Search and Retrieval
Storage	Archive Software	Innovation Data Processing FDRABR for Mainframe	Elective	
Storage	Archive Software	Symantec Netbackup	Target Elective	
Printers and Scanners	Printers	HP Printer M452dn	Standard	
Printers and Scanners	Document/ Image Scanners	HP Digital Sender Flow 8500fn2	Phase Out	
Printers and Scanners	Multi-Function Devices	HP Multi-Function Printer E87650z	Standard	
Printers and Scanners	Multi-Function Devices	HP Multi-Function Printer M681f	Standard	
Printers and Scanners	Print Server Devices and Software			

3.4. Network and Computer Accommodation

The Network and Computer Accommodation domain includes facilities used to house computer systems, and those technology elements that provide base level permanent or intermittent connectivity.

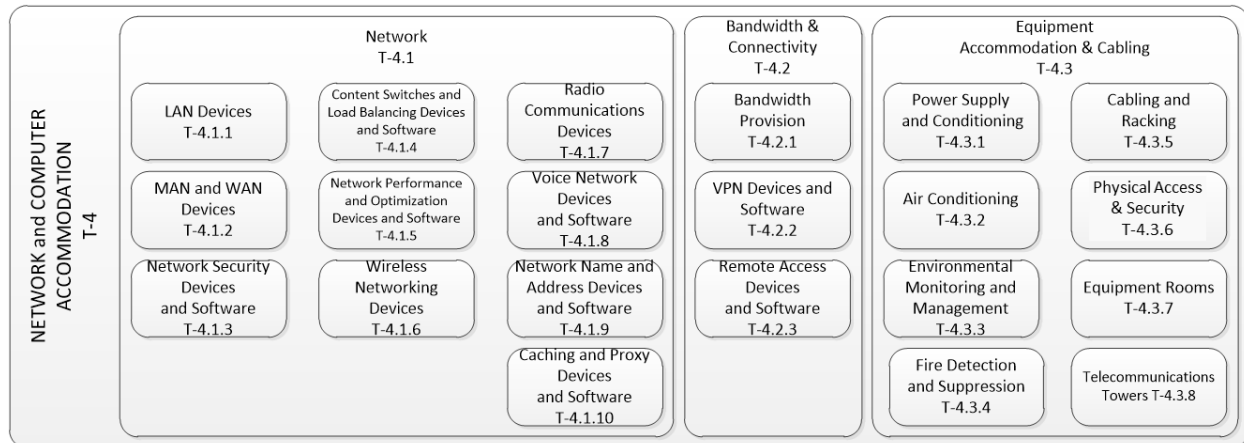


Figure 6. Network and Computer Accommodation Technology Domain

The Network and Computer Accommodation Technology Domain is composed of the following Technology Capabilities and Classes:

- **Network (T-4.1):** This capability includes those technology elements that provide base level permanent or intermittent connectivity. This includes wired and wireless modes.
 - **LAN Devices (T-4.1.1):** This class includes devices that perform an intrinsic function for a local area network. Examples include switches and hubs from Cisco.
 - **MAN and WAN Devices (T-4.1.2):** This class includes devices that perform an intrinsic function for a Metropolitan Area Network (MAN) or a Wide Area Network (WAN). Examples include routers supplied by companies such as Cisco.
 - **Network Security Devices and Software (T-4.1.3):** This class includes hardware and software whose main purpose is to provide security for a network, particularly in terms of preventing unauthorized access. Examples include firewalls such as the Checkpoint Firewall Software Blade and network access control, such as the Cisco NAC Appliance.
 - **Content Switches and Load Balancing Devices and Software (T-4.1.4):** This class includes devices that can redirect network connections to manage the performance of applications. Connection requests, and subsequent network traffic, is redirected to appropriate servers on the basis of a defined algorithm. The algorithm can be as simple as round robin or as complex as based on an evaluation of the current workload of the participating servers. Content switches, also known as layer 3 switches, have the ability to inspect the content of the network traffic and determine where to redirect the traffic. The Cisco CSS 11500 series of switches is an example.
 - **Network Performance and Optimization Devices and Software (T-4.1.5):** This class includes hardware devices whose purpose is to enable monitoring and/or improvement of activity levels (particularly traffic) on a network and its components. An example is Riverbed Appliances Devices and Cisco's Network Analysis Modules.
 - **Wireless Networking Devices (T-4.1.6):** This class includes devices that perform some intrinsic function for a wireless network. Wireless networks usually run over IP, and can provide LAN, MAN and even WAN functionality. An example is an 802.11n wireless router.
 - **Radio Communications Devices (T-4.1.7):** This class includes devices that use spectrum licensed from the ACMA, and are usually dedicated to voice communications. Radio communications can use long range high-frequency (HF) radio and short-range ultra-high-frequency (UHF) radios. Examples include two-way radio repeaters and base stations. Mobile devices, such as hand-held radios, should be classified to the Mobile Radio Devices class.

- **Voice Network Devices and Software (T-4.1.8):** This class includes devices such as Private Automatic Branch Exchange (PABX) and devices that enable voice over IP (VoIP), two-way radio interfaces, and radio control console systems. A PABX is an automatic telephone switching system within a private enterprise. VoIP is an Internet protocol telephony term for a set of facilities used to manage the delivery of voice information over the Internet.
- **Network Name and Address Devices and Software (T-4.1.9):** This class includes components that manage the database of names and addresses for potential network destinations and perform the function of translating network addresses from human-readable form to machine-readable form and back again. An example is the Microsoft DNS Server. This class also includes the software that assigns network addresses to devices on request. The primary example here is a Dynamic Host Configuration Protocol (DHCP) service.
- **Caching and Proxy Devices and Software (T-4.1.10):** This class includes components provided by a proxy server. A proxy server is a device that processes and filters all IP packets that are directed to it and decides which protocols and services can be served out of its cache. An example is Microsoft's Internet Security and Acceleration (ISA) Server.
- **Bandwidth and Connectivity (T-4.2):** This capability includes services, devices and software that provide bandwidth, connectivity, virtual private network and remote access capabilities.
 - **Bandwidth Provision (T-4.2.1):** This class refers to the sourcing of telecommunications capacity through third-party providers, external to the enterprise.
 - **VPN Devices and Software (T-4.2.2):** This class includes components that support the provision of secure networking between a central network and mobile workers or remote teleworkers. Cisco offers a range of hardware and software to support VPN services.
 - **Remote Access Devices and Software (T-4.2.3):** This class includes components that provide the ability to connect to a network from a distant location. Generally, this requires a computer, a modem and remote-access software to allow the computer to connect to the network over a public communications network (such as a phone or cable network). Examples include Microsoft's RAS.
- **Equipment Accommodation and Cabling (T-4.3):** This capability includes those facilities used to house and connect systems and associated equipment.
 - **Power Supply and Conditioning (T-4.3.1):** This covers all equipment which provides and conditions power including backup power systems and generation of power. To prevent single points of failure, all elements of the electrical systems, including backup system, are typically fully duplicated and critical servers are connected to both the A-side and B-side power feeds. This arrangement is often made to achieve N+1 redundancy in the systems. Static switches are sometimes used to ensure instantaneous switchover from one supply to the other in the event of a power failure. Where uninterruptible power supply is required, backup power from alternative sources such as diesel generators or other uninterruptible power sources can be utilized to mitigate the impact of events such as mains power failure.
 - **Air Conditioning (T-4.3.2):** The ambient temperature and humidity in equipment accommodation rooms may affect the performance of some electronic equipment, including possible malfunction. Air conditioning provides means of controlling temperature and humidity to desired levels.
 - **Environmental Monitoring and Management (T-4.3.3):** This class includes software and associated sensors that control and capture information on the performance of buildings, equipment rooms, and associated infrastructure in real time.
 - **Fire Detection and Suppression (T-4.3.4):** Fire suppression systems are designed for use in conjunction with other fire safety systems including smoke and heat detectors and alarm systems, to increase the level of fire protection within enclosed spaces such as data centers. Gaseous fire suppression is a form of suppression that uses inert gases and chemical agents to stabilize, reduce or eliminate fire propagation and resulting heat/smoke. This type of suppression system typically consists of the agent and its storage containers, release valves, piping and dispersion nozzles; as well as a system of controls linked to detection and alarm systems.

- **Cabling and Racking (T-4.3.5):** This class includes connectivity hardware that interconnects devices. This classification includes the cable types, patch panels, racks and cabling management systems.
- **Physical Access and Security (T-4.3.6):** Includes cameras (CCTV), access control systems, mantraps and other security systems used to monitor and control physical access to IT equipment rooms, racks.
- **Equipment Rooms (T-4.3.7):** A data center is a large purpose-built facility/building that provides a secure and controlled environment to support the operation of IT equipment. A computer room is a smaller, dedicated facility (which may or may not be purpose built) that is used to house operational equipment and systems. Equipment and telecommunications rooms house building and floor distributors, along with other specialized equipment. Best practice suggests these generally include redundant or backup power supplies, redundant data communications connections, environmental controls (e.g. air conditioning, fire suppression) and security devices.
- **Telecommunications Towers (T-4.3.8):** This class includes fixed infrastructure to support the antennae of two-way radio, wireless network devices and microwave radio equipment. This may include safety fencing, lightning protection earthing systems, full protection systems, cable and antenna support arrangements. Towers are typically freestanding or have guyed cable support, but antennae can also be mounted on a range of small structures attached to buildings. Towers typically have an adjacent equipment room.

Table 7, below, identifies the products and services that comprise FSA's current Network and computer Accommodation Technology Domain.

Table 7. Network and Computer Accommodation Technology Domain Standards

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Network	LAN Devices	Spectracom SecureSync	Elective	
Network	LAN Devices	HPE Switches	Target Elective	
Network	MAN and WAN Devices	HPE Routers	Elective	
Network	MAN and WAN Devices	Cisco Routers	Phase Out	
Network	Network Security Devices and Software	Barracuda Web Application Firewall	Standard	
Network	Network Security Devices and Software	Checkpoint	Standard	
Network	Network Security Devices and Software	ixia	Standard	Network Tap
Network	Network Security Devices and Software	Nipper Studio Auditor / Enterprise License	Standard	
Network	Network Security Devices and Software	McAfee IDS	Target Elective	
Network	Network Security Devices and Software	Palo Alto	Target Elective	
Network	Content Switches and Load Balancing Devices	Netscaler (Limited)	Elective	

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Network	Content Switches and Load Balancing Devices	F5 Local Traffic Manager (LTM)	Elective	
Network	Network Performance and Optimization Devices and Software	Zenoss	Standard	
Network	Network Performance and Optimization Devices and Software	BMC Discovery	Elective	
Network	Network Performance and Optimization Devices and Software	F5 Local Traffic Manager (LTM)	Elective	
Network	Network Performance and Optimization Devices and Software	Netscaler (Limited)	Elective	
Network	Network Performance and Optimization Devices and Software	HP Network Node Manager (Nnmi)	Target Elective	
Network	Network Performance and Optimization Devices and Software	SiteScope	Target Elective	
Network	Wireless Networking Devices	Xirrus XR-2436 Wireless Access Point	Standard	
Network	Wireless Networking Devices	Xirrus XR-630 Wireless Access Point	Standard	
Network	Radio Communication Devices	Shure ULXD2/SM58-G50 Microphone	Standard	
Network	Voice Network Devices and Software	Polycom 310 Conference Phone	Standard	
Network	Voice Network Devices and Software	Polycom 700 Conference Phone	Standard	
Network	Network Name and Address Devices and Software	Infoblox Trinzic	Target	
Network	Network Name and Address Devices and Software	DXC USPS IPAM	Target Elective	
Network	Caching and Proxy Devices and Software	Akamai	Standard	
Network	Caching and Proxy Devices and Software	Couchbase	Standard	
Network	Caching and Proxy Devices and Software	IBM WebSeal	Standard	Mid-tier Application Use
Bandwidth and Connectivity	Bandwidth Provision			
Bandwidth and Connectivity	VPN Devices and Software	Global Protect VPN Client	Standard	

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Bandwidth and Connectivity	VPN Devices and Software	NetScaler SSL VPN	Standard	
Bandwidth and Connectivity	VPN Devices and Software	Palo Alto Firewall Series 3320	Standard	
Bandwidth and Connectivity	Remote Access Devices and Software	TACACS	Target Elective	
Equipment Accommodation and Cabling	Power Supply and Conditioning	50-100 Watts per SF, 150 Watts per SF capable, mirrored fully redundant UPS systems (each 3600 KW).	Elective	
Equipment Accommodation and Cabling	Power Supply and Conditioning	150 Watts per SF, 200 Watts per SF capable, mirrored fully redundant UPS systems. Power density of 15 kw/rack capability	Target Elective	
Equipment Accommodation and Cabling	Air Conditioning			
Equipment Accommodation and Cabling	Environmental Monitoring and Management			
Equipment Accommodation and Cabling	Fire Detection and Suppression	Multi-zone dry-pipe sprinkler/smoke detector system with VESDA water detection system.	Elective	
Equipment Accommodation and Cabling	Cabling and Racking			
Equipment Accommodation and Cabling	Physical Access and Security	24x7 armed guards. CCTV surveillance, multilevel security card readers with battery backup, perimeter fence, gate controls.	Elective	
Equipment Accommodation and Cabling	Equipment Rooms			
Equipment Accommodation and Cabling	Telecommunications Towers	Multiple vendors, two redundant OC192's and eight redundant OC 48's.	Elective	
Equipment Accommodation and Cabling	Telecommunications Towers	Multiple vendors, diverse paths to demarcs	Target Elective	

3.5. Management and Control

The Management and Control Technology Domain comprises those technology elements that are not core to the business functionality, but nevertheless provide integrity, control and assurance that elements within the other domains are functioning correctly.

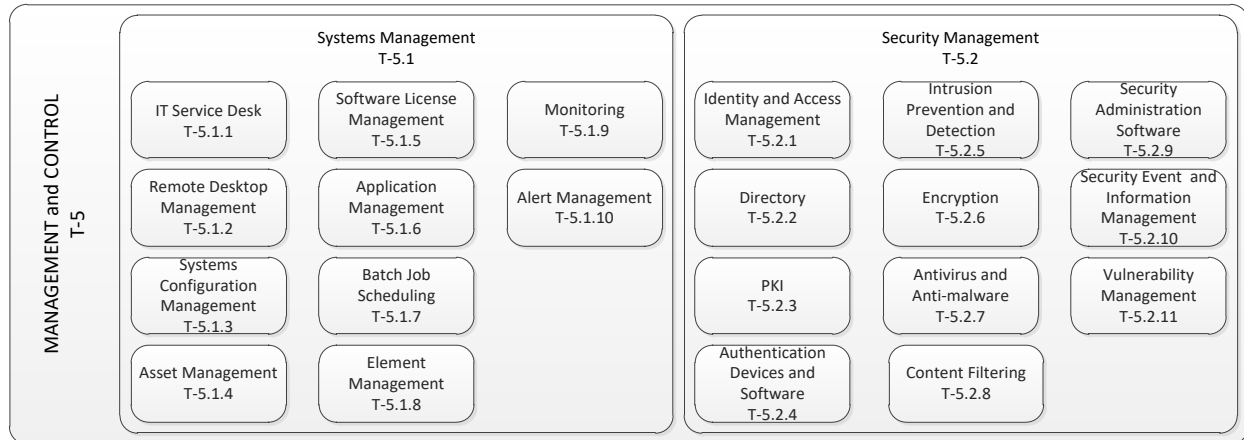


Figure 7. Management and Control Technology Domain

The Management and Control Technology Domain is composed of the following Technology Capabilities and Classes:

- **Systems Management (T-5.1):** This capability includes software that is concerned with managing the operation of an IT environment or system
 - **IT Service Desk (T-5.1.1):** This class includes software to support call management and logging activities of the IT service desk. The IT service desk is a single point of contact for end-users who need help. Having a single point of contact prevents significant losses in time spent by individual users looking for ways to fix problems and get help. The IT service desk does the following: receives all calls and emails on problems, records, classifies and prioritizes them, seeks a solution and keeps users updated. An example of software that supports this process is Zendesk.
 - **Remote Desktop Management (T-5.1.2):** This class includes software that supports the management of an enterprise's IT desktop from a central location. By and large, it obviates the need for support staff to attend on-site to service a desktop device. From the central location, support professionals can scan desktop devices, check the status of software licenses, download and update software and perform diagnostics. An example is Microsoft Remote Desktop.
 - **Systems Configuration Management (T-5.1.3):** This class includes tools that allow an enterprise to manage and control all of the configurable elements of its IT systems, including servers, operating systems, as well as networks and their elements. An example is Novell's ZENworks.
 - **Asset Management (T-5.1.4):** This class includes systems that support the management of an enterprise's IT assets (including PCs, servers, networks, and software) throughout the lifecycle of the asset from acquisition, through servicing and support, to disposal. Ivanti IT Asset Management Suite is an example.
 - **Software License Management (T-5.1.5):** This class includes applications that ensure compliance with vendors' software license restrictions (for example enforcing a maximum number of concurrent connections, or defined users.) An example of software that supports this process is ManageSoft from ManageSoft.
 - **Application Management (T-5.1.6):** This class includes software that supports the management and administration of enterprise applications across a diverse, distributed environment. The software monitors application availability and performance, collects

- performance data and allows predictive analysis. An example is Computer Associates' Enterprise Management software, part of the UniCenter suite.
- **Batch Job Scheduling (T-5.1.7):** This class includes systems that monitor the status of processing activities across the complex, heterogeneous IT platforms that are characteristic of a large enterprise. Assessing and responding to predefined system states, the job scheduler effectively ensures continuous and stable IT operation across all platforms. The scheduler automatically identifies critical events and either reacts to them automatically or alerts the respective user. An example is the UC4 Workload Automation Suite.
 - **Element Management (T-5.1.8):** The control consoles and utilities used by operations staff to directly manage elements such as storage areas, network devices, servers, databases etc. They are often, but not always, provided by the vendor of the element to be managed. Examples include Dell OpenManage; Cisco Works; EMC Celerra Manager.
 - **Monitoring (T-5.1.9):** This class includes software and hardware platforms that enable operational staff to monitor and track the performance of components (whether hardware, software or networks), manage availability, and provide insight on service level management. Examples include HP Openview and IBM Tivoli Netcool.
 - **Alert Management (T-5.1.10):** This class includes software that plans and monitors the entire alert management process, designates resources, arranges vacations, escalation plans and keeps track of all events as they occur. The alarming service should give certainty that, if a message is issued, it will be received, acknowledged and acted upon.
- **Security Management (T-5.2):** This capability includes security management devices and software
 - **Identity and Access Management (T-5.2.1):** This class includes systems that allow an enterprise to keep track of the many user accounts throughout the enterprise – not only on in-house-designed applications but also on purchased packages such as those from SAP and PeopleSoft. Sophisticated identity management systems contain middleware that gives the ability to interoperate with many types of directory systems. An example of such a system is the IBM Tivoli Identity Manager offering.
 - Access management services provide an enterprise with the ability to separate out authorized users of their systems from potentially unauthorized users and, in the case of the former, allocate to the user the pre-determined levels of access and capability. The system also provides management functions such as adding new authorized users, deleting and modifying others, and changing the levels and types of permissions associated with each user.
 - **Directory (T-5.2.2):** This class includes components that map logical names to physical addresses in a network. Directories are repositories for information about network-based entities such as applications, files, printers and people. Directory services provide a consistent way to name, describe, locate, access, manage and secure information about these resources. An example is Microsoft's Windows Active Directory.
 - **Public Key Infrastructure (PKI) (T-5.2.3):** This class includes components to manage public-key cryptography, an encryption technique that uses two mathematically related keys: a public key to encrypt messages and a private key to decrypt them. It also includes the various related systems for the issuance and accreditation of digital certificates. An example of a PKI system is the UniCert PKI software from Baltimore Technologies.
 - **Authentication Devices and Software (T-5.2.4):** This class includes multi factor authentication, whereby at least two different factors are used in conjunction to authenticate. Factors include: human (something you are), personal (something you know) and technical (something you have). Technologies used in multi-factor authentication include: tokens; biometrics; magnetic cards; smart cards (and card reader technology); phones.
 - **Intrusion Prevention and Detection (T-5.2.5):** This class includes systems consisting of hardware and/or software that monitor events occurring in a computer system or network for signs of intrusion or other malicious activity, and that takes measures to protect the system or network from such intrusions or activity. An example is Cisco Firepower.
 - **Encryption (T-5.2.6):** This class includes components that encode data in such a way that an unauthorized party cannot decode it, yet the receiver can readily decode it. Encryption capability is often provided as an embedded capability in electronic messaging software, but

- a freestanding example is the Enterprise Encryption Suite offered by PGP (Pretty Good Privacy).
- **Antivirus and Anti-Malware (T-5.2.7):** This class includes software designed to detect, remove, and/or protect a computer system from the effects of computer viruses. Well-known examples are McAfee's VirusScan or Symantec's Norton AntiVirus.
 - **Content Filtering (T-5.2.8):** This class includes components that will filter content based on organizationally defined rules. Filtering can include preventing the transmission of inappropriate language or images, malware, or security-classified information. Examples of content filtering software are McAfee's Privacy Service and Symantec's Web Security.
 - **Security Administration Software (T-5.2.9):** This class includes software that supports an enterprise in protecting its information assets by consolidating management of accounts, passwords and resources across a broad range of intranet and extranet platforms as well as allowing applications to be centrally managed. An example is Admin, an element of Computer Associates' eTrust suite.
 - **Security Event and Information Management (T-5.2.10):** This class includes tools that support an enterprise in reporting and analyzing the multitude of security alerts and event alarms that can be generated by tools from several vendors. An example is Computer Associates' eTrust suite.
 - **Vulnerability Management (T-5.2.11):** This class includes security patch management tools as well as corporate security policy compliance products. This class also includes vulnerability assessment tools such as penetration testing tools. Tools in This class typically compare the configuration of network and security devices and compare these with known updates and either recommend or automatically deploy changes.

Table 8, below, identifies the products and services that comprise FSA's current Management and Control Technology Domain.

Table 8. Management and Control Technology Domain

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Systems Management	IT Service Desk	NICE Engage (Quality Monitoring)	Standard	Technical Backbone
Systems Management	IT Service Desk	NICE WFM	Standard	Technical Backbone
Systems Management	IT Service Desk	Salesforce Service Cloud	Standard	Customer Relationship Management
Systems Management	IT Service Desk	Veeam Backup and Recovery	Standard	Technical Backbone
Systems Management	IT Service Desk	NICE Nexidia	Target	Technical Backbone
Systems Management	IT Service Desk	NICE Recording Compliance (PCI)	Target	Technical Backbone
Systems Management	IT Service Desk	NICE\Cisco CTI integration software	Target	Telephony
Systems Management	IT Service Desk	BMC Remedy	Elective	
Systems Management	IT Service Desk	Microsoft Dynamics	Phase Out	Customer Relationship Management
Systems Management	IT Service Desk	Oracle RightNow	Phase Out	Customer Relationship Management

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Systems Management	Remote Desktop Management			
Systems Management	Systems Configuration Management	Oracle Enterprise Manager	Standard	
Systems Management	Systems Configuration Management	BMC Atrium	Elective	
Systems Management	Systems Configuration Management	HP Server Automation	Target Elective	
Systems Management	Systems Configuration Management	Linux Docker Containers	Phase Out	
Systems Management	Asset Management			
Systems Management	Software License Management	BMC Atrium	Elective	Mid-Range Servers
Systems Management	Software License Management	Tad-Z	Elective	Mainframe
Systems Management	Application Management	AppDynamics	Standard	Digital Platform
Systems Management	Application Management	Red Hat Data Grid	Standard	
Systems Management	Application Management	Wily Introscope	Standard	
Systems Management	Application Management	SysDig Pro	Target	Digital Platform
Systems Management	Application Management	ManageEngine AD Manager	Elective	
Systems Management	Application Management	SysKit SP Docket	Elective	SharePoint Documentation Analysis and Auditing
Systems Management	Batch Job Scheduling	Azkaban	Standard	
Systems Management	Batch Job Scheduling	CA ESP	Standard	
Systems Management	Batch Job Scheduling	Autosys	Elective	
Systems Management	Batch Job Scheduling	CA 7	Elective	
Systems Management	Batch Job Scheduling	Phoenix JES3	Elective	Mainframe Job Entry Subsystem
Systems Management	Element Management	Firemon	Elective	Manage and Monitor IT Assets
Systems Management	Element Management	Micro Focus Operations Manager	Elective	Manage and Monitor IT Assets

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Systems Management	Element Management	HP Network Node Manager (NNMi)	Target Elective	
Systems Management	Monitoring	BMC Patrol	Elective	
Systems Management	Monitoring	ConsoleWorks	Elective	
Systems Management	Monitoring	DPA	Elective	
Systems Management	Monitoring	Metalogix Diagnostics Manager	Elective	
Systems Management	Monitoring	Micro Focus SiteScope	Elective	Systems and Application Monitoring
Systems Management	Monitoring	NetApp OnCommand Insight (OCI)	Elective	Infrastructure monitoring
Systems Management	Monitoring	Omegamon	Elective	
Systems Management	Monitoring	DBMON	Target Elective	
Systems Management	Monitoring	HP Network Node Manager (NNMi)	Target Elective	
Systems Management	Monitoring	HP OneView	Target Elective	
Systems Management	Monitoring	HP Operations Manager (HPOM)	Target Elective	
Systems Management	Monitoring	HP Storage Operations Manager	Target Elective	
Systems Management	Alert Management			
Security Management	Identity and Access Management	IBM Tivoli Federated Identity Manager (TFIM)	Standard	Mid-Tier Application
Security Management	Identity and Access Management	IBM Tivoli Identity Manager/IBM Security Identity Manager (ISIM)	Standard	Mid-Tier Application
Security Management	Identity and Access Management	IBM Tivoli License Compliance Manager Agent	Standard	Mid-Tier Application
Security Management	Identity and Access Management	IBM Tivoli SAM Adapter	Standard	Mid-Tier Application
Security Management	Identity and Access Management	IBM Tivoli Security Access Manager (SAM/ISAM)	Standard	Mid-Tier Application

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Security Management	Identity and Access Management	IBM Tivoli Session Management Service (SMS)	Standard	Mid-Tier Application
Security Management	Identity and Access Management	IBM Tivoli Storage Manager Plant	Standard	Mid-Tier Application
Security Management	Identity and Access Management	KeyCloak	Standard	
Security Management	Identity and Access Management	RACF (Mainframe)	Standard	
Security Management	Directory	IBM Tivoli Directory Integrator	Standard	Mid-Tier Application
Security Management	Directory	IBM Tivoli Lightweight Directory Access Protocol (LDAP)	Standard	Mid-Tier Application
Security Management	Directory	OpenLDAP	Standard	
Security Management	Directory	Windows Active Directory	Standard	Ed.gov, Citrix, and SharePoint
Security Management	Public Key Infrastructure (PKI)	HP Network Node Manager (NNMi)	Target Elective	
Security Management	Authentication Devices and Software	Centrify	Standard	Non - Mainframe Privileged Users
Security Management	Authentication Devices and Software	CyberArk	Standard	Security Access Management
Security Management	Authentication Devices and Software	ez/PIV	Standard	Mainframe Access via PIV
Security Management	Authentication Devices and Software	Protegrity Tokenization	Standard	
Security Management	Authentication Devices and Software	Symantec Token	Standard	Mid-Tier Application
Security Management	Authentication Devices and Software	TACACS	Target Elective	
Security Management	Intrusion Prevention and Detection			
Security Management	Encryption	Cerebus FTP	Elective	Secure File Transfer

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Security Management	Encryption	Tectia	Elective	Secure Admin, File Transfer and Application Connectivity for zOS
Security Management	Antivirus and Anti-Malware	Core Impact	Standard	Forensics Analysis
Security Management	Antivirus and Anti-Malware	Encase	Standard	Forensics Analysis
Security Management	Antivirus and Anti-Malware	Forescout	Standard	Network Access Control
Security Management	Antivirus and Anti-Malware	McAfee ePolicy Orchestrator (ePO)	Elective	
Security Management	Antivirus and Anti-Malware	Tanium	Standard	Malware Discovery and Detection
Security Management	Antivirus and Anti-Malware	McAfee for SharePoint	Elective	Antivirus and Anti-Malware for SharePoint Sites
Security Management	Content Filtering	Microsoft Office 365 Anti-Spam Protection	Standard	
Security Management	Security Administration Software	FedTRAQ	Standard	Vulnerability and Security Assessment Tracking
Security Management	Security Administration Software	ISMTRAQ	Standard	
Security Management	Security Administration Software	RedSeal	Standard	Security Case Management
Security Management	Security Administration Software	RSA SecOps	Standard	Security Case Management
Security Management	Security Administration Software	SocTRAQ	Standard	Vulnerability and Security Assessment Tracking
Security Management	Security Event and Information Management	Activu	Standard	Security Data Analytics
Security Management	Security Event and Information Management	ArcSight	Elective	Security Data Analytics
Security Management	Security Event and Information Management	Elastic Search	Standard	Security Data Analytics

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Security Management	Security Event and Information Management	Kibana	Standard	Security Data Analytics
Security Management	Security Event and Information Management	Logstash	Standard	Security Data Analytics
Security Management	Security Event and Information Management	Splunk	Standard	Security Data Analytics
Security Management	Security Event and Information Management	Splunk Cloud	Standard	Security Data Analytics
Security Management	Security Event and Information Management	syslog-ng	Standard	Security Data Analytics
Security Management	Vulnerability Management	App Detective PRO	Standard	Vulnerability Scanning
Security Management	Vulnerability Management	Burp Suite Professional	Standard	Vulnerability Scanning
Security Management	Vulnerability Management	HP WebInspect	Standard	Vulnerability Scanning
Security Management	Vulnerability Management	PENTRAQ	Standard	Vulnerability Scanning
Security Management	Vulnerability Management	Qualys Web Application Scanner	Standard	Vulnerability Scanning
Security Management	Vulnerability Management	Tenable Security Center	Standard	Vulnerability Scanning

Section 4. FSA Technology Standards

The FSA Technology Standards covers technology standards used to support the FSA enterprise architecture. Per OMB Circular A-119, a technology standard is a common and repeated use of rules, conditions, guidelines or characteristics for products or related processes and production methods, and related management systems practices.

FSA has developed Java-based Reusable Common Services (RCS) components that application groups use to lessen programming efforts and enforce best practices that work efficiently within the FSA environments. FSA has developed Reusable Common Services for the Integrated Technical Architecture (ITA) and the Access and Identity Management System (AIMS).

ITA Reusable Common Services: It is a set of reusable components to applications hosted in the ITA and FAFSA environments. Application groups can use these reusable components to lessen programming effort and enforce standard modes of business and best practices. Some examples of reusable components are Audit Tracking Framework (Audit Logger), Email, Google Search, IMAP, etc.

AIMS Reusable Common Services: It is a set of web service functions to bridge communication between other FSA applications and the AIMS TIM/SAM environment. These include web services for creating an account, change password, updating a user's account, and retrieving the attributes for a given users account. The web services are secured via the ESB and access to call them is restricted based on application requirements.

Table 9, below, identifies the technical standards that comprise FSA's current Technology Standards.

Table 9. FSA Technology Standards

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Application Development Software	Application Development Tools and Environments	.NET	Standard	Application Development Software
Application Delivery Platform	Application Server Software	ITA Reusable Common Services (RCS)	Standard	Application Delivery Platform
Security Management	Authentication Devices and Software	AIMS Reusable Common Services (RCS)	Standard	Security Management
Security Management	Encryption	Certificate Standard Signing Request (CSR) (2048 bits)	Standard	Security Management
Security Management	Encryption	Certificate Standard Signing Request (CSR) (1024 bits)	Phase Out	Security Management
Security Management	Encryption	Cryptographic Hash Strength SHA-2 (256 bits)	Standard	Security Management
Security Management	Encryption	Encryption Algorithm AES 256	Standard	Security Management
Security Management	Encryption	HyperText Transfer Protocol Secure (HTTPS)	Standard	Security Management
Security Management	Encryption	HyperText Transfer Protocol (HTTP)	Phase Out	Security Management

TECHNOLOGY CAPABILITY	TECHNOLOGY CLASS	PRODUCT OR SERVICE	CLASSIFICATION	CONTEXT
Security Management	Encryption	Transport Layer Security (TLS) 1.3	Target	Security Management
Security Management	Encryption	Transport Layer Security (TLS) 1.2	Standard	Security Management
Security Management	Encryption	Transport Layer Security (TLS) 1.1	Phase Out	Security Management
Network	Network Name and Address Devices and Software	Network Time Protocol (NTP) Stratum 1	Standard	Network

Appendix A - Acronyms and Abbreviations

Table 10. Acronyms and Abbreviations

ACRONYM	DEFINITION
AIMS	Access and Identity Management System
API	Application Programming Interface
BAM	Business Activity Monitoring
BI	Business Intelligence
BIOS	Basic Input Output System
BPM	Business Process Management
BRE	Business Rule Engine
BRMS	Business Rule Management System
COE	Common Operating Environment
CMS	Content Management System
CSR	Certificate Standard Signing
DBMS	Database Management Systems
DevOps	Development and Operations
DHCP	Dynamic Host Configuration Protocol
EBC	Enterprise Business Collaboration
ETL	Extract, Transform Load
GIS	Geographic Information System
GPEA	Government Paperwork Elimination Act
GPS	Global Positioning System
HF	High-frequency
HPE	Hewlett Packard Enterprise
HPOM	HP Operations Manager
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IBS	Integration Broker Suite
IIS	Internet Information Server
I/O	Input / Output
IP	Internet Protocol
ISA	Internet Security and Acceleration
ITA	Integrated Technical Architecture

ACRONYM	DEFINITION
JVM	Java Virtual Machine
LAN	Local Area Network
LDAP	Lightweight Directory Access Protocol
LTM	Local Traffic Manager
MAN	Metropolitan Area Network
MOM	Message-Oriented Middleware
MS	Microsoft
NAS	Network Attached Storage
NIST	National Institute of Standards and Technology
NNMi	Network Node Manager
NTP	Network Time Protocol
OLAP	Online Analytical Processing Tools
ORB	Object Request Broker
OS	Operating System
PABX	Private Automatic Branch Exchange
PGP	Pretty Good Privacy
PKI	Public Key Infrastructure
PSTN	Public switched telephone network
RAC	Real Application Cluster
RAID	Redundant Array of Independent Discs
RC	Rivest Cipher
RCS	Reusable Common Services
SMS	Short Messaging Service
SQL	Structured Query Language
SSL	Secure Sockets Layer
SSRS	SQL Server Reporting Services
TFIM	IBM Tivoli Federated Identity Manager
TLS	Transport Layer Security
TSPG	Technical Standards and Products Guide
UHF	Ultra-high frequency
UML	Unified Modeling Language
USB	Universal Serial Bus
VAX	Virtual Address Extension

ACRONYM	DEFINITION
VM	Virtual Machine
VoIP	Voice over IP
WAN	Wide Area Network
WCM	Web Content Management