

Dynamic Mobility Applications Open Source Application Development Portal

Task 6.1a: Architecture and High-Level Design
Task 6.1b: List of Requirements included in
Initial Architecture and High-Level Design

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ITS Joint Program Office

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16. Abstract USDOT is embracing the concept of an open source application development. For the initiative to take place, a robust and dynamic application staging environment must be in place that offers capabilities and features for a distributed team and community members to collaborate and build applications. This document will present architectural views and a high-level design of the portal system.					
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Important Changes to Original Submission

This document offers a detailed discussion of the system's functionality that was planned to be implemented. However, following the Agile Development methodology, during the course of system development, diligent decisions were made based on the latest information received or on technical constraints at the time to postpone or not to implement a feature. For this reason, sometimes an envisioned feature is installed but, it is not enabled or not fully configured. For instance, the envisioned community subsystem's forum has the discussion via email is a feature but it is disabled for security reasons. In the future, if such features are deemed necessary, they can be enabled. Some features may not get implemented by the time the system in production and can be enhanced in the future releases of the system. Please refer to the latest Feature Backlog which keeps track of all discussed features and their development status.

Application Staging Environment

In the original OSDAP system concept, Application Development Environment (ADE) was envisioned to be a collaborative development workspace where multiple developers and collaborators can write source code and build executable applications directly online. Several system solutions were considered in earnest including CollabNet; however, this type of system was deemed to be not conducive to the type of development projects that OSADP would host. Besides, the license per-seat license costs was prohibitive and not the most cost effective model.

USDOT related development projects are contract based. Project code developers in such projects would design and build the code in their own development environment and test the applications with their external systems and data which would not be easily integrated with an online development environment. The application source code, after testing, get upload into a collaborative source code hosting such as GitHub or SourceForge, etc. USDOT approved a shift in system concept for the discussed reasons. Current OSADP system uses an Application Staging Environment (ASE) for staging application, where the uploaded source code get peer reviewed, issue tracked, and changes can be made collaboratively by development team members. In other words, the revised system design will no longer allowing application development to take place directly on OSADP; and instead applications will be developed in various development team environment. The mature application source code are source controlled on a staging environment and be prepared for release on OSADP

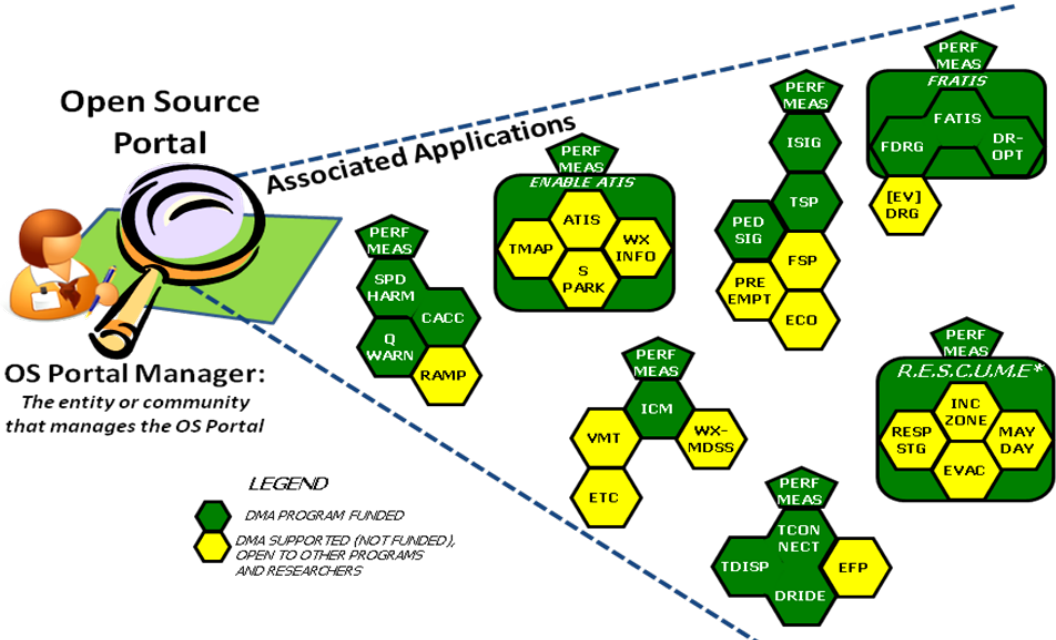
Due to this shift in OSADP system architecture, all previous notions of ADE have been replaced by ASE throughout this document.

Chapter 1. System Scope

This document describes the architectural views and high-level design of the Dynamic Mobility Applications (DMA) Open Source Application Development Portal (OSADP) system in detail, referencing IEEE-Std. 1471-2000 and IEEE-Std. 1016-1998. The content discussed in this document was used as the one of the key references for the system design and construction process.

The deployment of the DMA OSADP is a USDOT-sponsored initiative to provide a forum for developers to collaborate and share insights, algorithms, and source code on DMA research projects. Initially, the portal was used for developing the initial USDOT DMA program application bundles, as shown in Figure 1. However, the system architecture also allows new projects to commence from within the user community. Mobility applications developed can share data needs with safety and environment applications of the Federal Highway Administration (FHWA) Intelligent Transportation Systems (ITS) research program.

The portal supports the capabilities discussed in the Concept of Operations, which summarized the cumulative knowledge and understanding gaining from the User Needs workshops, the Assessment of Open Source Development Web Resources, and the System Requirement Specifications (SyRS), Tasks 2, 3 and 4 of this Task Order. This system is not all-encompassing; it is focused on building an open source development portal for USDOT mobility applications.



Source: Joint Program Office Intelligent Transportation Systems Website

Figure 1-1. USDOT DMA Program Application Bundles

At a high level, the DMA OSADP is a web portal that cultivates and promotes a friendly and collaborative community involved in the development of transportation mobility applications.

Chapter 2. Purpose

Based on the results of the previously completed Tasks 2-5, the Leidos team gained a clear view of the system requirements and the technologies that are both available and applicable to support the DMA OSADP's Concept of Operations.

Specifically, in Task 5, we conducted an assessment of the technologies that can be leveraged to build an integrated open source application development portal system. This effort focused on using the enabling technologies and existing solutions for building a robust and efficient portal system that could meet or exceed the USDOT DMA program software development needs.

In the following sections, we will revisit the system's stakeholders, particularly the users and operators of the system, and express the architectural views from their perspectives and concerns. Technology selection decisions were made based on business and system rationale. From there, the technologies and existing solutions were integrated into a high-level design for DMA OSADP portal system.

Chapter 3. Identification of Stakeholders and Concerns

Stakeholders

Stakeholders include anyone or any organization that has a stake in the program, whose interests may be positively or negatively affected by the project's success or failure. This section examines in close detail the stakeholders involved in the operations of the DMA OSADP system.

Each stakeholder comes to DMA OSADP with different expectations and interests. To streamline the architectural discussion, we combined the stakeholder types into three primary groups that share similar expectations and usage characteristics. Based on their expectations and operational behavior characteristics, we described the system architecture views. These views became the basis for the system design process included later in this document. The primary user groups are:

1. **Application Users** includes those who download the applications from the Released Open Source Repository (ROSR) for use, testing, or further enhancement and modification. This user group includes:

- a. Users from for-profit companies who may want to leverage open source applications in their environment or to make further investment in commercializing a particular application.
- b. Users from within USDOT administrations such as FMCSA, FWHA, RITA, etc.
- c. Users from different state and local transportation administration e.g. California High Way Patrol.
- d. Students, professors, and researchers from Academia community

2. **Application Developers** who participate in the DMA OSADP as registered users and have been approved as application development contributors (ADC), include:

- a. Contractors (for example, experts for hire from staff augmentation companies)
- b. Consultants (for example, specialists and experts, employed either independently or through a company)
- c. Developers (for example, programmers, designers, architects, writers, project managers, and testers)

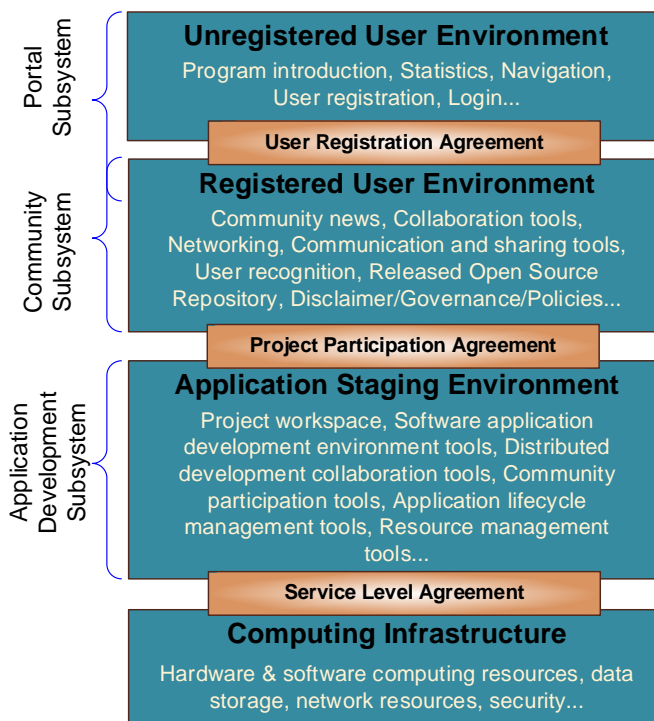


Figure 3-1. DMA OSADP's 4-Tier Architecture

- 3. Administrative staff** who operates and maintains the DMA OSADP. Example of this user group may include:
- a. Sponsors (representatives from USDOT, or other federal, state, local offices, funding agencies, etc.)
 - b. Operators (for example, the Portal Manager (PM) and System Administrators (SA))
 - c. Policy and governance directors (for example, Governance Manager and license agreement enforcer)

Unregistered users, mentioned in this document, are also considered a user group. Unregistered users include visitors who come to the portal's Internet website; they are not considered stakeholders of the DMA OSADP system until they complete the user registration and are approved as a member of the DMA OSADP. Appendix A provides a more comprehensive description of system user categories as a reference.

It is not uncommon for a user to have multiple roles and have different perspectives of the portal system. For instance, a university researcher who is involved in an advanced transportation research subject may be an application user downloading an application from the ROSR; he may then modify and enhance the code for upload back to ROSR. In this scenario, the researcher is an application user as well as an application developer.

Physical Architecture Concerns

The mission of the portal system is to establish and promote a collaborative community of interest in which transportation-related open source applications will be developed and shared. The portal subsystem provides the basis for a Web-based presence on the Internet. The community subsystem is built upon the portal subsystem to provide a conducive environment for collaboration, leveraging, and sharing innovative ideas, expertise and finished applications. The application staging subsystem offers a software development environment with tool sets for application creation. The integration of these subsystems provides the essential elements for a software application development community to exist and thrive collaboratively.

Utilizing COTS and open source solutions to construct the subsystems and integrate them into the portal was an effective way to leverage mature technologies, ensure timely delivery of the system, lower overall system costs, and help mitigate risks. The portal system requirements (SyRS) were implemented based on this architectural framework. The system is hosted on a secure computing cloud to enable ease of access for distributed members.

The following sections of this document discuss the architectural viewpoints; following this discussion is an overview of the portal system design.

Security Architecture Concerns

Security measures were implemented to protect all information and data on the portal system, while in transition as well as while at rest. Different layers of security were implemented to protect the data and information in the DMA OSADP system, including network security, host-based security, and application security. Together, these layers protect the data at the core of the system.

Users may gain access to the portal system in several ways; and the foundation of access control mechanisms is based on identification and authentication processes, which identify and verify the user to be who the person claimed to be. Besides the Login prompt on the portal's home page, users may go directly to the Application Staging Environment, the community discussion forum(s), or another specific part of the system.

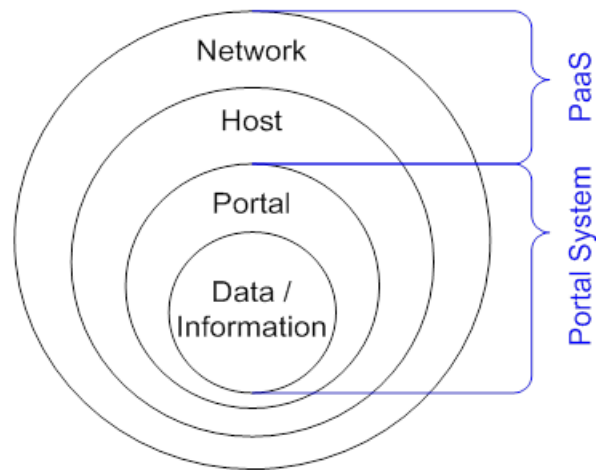


Figure 3-2. Security Protection Layers.

Function Decomposition

In this section, the portal system's major functions contained in the SyRS document are further decomposed and sorted by the subsystems.

Each subsystem comes with administrative panels allowing system administrators to configure and customize the subsystems to meet the requirements. Since most of these panels are not accessible to regular registered users and application developers, they are not discussed in details in this document. Administrative capabilities are documented and explained in system administrator's guides that is available to those who are responsible for providing operations and maintenance of the subsystems.

Registered users are able to edit their own profiles after logging into the subsystems. In addition, registered users can view public portions of other users' profiles. Sharing member information is critical in raising awareness among the community members and promote productive collaboration.

Portal Subsystem (PS)

Unregistered users have access to the following capabilities on the Portal Subsystem. They are able to:

- 1) View website introductory content which may include selected news and statistics of the OSADP.
- 2) Perform searches on the DMA portal public website
- 3) Access, complete, and submit the User Registration form
- 4) Require confirming e-mail address of registering users on the portal via User Registration function.
- 5) Communicate with portal manager via a feedback form
- 6) Read FAQ (frequently asked questions) with answers.

Contributors will access to the following functions on the Portal Subsystem. They are able to:

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- 1) Store and share information in the ROSR, including:
 - a. Source code for a hosted application on the portal
 - b. Application source code Algorithms for a hosted application on the portal and allow registered users to access and download them.
 - c. Pseudo-code for a hosted application on the portal and allow registered users to access and download them.
 - d. Benchmark data sets for a hosted application on the portal and allow registered users to access and download them.
 - e. Benchmark data sets and associated metadata for a hosted application on the portal (UN1.3) and allow registered users to access and download them.
 - f. Documentation for a hosted application on the portal and allow registered users to access and download them.
 - g. Self-contained, self-validating, and executable formal specifications of test cases to be applied to one or more target modules of hosted projects.
 - h. Capability to store metadata for a hosted application on the portal.
 - i. Governance document for a hosted application on the portal and allows registered users to access and download them.
 - j. Data interface standards for a hosted application on the portal and allow registered users to access and download them.
- 2) Perform searches against open source contents by type.
- 3) View online tutorial on the portal in Community and Application Staging environment specifically.
- 4) Sort project by application category and show related items.
- 5) Look up a common terminology and acronym reference.
- 6) Configure and customize the primary web user interface screen for emphasizing features of interest to them via pre-defined templates.
- 7) Host open source applications and source code from other federal agencies per authorization from the Portal Manager.
- 8) View usage statistics including user visit, hits, downloads, and uploads to registered users.
- 9) Read access ROSR and read description of applications.
- 10) Recognize and make attribution to application developers and contributors visibly on the application in the ROSR.
- 11) Recognize and make attribution to contributors of core assets visibly on the asset items in the ROSR.
- 12) Support the following four most popular Internet browsers including Microsoft Internet Explorer, Mozilla Firefox, Safari, and Chrome, and shall stay compatible with at least the latest two versions of the browser releases.

Community Subsystem (CS)

Only Registered Users are allowed to access the Community Subsystem environment. Within this CS environment, registered users will have the capability to:

- 1) Subscribe for notifications when a specific element of the ROSR is changed.
- 2) Share developer community news for a hosted application.
- 3) Obtain online help from other community members and the portal administrators.
- 4) Communicate with project contributors regarding a hosted application via a community discussion forum.
- 5) Subscribe to receive email notifications on updates to a hosted application.
- 6) Participate in email discussion via community mailing lists.
- 7) Collaborate on writing and editing online documents.
- 8) Receive notification in advance on interesting community events.

- 9) Document application specific resolution for technical issues such as API, objects, libraries and GUI of hosted applications.
- 10) Give credit and acknowledge the original creator and subsequent contributors of the shared source code or application by displaying their names visibly in association with the shared item, in the ROSR.
- 11) Download application source code and associated files, in the ROSR.
- 12) Upload multiple files into the ROSR simultaneously.
- 13) Submit bug reports specific to each DMA-hosted application into a threaded discussion viewable by other users.

Application Staging Environment (ASE)

In order to gain access to ASE, a registered user needs to obtain approval from the Portal Manager and agree to terms outlined in the application development agreement. ASE provides following capabilities:

- 1) Allow Contributors to connect to the Application Staging Environment via web browser.
- 2) Show attribution to authors and co-authors of source code
- 3) Secure scalable computing resources including CPU, memory, network access and bandwidth, data storage capacity, etc. within 5 working days after the request is formally submitted.
- 4) Host multiple open source applications during all phases of development
- 5) Track and control changes to hosted projects' source code.
- 6) Track and control changes to hosted projects' files such as documentation and web pages.
- 7) Save, maintain version control, and make documents and images of printed, project-related documents searchable and share-able to authorized users.
- 8) Track and control changes to hosted projects' benchmark data and supporting metadata.
- 9) Create a custom home page for hosted applications through the use of a WYSIWYG editor.
- 10) Assign defects associated with a hosted application to project members (Developer, Committer, Tester, and Reviewer).
- 11) Perform unit testing of developed applications on external servers and system
- 12) Track defects associated with a hosted application.
- 13) Track issues associated with a hosted application.
- 14) Access hosted application data and files from any location with Internet access. Note: This intention of this user need statement makes clear that no special network location is required specifically as the source of access to reach the Application Staging Subsystem. For some systems, users are required to access them from a particular originating network due to firewall and network access policies.
- 15) Provide information about a hosted application in a Wiki format.
- 16) Require contributors to include a user's guide for the shared application or source code.
- 17) Collect and display metadata describing the contents and context of a shared item such as purpose of the shared item, means of creation, time and date of creation, creator or author of shared item, and standards used.
- 18) 'Fork' a project or creating a similar project based on an existing one, with approval from Portal Manager.
- 19) Use the shared item to provide updated information on its usage (e.g., name of project, role of the application in the project, etc.).
- 20) Specify which open source agreement for releasing the open source applications into the ROSR.
- 21) Join the application staging environment.

Security Subsystem (SS)

The Security Subsystem (SS) will consist of enabling security technologies that may reside on different physical subsystems including PS, CS, and ASE. Virtually, it provides a set of functions that protect the data and information of the portal system. The capabilities provided by the security subsystem include:

- 1) System Administrator (SA) can view login history of portal users.
- 2) SA can immediately detect, eliminate or quarantine viruses from infected uploaded items before storing them into the ROSR.
- 3) SA can upgrade all critical security patches to ASE within 5 business days after they are available.
- 4) PM can review and approve all content added to the ROSR.
- 5) SA can prevent unauthorized access into computers and computer networks via all access points with strong security validation and authentication.
- 6) SS will comply with PCI Security Standard Council recommendations and security best practices.
- 7) SS will display an audit trail of modified files and history of major changes to application source code and files.
- 8) SA can notify all registered users of any identified threats or vulnerabilities relating to any elements of the ROSR.
- 9) SA can notify all users under Contributor Category of any identified threats or vulnerabilities to a specific application and corresponding benchmark data sets, documentation, etc.
- 10) SS can perform weekly website and system scan and sweep to ensure the applications and supporting files are clear of injected malware or viruses that could transmit malicious viral agent to portal user's computer.
- 11) SS can prevent automated (non-human) user registration.
- 12) SS can conduct encrypted data transfer via HTTPS for protection of private information such as the user registration process via 128-bit SSL certificate.
- 13) SS can record and store all system administration access activities in system logs.
- 14) SS can automatically log out a user session after 30 minutes of inactivity.
- 15) SS can enforce "strong" passwords requirements; passwords rated "medium" or lower can be locked or banned.
- 16) SA can enforce immediate lock down for at-risk users, which effectively shut down all system resources access upon activation.
- 17) SS can force users to review site Security Policies every twelve months.
- 18) SA can assign privileges at a granular level to users based on role and responsibility.
- 19) SA can patch software defects and upgrade system functions of the Portal Subsystem.
- 20) SA can perform website maintenance routines per portal manager's direction.
- 21) SA can back up the portal and all hosted applications on the portal to offsite server.
- 22) SA can, in case of content loss, recover a version of backed up application source code and files to operating condition within 24 hours.
- 23) SA can perform the following: daily log review for security and system functionality issues; daily user submitted reports and requests review; daily review of system usage and analytic reports; annual system review including reports of system capacities and functionality.
- 24) SA can notify users about system scheduled maintenance downtime 15 days in advance to all users via email and on portal public news bulletin.
- 25) SA can broadcast emergency system shutdown to all users via email and on portal public news bulletin.
- 26) SA can collect system statistics regarding usage, performance and user access.
- 27) SA can review and analyze collected system statistics on usage, performance and user access.
- 28) SA will have a special access path for accessing the back-end system instead of going through the typical user login page. This access path provides additional security protection.

Integrated Portal System (IPS)

The Integrated Portal System being referred to here is the encompassing system, a composite of the subsystems. Its functions are provided by the integrated whole and not by individual subsystems. The capabilities provided by the integrated portal subsystem include:

- 1) DMA OSADP System servers shall be hosted in a physically secure location
- 2) IPS can support a minimum 100 concurrent users.
- 3) IPS can host at minimum 40 concurrent applications and associated documents in the ROSR, with the ability to scale up storage capacity to accommodate additional applications.
- 4) IPS can recover, in case of an outage, all portal functionality and contents within 1 week after loss of service.
- 5) IPS can allow SA and PM to verify user compliance with the portal governance and operation policies.
- 6) IPS can allow SA and PM to verify compliance with required standards for data privacy.
- 7) IPS can allow SA and PM to verify compliance with required standards for data security.
- 8) IPS can allow SA and PM to verify compliance with required standards for quality.
- 9) IPS can allow SA and PM to verify compliance with required standards for authorized access.
- 10) IPS can allow SA and PM to verify compliance of service level agreement (SLA) with the hosting service provider and other computing service providers to ensure prompt and high-quality services and support.

Chapter 4. Architecture Views

Stakeholder interaction with the system will be represented by three viewpoints: application users, application developers, and administrators as discussed in previous sections. The following tables show the viewpoint of these users by describing the view with their particular interests or concerns of the system and how the view is being modeled.

Application User’s Viewpoint and Views

Table 4-1. Application User's Viewpoint

Viewpoint Element	Description
Application users	All registered users interested in using, testing, modifying applications
Concerns	<ul style="list-style-type: none"> • Read and understand the license terms of use associated with a particular application • Download applications, data and other artifacts from ROSR • Upload to share modified source code of download application • Provide feedback on application via discussion forum on the Community subsystem • Participate in the community discussion and collaboration
Modeling technique	Subsystem access diagram (see Figure 4) Outer boxes = subsystem; inner boxes = business functions. Semantics = functions accessed and performed in the subsystems.

Application Developer’s Viewpoints and Views

Table 4-2. Application Developer’s Viewpoint

Viewpoint Element	Description
Application developers	Project managers, developers, committers, testers, writers, reviewer, project sponsors, and others who contribute to application development
Concerns	<ul style="list-style-type: none"> • Access application staging subsystem environment • Use tools and resources of the Application Lifecycle Management to design, create, modify application source code • Release application, data, and other artifacts to the ROSR • Participate in the community discussion and collaboration
Modeling technique	Subsystem access diagram (see Figure 4) Outer boxes = subsystem; inner boxes = business functions. Semantics = functions accessed and performed in the subsystems.

Administrator’s Viewpoint and Views

Table 4-3. - Administrator's Viewpoint

Viewpoint Element	Description
Administrators	Portal manager, Governance manager, portal moderators, and system administrators
Concerns	<ul style="list-style-type: none"> • Access all subsystem environments as authorized • Use tools and resources of the Application Lifecycle Management to design, create, modify application source code • Provide technical support for the registered users as needed • Provide stewardship for the user community including enforcing policies and governance
Modeling technique	Subsystem access diagram (see Figure 4) Outer boxes = subsystem; inner boxes = business functions. Semantics = functions accessed and performed in the subsystems.

Figure 4-1 illustrates the user viewpoints of the system and major components in each of the subsystem model.

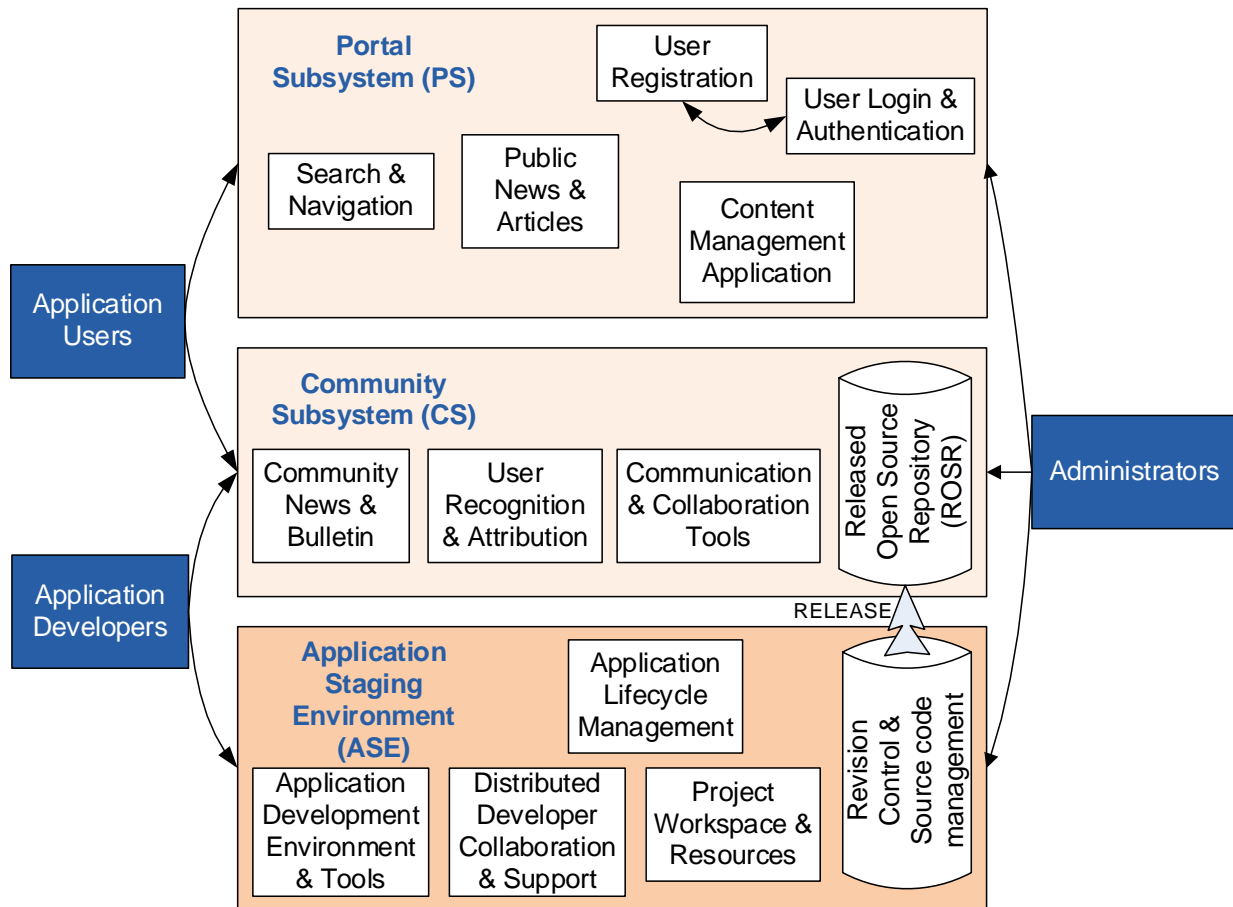


Figure 4-1. DMA OSADP Architectural Viewpoints and Views

Operational View

Figure 4-2 below provides an operational view of the OSADP system with the architectural viewpoints. Between the architectural tiers, User Registration & Agreement and Project Participation Agreement labels are placed on arrows indicating the direction of effects. For instance, unregistered users, after completing user registration and agreeing to the user's obligations, will be granted access to the Registered User Environment. Likewise, registered users, after agreeing to the terms and conditions may be allowed to participate in the Application Staging Environment.

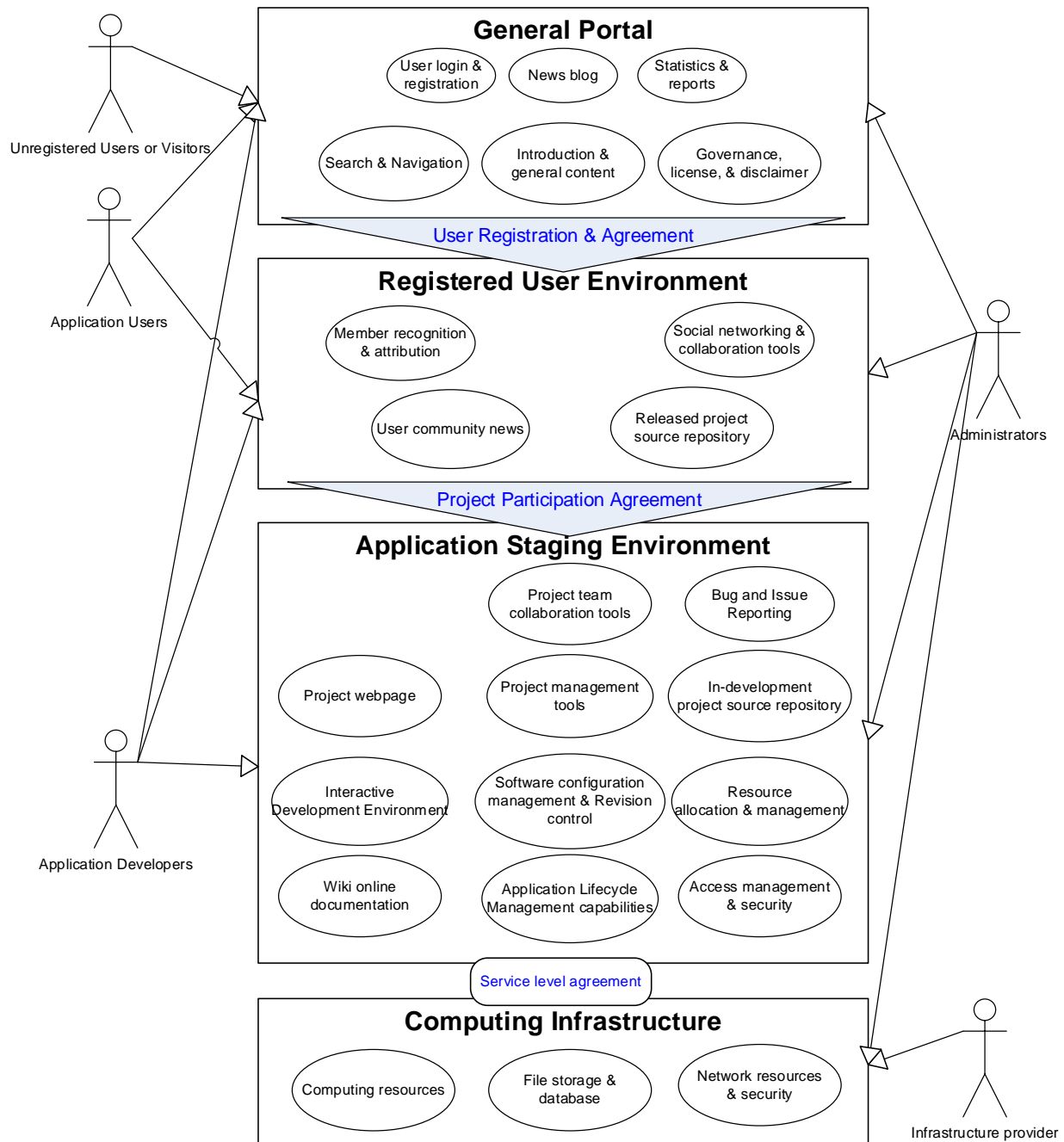


Figure 4-2. DMA OSADP System's Operational View

At a high level, the DMA OSADP system offers following major elements:

- **General Portal** - Open to the public, this public portal is accessible to everyone on the World Wide Web, where general information is made available. Visitors will be able to see:
 - News and information about the DMA program
 - Descriptions of DMA on-going projects

- Eligibility and registered user's benefits will be explained briefly here
- A visible link to user registration form for interested users to become registered user and gain access to the Community resources in the Registered User Environment
- **Registered User Environment** - By completing the user registration and following approval, an unregistered user may become a registered user and gain access to community resources and communication tools. Application users can access the functions and be able to download application code and artifacts offered in this level, including:
 - Collaboration tools:
 - Discovering and joining user groups
 - Sharing ideas and exploring other ideas
 - Participating in discussion forums
 - Sharing knowledge, experience and lessons learned
 - Forming new product ideas and proposing new projects
 - Finding answer and solutions
 - Social networking communicating with other community members
 - Recognizing and giving attribution to community contributors
 - Released Open Source Repository:
 - Ability to download DMA application source code and associated core assets
 - Sharing application source code and enhanced source code derived from the base application code from this site
 - Contributing non-source code core assets such as test data, algorithms, etc.
 - Reporting application bug and issues
- **Application Staging Environment** - This environment is accessible mainly by project contributors or application developers, a class of registered users who directly participate in the development of the application. Access to this environment is granted either through a USDOT project bid-and-proposal award process or through participation in an approved community-initiated project. Before joining this collaborative development environment, these users are required to accept additional terms and conditions specified in the project participation agreement, which stipulate a range of operating policies including IP and responsibility to the development team and its objectives. The main capabilities of this environment include:
 - Software development tools and resources:
 - Code management
 - Software configuration management
 - Application lifecycle management
 - Project webpage
 - Project team workspace
 - Project hosting
 - Developer resources
 - Online documentation
 - Issue management and bug tracking
 - Collaboration tools for distributed development team members

Stable application source code developed here may eventually be available in the ROSR in the Registered User Environment. An application developer of one project may be able to participate in another, depending on interest, skills, affiliation, and status of funding; this involvement will be evaluated case by case basis by the Project Manager and Project Sponsor.
- **Computing Infrastructure** – The system is hosted at a commercial hosting facility that allows distributed users to reach the system resources from any network location. This Computing Infrastructure tier is not discussed in detail in the architecture views because the infrastructure

resources are obtained via acquisition and are therefore bound by service level agreement. Operationally, the system administrator interfaces with the infrastructure provider's representatives for technical resource needs and typically does not involve other users. The computing infrastructure has the following:

- Ability to scale up computing resources to meet demand, including: adding CPU, memory, data storage, network bandwidth, etc. within short turn-around time.
- System environments will follow best practices for data security according to the PCI Security Standards Council, securing data at-rest as well as in-transition.

The administration class users known as Administrators provide stewardship to all three environments described above based on needs. They operate and maintain DMA OSADP system at all architectural tiers.

System Views

As described in previous Task deliverables, including Operational Scenarios and System Requirements Specifications (SyRS), DMA OSADP is an integrated system, comprised of several subsystems and enabling technologies. Figure 5 shows the elements that make up the DMA OSADP system.

The Portal Subsystem (PS) is touched by all user types and its functions act as the hub for all subsystem access. For this reason, architecturally it becomes the primary subsystem that other subsystems integrate with.

The Community Subsystem (CS) operates a collaborative site and offers communication tools and channels for supporting the community activities including group discussion forums, user blogs, networking application, etc. The CS functions are integrated tightly with the PS to present a seamless experience for user going from PS to CS. The user inference is designed to achieve this goal. In addition, the CS hosts the ROSR where source code developed in the Application Staging Environment and other artifacts can be uploaded and maintained for the all community members to access.

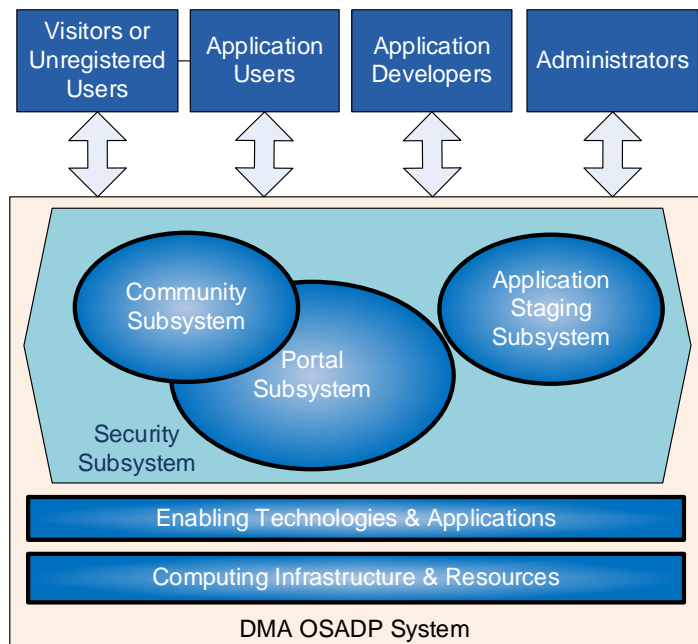


Figure 4-3. DMA OSADP System Views

The ASE hosts the development environment. While this subsystem can operate as a stand-alone environment, it will be integrated with PS and CS.

The OSADP includes a set of tools and technologies not situated within any particular subsystem. These technologies are viewed collectively as the security subsystem (SS) which provide protection for the data and content within the portal system. Cloud based PaaS hosting solution provides network and (servers) host layers, shown as outer rings of the concentric circles in Figure 4-3.

The above subsystems may share computing resources on a large server or be deployed on several servers connecting to shared databases and repositories.

Technical View

The main functions of the portal system are built from existing solutions and enabling technologies. The integrated portal system consists of the following elements:

- A content management system is used for the PS
- A discussion forum system is used as the CS
- An integrated development environment is used as the Application Staging Environment (ASE). The ROSR is constructed from a version control application from this subsystem
- The SS is integrated into the above subsystems utilizing enabling technologies to facilitate a unified user account authentication mechanism for all subsystems. The SS consults with PCI Security Standard Council guides and security best practices and implements the applicable recommendations.

Consistency among Architectural Views

The unified design of the DMA OSADP and the integration of its subsystem environments allows users to feel a sense of consistency within the portal and provide them with a seamless experience while accessing it. Different user types have different perspectives or viewpoints of the portal system; however, no architectural inconsistency exists.

Architectural Rationale

The above architectural concept was selected because it provides a cost effective way to realize the portal requirements while meeting the schedule limitations imposed by the development schedules of the DMA bundles. Technically, the architecture offers the following advantages:

- Modular design. The subsystems fulfill the system requirements and fit into the modular environment described in the Concept of Operations document.
- Proven technologies. The functions implemented in DMA OSADP are leveraged from existing and proven technologies. Each subsystem technology selected for integration has been in use at many websites and has been tested by hundreds of thousands of users. This selection criterion ensures stability for the overall portal system.
- Scalable architecture. Modular design also enables scalability. As more users join the portal system, additional infrastructure and computing resources can be added to meet the expanded demand.
- Flexible ASE. The portal system hosts different application development projects with diverse programming languages. The ASE may be configured to work with different third parties applications and modules including version control application and issue trackers.
- Distributed team collaboration. Cloud computing infrastructure enables distributed team members to collaborate and leverage from one another's from different physical locations.

Chapter 5. System Design

Design Decisions

Based on analysis done in Task 5, the following technology solutions are recommended for the OSADP system integration:

- 1) **Online GitHub repositories** are used as the foundation for the application staging subsystem. The same technology has been used to power SourceForge and Forge.mil, which have shown to support hundreds of thousands of developers. The solution provides a comprehensive software development environment that satisfies the DMA application development needs.
- 2) **Joomla CMS** is the most popular open source content management system used on the Internet. With proven records of deployment in commercial as well as government environments, its flexible design allows features and capabilities to be added or deleted easily. The capability core set was used as the foundation for the DMA portal subsystem.
- 3) **Kunena Discussion Forum** is tightly integrated with the Joomla CMS solution. This integration presents a clear advantage over other stand-alone forum technology choices. Security is enhanced by virtue of its integration with Joomla's user account management. As a modern technology, it also comes with advanced add-ons such as Kunena Latest, Kunena Statistics and Kunena JomSocial that promote collaboration within the community.
- 4) **Amazon Cloud hosting** facilitates access for distributed developers. Its platform-as-a-Service (PaaS) system offered resources needed for DMA portal system.

In addition, **OS platform: Red Hat Linux** was used as the operating system as it's open and not locked into a proprietary technology. Technical support licenses were purchased to ensure operating system related issues can be investigated and get resolved by experts.

System Inputs and Outputs

Table 5-1 show inputs and outputs of the OSADP by subsystems and overall portal system:

Table 5-1 - System Inputs and Outputs

	Portal Subsystem	Community Subsystem	Application Staging Environment	Portal System
Inputs	<ul style="list-style-type: none"> • User registration (unregistered users) • Login authentication (registered users) • User uploads 	<ul style="list-style-type: none"> • User postings (text, image, diagram) as input to discussion forum 	<ul style="list-style-type: none"> • Application development artifacts (created online) • Application artifacts (uploaded or migrated) • Issue/bug entries 	
Outputs	<ul style="list-style-type: none"> • Usage statistics • Project information • Announcements • Recognition and attribution (individual 	<ul style="list-style-type: none"> • Discussion forum content updates • News and 	<ul style="list-style-type: none"> • Project page updates • Documentation • Project files • Issue/bug reports • Version control system 	<ul style="list-style-type: none"> • Database updates • Backup contents from all subsystems

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	Portal Subsystem	Community Subsystem	Application Staging Environment	Portal System
	and team) <ul style="list-style-type: none"> • Application and artifacts (downloadable) • Policy and governance documents 	bulletins	updates <ul style="list-style-type: none"> • Released open source codes to ROSR • Configuration management system updates 	

Design Considerations

In Task 5, technology choices for the subsystems were compared and contrasted with one another for determining the best-fit solutions for portal system integration. System hosting on the cloud was selected for facilitating distributed application developer’s access. Cloud hosting provides a cost effective and timely solution for integrating capabilities from proven technologies in order to meet and exceed the system requirements. The technology selection decisions discussed in the Task 5 deliverable influenced and affected our design considerations.

Design Assumptions and Constraints

Below are highlights of the DMA OSADP system design assumptions:

- 1) The DMA OSADP development environment will be limited:
 - a. The number of ASE licenses and computing resources will be limited in the environment.
 - b. The final portal system for production will be deployed at a hosting facility, equipped with computing resources to match the expected usage load and the appropriate level of licenses will be acquired to meet the real demands.
- 2) The ASE solution from Github private repository service will provide a comprehensive ALM environment for application development. The PS solution from Joomla will offer many features in the core set that satisfy some major system requirements. Joomla’s Extension Directory will supply many plug-ins and modules that can be used to further augment the portal system to meet the system requirements.
- 3) The CS solution from Kunena, tightly integrated with Joomla CMS, will satisfy many forum and discussion features and capabilities required by DMA OSADP community environment.
- 4) The final portal governance being prepared by USDOT may affect the final portal system’s workflow and effectively its design.
- 5) Registered users will agree to terms and conditions for completing the user registration.
- 6) The system will be hosted a commercial hosting facility that meet USDOT IT and security standards.

Below are highlights of the DMA OSADP system’s design constraints:

- 1) The system must support not only application development and source code, but also be able to host test data sets, supporting metadata, testing procedures, documentation, algorithms, methods, etc. The system must support a range of diverse data types and file formats.
- 2) The system must support the development of applications that will run on system platforms such as Windows, Linux, etc.
- 3) The system must support multiple programming languages.
- 4) The system will be scalable to support the development of specific USDOT Dynamic Mobility Applications and other future applications that have not been identified.
- 5) The system will operate on COTS computing hardware and software.

- 6) The Portal Subsystem will comply with Section 508 of the Rehabilitation Act and the Access Board Standards.
- 7) The system will develop and manage open source applications according to open source licensing agreement chosen for the released application.
- 8) The system will develop and manage open source applications according to the Governance to be defined by USDOT.
- 9) The system must fully comply with federal policies, regulations, and guidelines regarding restrictions on the foreign export of federally-funded research materials.

System Behaviors

The following subsections highlight the users' interaction with the portal system and how the system may respond to user's actions.

User Registration

User registration is moderated and requires approval from portal manager. The USDOT-authored portal governance document defines the approach and determines the appropriate method for finalizing a user registration.

The user is challenged and prompted to provide information to establish unique electronic identification. Email confirmation is sent upon registration for verification. For preventing computer based registration attempts, CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) technology prompts users for manual input. CAPTCHA is a type of challenge-response test used in computing as an attempt to ensure that the response is generated by a person. Clear and concise messages are communicated to the user to set proper expectation when the user registration is in progress.

Joining Application Staging Environment

An interested party may become an ADE user by one of two methods:

- a) Completing ADE user registration form as a development team member of a procured project
- b) Completing ADE user registration form from within Community portal and get approved.

ASE user registration does NOT require the user to have been registered with the community portal. However, for practical purposes, most application developers register with the community portal because, in order to get involved in the community, a login is required.

The registration process was approved by USDOT.

Community Monitoring

Community members are encouraged to participate and collaborate with other users and adhere to the set forth community policies. The Portal manager and portal moderator may intervene when somebody violates one of the community policies to issue warnings, enforce a temporary suspense, or evict the user from the community. The details are discussed in the community forum policies.

Application Release

After an application has completed unit and system testing and is deemed to be ready for sharing with the community members, it can be released to the ROSR. The project team must prepare appropriate release notes and documentation with instructions. A designated Committer posts the software and related artifacts to the ROSR for the user to download.

Figure 5-1 shows the workflow of an application release process:

- #1. Beginning with the project team where the code is being created, application source code and relevant supporting files gets committed to the Application Staging Environment (ASE).
- #2. Before being shared with the community, the application package gets tagged with appropriate outbound license information, gets tested and reviewed for determining its readiness for release.
- #3. The application gets a comprehensive review by OSADP reviewers
- #4. The application package is moved into the ROSR
- #5. Upon passing review the application package is released on OSADP with proper announcements on the forum and on the OSADP
- #6. Any registered users can download the application package for use. The application source code may or may not get shared to OSADP user later.
- #7. If the source code is to be shared back to the ROSR, the developers can initiate contact with the existing development team and request a pull-request and upload the changes. This process would trigger a code review process and activate collaboration activities for incorporating the changes to the same repository.
- #8. Before any of the enhanced code gets admitted into the ASE they have to go through change verification and review for license terms of use.
- #9. Only when the code is deemed safe and appropriate for inclusion, it will be synched with the ASE where it eventually becomes a part of the OSADP shared open source.
- #10. In certain cases, a user may decide to fork an OSADP released application as an independent open source repository. In this case, the application developer needs to coordinate with OSADP System Administrator as this process cannot be performed automatically.

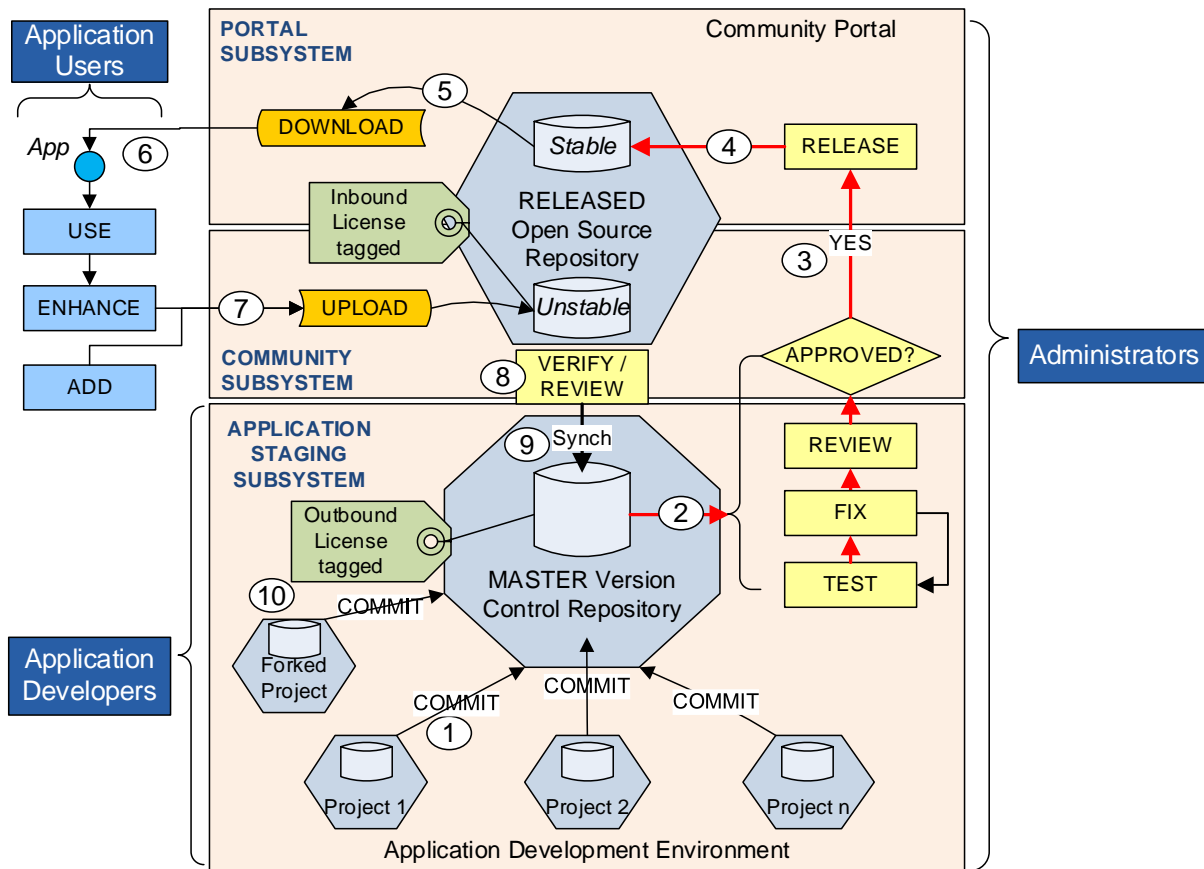


Figure 5-1. OSADP Source Control Repository Design - Workflow

Application Users' Download

A registered user can download any application or other source code posted in the ROSR. The download file is zipped up in an archive format for fast download performance. This preserves the file structure in the same environment it was created. The zip download file includes documentation and instructions for installing the software.

Statistics Dashboard

Vital statistics and information are shown on a dashboard on the portal website. Unregistered users who visit the public website may see a portion of the dashboard, while registered users can see a more extensive display on the main portal and on other pages with the community environment. Appropriate statistics and useful information are automatically compiled, collated, and then fed from ASE, CS and PS to the portal dashboard for display.

Recognition

Recognition of an individual's exceptional performance may be done in several ways. The user may be nominated by peers from within the community or project teams. An approval workflow is required to determine who will review and approve the recognition recommendation. An approved request is posted automatically on the portal's main page and other pages in the portal environment.

System Data

The system data and information is stored in various formats and kept in different repositories. Some data is kept with the subsystem's repository where it is generated; other data may be kept in separate storage holding. At a high-level, the major portal systems contents is kept as described below:

- Portal content including blog postings is stored in the CMS database
- Community discussion postings is kept in a database created by Kunena application.
- ROSR data is kept in a file management system that allows users to browse the file listing, view file content, and download related file in a zip file.
- A project can choose a flavor of revision control management application: *subversion* or *git*
- Workspace and related contents is managed by only GitHub repositories
- Modules are created and customized to summarize useful statistical information from different data repositories and databases and render statistics on a dashboard. Data can be expressed in percentage or sorted by most viewed, latest, or some other preference sorting.

Approach to Security and Privacy

Section 5.3 of this document touches on System Architectural Concerns and section 8.1 goes into detail on the System Breakdown Structure and the relationships between them including communication security.

As an element of the footer for most of the web pages, a privacy statement is visibly placed, discussing the portal position on data and information privacy issues. In additions, similar language covers governing policies, and provide a disclaimer on the portal system specifying the scope of rights and obligations that may be exercised and enforced by parties in a legally recognized relationship, particularly in situations that involve some level of uncertainty, waiver, or risk.

Design and Fabrication Decisions

In addition to the technology and product decisions discussed in section 7.1, other non-functional decisions were made before the system was implemented, including:

- The URL of the website was selected and reserved on [domain registry](#). The domain name selection was indicative of the purpose or scope of the DMA program. USDOT approved the final domain name for its acquisition.
- The portal system was unified on a thematic presentation. Templates of the system were used for a consistent presentation color scheme to create the seamlessness when a user crosses from one environment to another.
- A logo was created, and appears on most, if not all, web pages within the portal.
- A simple and friendly graphic user interfaces (GUI) was applied throughout different environments of the system.

Chapter 6. System Architectural Design

In this section, the system components shown in Figure 6 are discussed in further details. A System Breakdown Structure (SBS) with unique identifier was used to label each subsystem and associated sub-components. Detailed description of each SBS node was described including relationships among these components.

System Structure

The DMA OSADP system in Figure 5 is decomposed and shown in a SBS in Figure 7. The subsystems are presented in the 2nd row. Under the portal subsystem, two columns show a separation between public portal where it's viewable by anyone on the Internet and community portal where only registered users can access. Detailed features of each of the SBS node are further defined later in this section.

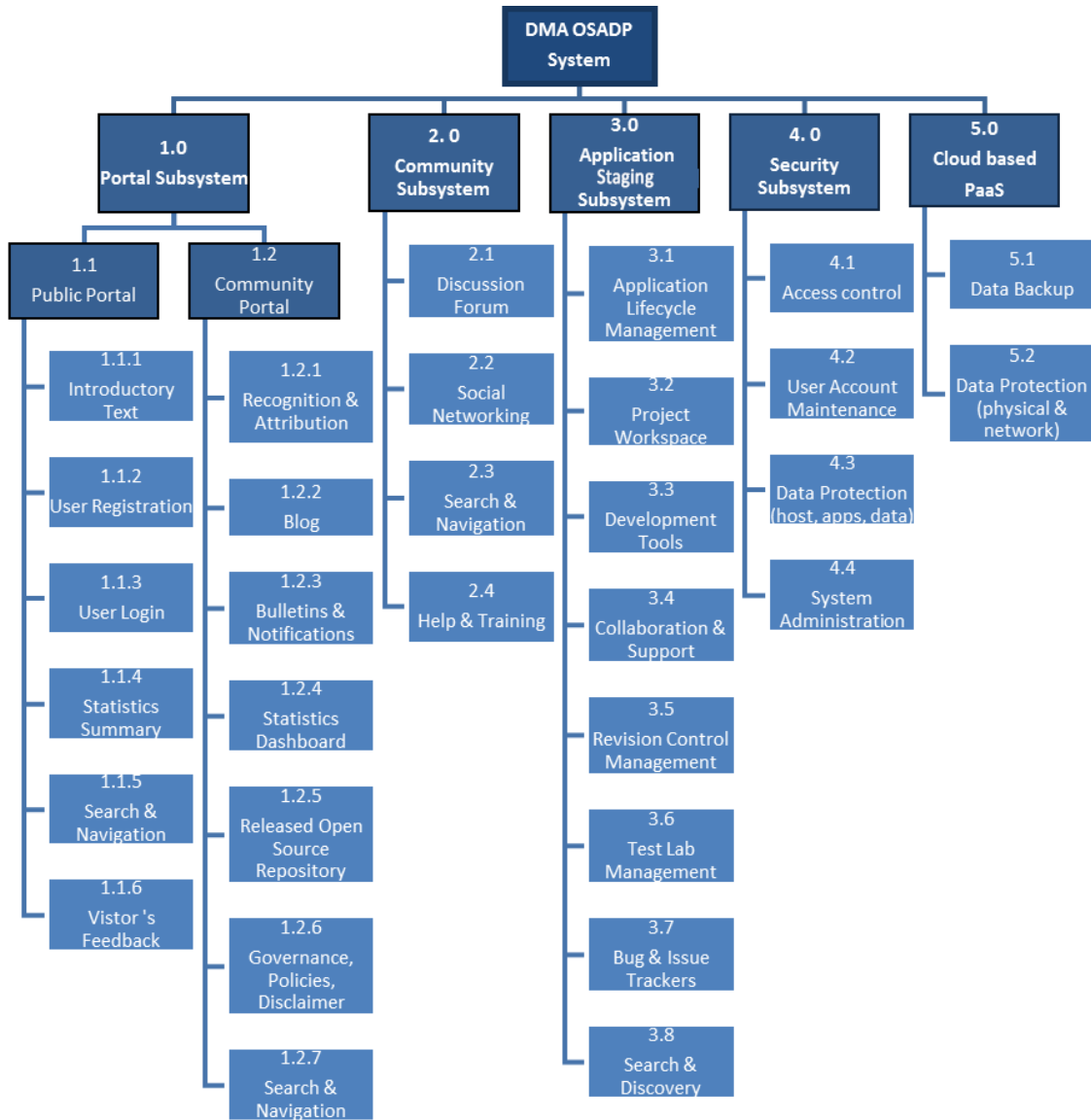


Figure 6-1. DMA OSADP's System Breakdown Structure

Components and Interrelationships

Subcomponents under each subsystem are discussed in details in the following section. Each table covers a node of the SBS tree in discussing the functional role of the component, any relationship with other components, technology being considered in the implementation, computing resources required, and its development status. Each table also maps the node of the SBS to the Requirement Traceability Matrix (RTM) developed in Task 4 and the SyRS document.

SBS Element	Description
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1.1	SBS Name:	Public Portal	RTM item satisfied:	3.4.1.12, 3.4.1.21
Sub-elements	All elements under 1.1 grouping are related to this major SBS element.			
Functions	Public Portal is the primary interface with Internet users and it's open to everyone. The portal does not have substantial content; however, it will show sufficient information to introduce itself to users. It has a link to User Registration and includes instructions for completing the registration process. Users with proper access can log in through public portal. Some search and navigation capabilities will be provided; however data is expected to be shallow in this environment. Public Portal and Community Portal are essentially the same portal subsystem, partitioned by access control.			
Component relationships	Access control (4.1), user account maintenance (4.2). All sub elements in 1.1 grouping is related to public portal.			
Technology used	Joomla CMS was used to provide the functions and interface of the public portal. A Web server is required for CMS installation.			
Computing resources	Joomla CMS shares resources on an application server with a dual 2GHz CPU, 4 GB of RAM and 40 GB of storage. A web server runs to support the Joomla CMS.			
Development status	Joomla CMS provides the application for this function. Configuration and customization were done during the development phase.			

SBS Element	Description			
1.2	SBS Name:	Community Portal	RTM item satisfied:	3.4.1.14, 3.4.1.16 3.4.1.17, 3.4.1.21
Sub-elements	All elements under 1.2 grouping are related to this major SBS element.			
Functions	Community Portal is the primary interface for all registered users. It acts as the 'home' site for navigating to other areas of the portal system. Contents of Community Portal built up over time; initially it had information describing the overall picture of the portal system. It now has links to other sub-elements listed under the 1.2 grouping of the SBS, which is described in more detail later. Some search and navigation capabilities are provided to allow users to seek out information from the portal subsystem elements as well as community discussion forum. Community Portal and Public Portal are essentially the same portal subsystem, partitioned by access control.			
Component relationships	Access Control (4.1), User Account Maintenance (4.2). All sub elements in 1.2 grouping is related to Community Portal. Since the portal subsystem act as the foundation for all other subsystems, Community Portal relates to most of SBS elements.			
Technology used	Joomla CMS was used to provide the functions and interface of the Community Portal. A Web server is required for CMS installation.			
Computing resources	Joomla CMS shares resources on an application server with a dual 2GHz CPU, 4 GB of RAM and 40 GB of storage. A web server runs to support the Joomla CMS.			
Development status	Joomla CMS provides the application for this function. The GUI was a major focus of this element. Configuration and customization was done during the development phase.			

SBS Element	Description			
	1.1.1	SBS Name:	Introductory Text	RTM item satisfied:
Sub-elements	None.			
Functions	Brief paragraph(s) was posted on the Public Portal GUI to describe the purpose of this website. Frequently asked questions (FAQs) were made publicly assessable, answering common questions from visitors.			
Component relationships	No functional relationship with any other SBS elements; however, this introductory text states the high-level purpose and goal of the website and effectively it relates to all components of the entire system.			
Technology used	Text editing. Joomla CMS was used to manage the textual content.			
Computing resources	Insignificant.			
Development status	Completed.			

SBS Element	Description			
	1.1.2	SBS Name:	User Registration	RTM item satisfied:
Sub-elements	User Registration form; a workflow for approving registration request (if required by governance)			
Functions	A link from Public Portal takes an unregistered user to the User Registration page where a form is presented and used is expected to complete the required fields.			
Component relationships	User Login (1.1.3), Access control (4.1), user account maintenance (4.2).			
Technology used	Joomla CMS.			
Computing resources	Same computing resources required to run Joomla CMS.			
Development status	Core function comes from Joomla CMS. Customization was required. Instructional text was written to guide users through the registration process.			

SBS Element	Description			
1.1.3	SBS Name:	User Login	RTM item satisfied:	3.3.1.5, 3.3.1.6, 3.3.1.7
Sub-elements	None			
Functions	User login is the default “entrance” to the Community Portal if authenticated successfully. The username and password is prompted by the Access Control of the Security Subsystem. The user entered fields is verified with Access Control database to authenticate the user and determine the type of privileges the user have been granted, which authorize user access to certain areas within the portal system. If a user fails to provide proper authentication, user is be given an option to repeat the attempt 3 times; a pause is imposed where user cannot repeat the login operation. This is one of the measures to prevent machine login attempts. User may also request a password reset via “forgot my password” where email is sent to user’s registered email address and the user needs to authenticate by the fact that the user can access the email account.			
Component relationships	User Registration (1.1.2), Access Control (4.1), User Account Maintenance (4.2).			
Technology used	Joomla CMS.			
Computing resources	Insignificant computing resource required.			
Development status	Core function will be from Joomla CMS. Customization will be required. Instructional text will be written to guide users through the login process.			

SBS Element	Description			
1.1.4	SBS Name:	Statistics Summary	RTM item satisfied:	3.4.1.22
Sub-elements	Several sources may be queried to build the statistical summary, including ROSR, list of project, number of project, etc. Functionally this element is akin to Statistics Dashboard (1.2.4). However, the amount of information aggregated for this SBS element may be less compared to the Community Portal based dashboard.			
Functions	This statistical information gives visitors to the Public Portal a sense of what project activities may be going on in the Community Portal and in the Application Development environment. Initially the data was skimpy, but it became more substantial as more projects took residence in the portal system.			
Component relationships	This element depends on the data sources where it queries information from; hence it has a dependent relationship with these sources.			
Technology used	A ‘dashboard’ Joomla Plug-in or a script to be built from scratch.			
Computing resources	Insignificant computing resource required.			
Development status	Completed.			

SBS Element	Description			
1.1.5	SBS Name:	Search and Navigation (Public Portal)	RTM item satisfied:	3.4.1.11
Sub-elements	Web pages accessible by unregistered users. The scope of this SBS element covers ONLY the Public Portal. Menu and tabs present the navigation options.			
Functions	The search engine keeps a separate index for Public Portal content. By typing keyword(s), a set of results is shown, if relevant content exists. Results served up by the search engine are ONLY on content accessible by the unregistered users. Menu selections and tabs with links allows the users to jump to different sections of the Public Portal.			
Component relationships	The search and navigation take users to the sought contents and therefore be dependent of the Public Portal's content.			
Technology used	A Joomla Plug-in for Search engine or a customized Google search engine instance. For menu and tabs, Joomla CMS supplies this capability.			
Computing resources	Insignificant computing resource required. When a new content is added, the search engine will index automatically.			
Development status	An existing technology was leveraged to build this SBS element. Customization and configuration was done during development phase.			

SBS Element	Description			
1.1.6	SBS Name:	Visitor's Feedback	RTM item satisfied:	3.4.1.13
Sub-elements	Web link, web form for feedback			
Functions	A link is visible on the Public Portal to allow any users including visitors (unregistered users) to communicate with the Portal Manager. A web form is shown for the user to enter comment. Submitted feedback is forwarded the Portal Manager.			
Component relationships	Public Portal (1.1)			
Technology used	A Joomla Plug-in for feedback was used.			
Computing resources	Insignificant computing resource required.			
Development status	An existing technology was leveraged to build this SBS element. Customization and configuration was done during the development phase.			

SBS Element	Description			
1.2.1	SBS Name:	Recognition and Attribution	RTM item satisfied:	3.4.2.10, 3.4.4.6, 3.4.4.7, 3.6.1.8
Sub-elements	ROSR database and/or workflow for nomination evaluation are required.			
Functions	<p>Recognition and attribution are visible on Community Portal. Recognition may be nominated by peers; in that case, a workflow is made available to allow community members to nominate and express details for the nomination for an individual. The workflow may involve Portal Manager's evaluation before it gets published.</p> <p>Attribution may be derived directly from databases based on numerical values and information about the user. For instance, an attribution could be developer who have written the most code lines, or who is involved in the most projects, or who authors the most-liked application or feature. For initial release, attribution is made for every developer who participated in an open source project.</p>			
Component relationships	Community Portal (1.2)			
Technology used	A script was written to perform data extraction and analysis. A Joomla smart plug-in may already existed that was customized to perform this task.			
Computing resources	Insignificant computing resource required.			
Development status	Leveraging existing smart plug-in was possible and customized in development phase			

SBS Element	Description			
1.2.2	SBS Name:	Blog	RTM item satisfied:	3.4.2.8
Sub-elements	Articles; RSS feed; Photos; Status derived from databases			
Functions	<p>Blog is a publication tool to post articles and related writing on the Community Portal. The function of the blog is analogous to a content website. It can also be an aggregation point for sharing related news from other sources fed via Real Simply Syndication (RSS). Blog reader can offer comments on an article and indicate approval or disapproval with thumbs-up or thumbs-down.</p>			
Component relationships	Function of a blog is akin to Bulletins & Notifications (1.2.3) to be described later.			
Technology used	Joomla CMS has blog publication functions that were customized to fit this purpose.			
Computing resources	Medium computing resource required. The publication requires no significant resources but if an article is popular and get read by many Community members it could generate some computer loads.			
Development status	Joomla CMS provided the technology. Customization and configuration was required.			

SBS Element	Description			
1.2.3	SBS Name:	Bulletins & Notifications	RTM item satisfied:	3.3.1.8, 3.3.1.9, 3.4.1.14, 3.4.1.16, 3.4.2.1, 3.4.2.5, 3.4.2.8, 3.7.2.2, 3.7.2.3
Sub-elements	Publication editor, webpage composition tools; workflow for content approval, etc.			
Functions	<p>News bulletins and announcements can be posted to the public, the community at large, or a sub-group of the Community. It has the ability to direct the news to be placed on certain areas of the Community Portal. This is a tool for the portal manager and other designated administrators to post news and make announcements to the Community members. This publication tool was used to publish content to the Public Portal.</p> <p>Registered users can also subscribe to news and updates of a particular item of interest.</p>			
Component relationships	Joomla CMS and Blog function (1.2.2) described above.			
Technology used	Joomla CMS has blog publication functions that was customized to fit this purpose.			
Computing resources	Medium computing resource required. The publication requires no significant resources but if an article is popular and get read by many Community members it could generate some computer loads.			
Development status	Joomla CMS provided the technology. Customization and configuration was required.			

SBS Element	Description			
1.2.4	SBS Name:	Statistics Dashboard	RTM item satisfied:	3.4.1.22
Sub-elements	Databases and various data sources			
Functions	Statistics dashboard brings the essential information to the forefront for the Community to see. The content can be ranking or rating a certain project's popularity or an increasing number of application downloads. The technology allows selection of data sources and information to be analyzed, ranked and posted on the Dashboard.			
Component relationships	Statistics Summary (1.1.4)			
Technology used	Many Joomla CMS smart plug-ins satisfied this function. Customization and configuration was required.			
Computing resources	Insignificant computing resource required.			
Development status	Selection of the most appropriate Joomla CMS plug-in was selected and customized during development phase.			

SBS Element	Description				
1.2.5	SBS Name:	Released Open Source Repository	RTM item satisfied:	3.3.1.3, 3.4.1.1-9, 3.4.1.15, 3.4.1.19, 3.4.2.11-12, 3.4.3.14, 3.4.4.4-8	
Sub-elements	File manager, file folder archiving, statistics about the application				
Functions	<p>Released Open Source Repository or ROSR holds the applications and other artifacts to be shared with the community. Registered users can explore the content of ROSR and download any particular items or the entire application from it. A user can also 'fork' the set of code from ROSR and in effect, create a new deviation from the main version control branch. Forking a project on DMA OSADP requires the user to have access privileges within the Application Development Subsystem. Some approval from the portal manager is required for the fork operation to be completed.</p> <p>Description and metadata of application and major artifacts and developer's information were made available.</p> <p>A user may make enhancement modifications to a download code and upload it back to ROSR. The upload code may require peers review and will not be instantaneously integrated into ROSR. Besides code review, uploaded content needs to be scanned for virus and malware.</p>				
Component relationships	Revision Control Management (3.5)				
Technology used	GitHub, Subversion				
Computing resources	Medium computing resources required.				
Development status	GitHub provided the core functionality for this element. Customization and configuration was required.				

SBS Element	Description				
1.2.6	SBS Name:	Governance, Policies, and Disclaimer	RTM item satisfied:	3.3.1.18, 3.4.1.8, 3.6.1.3-5	
Sub-elements	Editor, website design				
Functions	<p>On the Community Portal, governance provided the "ground rules," which dictated certain operations on the portal. Policies were also posted to make clear operational preferences that everyone must adhere to including topics on privacy, licensing, etc. A general disclaimer was posted to discern certain presumed claims by the users. Links to these web pages are placed in the footer navigation bar of every web page as part of the website template.</p>				
Component relationships	Community Portal (1.2),				
Technology used	Joomla CMS				
Computing resources	Insignificant computing resource required.				
Development status	The content was provided by USDOT personnel and incorporated into the portal template.				

SBS Element	Description		
1.2.7	SBS Name:	Search & Navigation (Community Portal)	RTM item satisfied: 3.4.1.10
Sub-elements	Web pages accessible by registered users, but outside of ASE. The scope of this SBS element covers ONLY the Community Portal. Menu and tabs present the navigation options.		
Functions	Search and Navigation engine is a separate index for Community Portal content. By typing keyword(s) a set of results are shown, if relevant content exist. Results served up by the search engine is for content ONLY accessible by the registered users. Menu selections and tabs with links allow users to jump to different sections of the Community Portal.		
Component relationships	The search and navigation take users to the sought contents and therefore be dependent of the Community Portal's content.		
Technology used	A Joomla plug-in for search engine or a customized Google search engine instance. Joomla CMS supplies menu and tabs.		
Computing resources	Insignificant computing resource required. When a new content is added, the search engine indexes automatically.		
Development status	An existing technology was leveraged to build this SBS element. Customization and configuration was done during development phase.		

SBS Element	Description		
2.1	SBS Name:	Discussion Forum	RTM item satisfied: 3.4.2.4, 3.4.2.6, 3.4.4.1
Sub-elements	Joomla CMS and extensions		
Functions	Discussion Forum is an application that facilitates the exchange and sharing of thoughts and ideas interactively between Community members. It is also a community builder application. The degree of flexibility in access control is reserved for administrators only or be opened to everyone. Topics can be created by administrators or members themselves. User postings can be monitored and reviewed before posting or automatically displayed. The administrators can configure and control the flexibility. User can be given warning or banned if a guideline is violated.		
Component relationships	Kunena is a native Joomla extension. This is a major design advantage. Joomla and Kuenta is pre-integrated and they share the same design framework; therefore the interoperability is very high. Kuenta users can access Discussion Forum and related features using the same login as Joomla. See Kunena features for more information.		
Technology used	Joomla CMS, Web server		
Computing resources	Medium to high computing resources requirement, depending on the Forum activities.		
Development status	Kunena integration with Joomla CMS provides the core Discussion Forum component. Customization and configuration was required during development phase.		

SBS Element	Description
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2.2	SBS Name:	Social Networking	RTM item satisfied:	3.4.2.4
Sub-elements	Joomla CMS, Kunena Discussion Forum			
Functions	<p>Social Networking application allows users to participate in existing social networks or create a new social network with photo and video gallery, event management, activity stream and other features. Among many typical features, it offers: on-site notification, <i>friendship</i> system, event management to manage community activities, private communication with <i>friends</i>, 'Like' and 'Comment' on activity stream, and invite new members with Facebook friend inviter, etc.</p> <p>This SBS element allows Community members to collaborate, invite specialists who may share interest in the DMA program to join the Community.</p>			
Component relationships	Discussion Forum (2.1), Community Portal (1.2)			
Technology used	JomSocial is a social networking application that provided these features. JomSocial is a native Joomla extension and works best in a Joomla CMS installation and it integrates tightly with Kunena Discussion Forum.			
Computing resources	Medium to high computing resources requirement, depending on the level of activities.			
Development status	JomSocial integration with Joomla CMS provided the core Social Networking component. Customization and configuration was required during development phase.			

SBS Element	Description			
2.3	SBS Name:	Search & Navigation (Community Subsystem)	RTM item satisfied:	3.4.1.10
Sub-elements	Web pages accessible by registered users, but outside of ASE. The scope of this SBS element covers ONLY the Community Discussion Forum. Menu and tabs present the navigation options.			
Functions	<p>Search and Navigation is a separate index for Discussion Forum content. By typing keyword(s), a set of results is shown, if relevant content exists. Results served up by the search engine is for content ONLY accessible by the registered users.</p> <p>Menu selections and tabs with links allows the users to jump to different sections of the Discussion Forum areas.</p>			
Component relationships	The search and navigation take users to the sought contents and therefore be dependent of the Discussion Forum's content.			
Technology used	A Joomla plug-in for search engine or a customized Google search engine instance. Kunena Discussion Forum supplies menu and tabs.			
Computing resources	Insignificant computing resource required. When a new content is added, the search engine indexes automatically.			
Development status	An existing technology was leveraged to build this SBS element. Customization and configuration was done during development phase.			

SBS Element	Description			
2.4	SBS	Help & Training	RTM item satisfied:	3.4.1.14, 3.4.2.3

	Name:			
Sub-elements	Help, guides, tutorial, training materials, etc.			
Functions	Self-help materials was posted on Community Portal for user's reference. Links to help, tutorial and other training materials was made visible for Community members (registered users) to access.			
Component relationships	Community Portal (1.2)			
Technology used	A Joomla plug-in.			
Computing resources	Insignificant computing resource required.			
Development status	An existing plug-in was leveraged to build this SBS element. Customization and configuration was done during development phase.			

SBS Element	Description			
3.1	SBS Name:	Application Management	Lifecycle	RTM item satisfied: 3.4.2.7, 3.6.1.6
Sub-elements	Entire software development process			
Functions	<p>Application Lifecycle Management (ALM) is a continuous process of managing the life of an application through governance, development and maintenance. ALM include features of business management to software engineering, made possible by tools that facilitate and integrate requirements management, architecture, coding, testing, tracking, and release management.</p> <p>ALM allows project teams in ASE to plan the whole application lifecycle online and collaboratively.</p>			
Component relationships	Application Development Subsystem (3)			
Technology used	GitHub ALM component.			
Computing resources	Medium to high computing resources requirement, depending on software development activities.			
Development status	GitHub provided the core function for this SBS element. Customization and configuration was required.			

SBS Element	Description			
3.2	SBS Name:	Project Workspace	RTM item satisfied:	3.4.2.2
Sub-elements	Application software development process			
Functions	Project Workspace: Each Application Developer was allocated a personal workspace with flexibility for customization to individual needs and preferences. Personal Workspace by default is connected to your projects and teams, giving you immediate access to items assigned to you or requiring your intervention, and read the latest project news. A dashboard of activities and tasks across all your projects is shown allowing you to gain insights into key metrics such as start/end date, open tasks, and estimated and actual efforts.			
Component relationships	Application Development Subsystem (3), Application Lifecycle Management (3.1)			
Technology used	GitHub Project Workspace component.			
Computing resources	Medium computing resources requirement depending on software development activities.			
Development status	GitHub provided the core function for this SBS element. Customization and configuration was required.			

SBS Element	Description			
3.3	SBS Name:	Development Tools	RTM item satisfied:	3.4.2.7
Sub-elements	Code, build, test, release application			
Functions	Development tools necessary for code developers to develop applications, including: <ul style="list-style-type: none"> • Write code • Trace code commits • Browse and manage code repositories • Integrate Hudson or Jenkins build tools • Automate build and delivery traceability 			
Component relationships	Application Development Subsystem (3), Application Lifecycle Management (3.1), Project Workspace (3.2) and Collaboration & Support (3.4)			
Technology used	GitHub components.			
Computing resources	Medium computing resources requirement depending on software development activities.			
Development status	GitHub provided the core function for this SBS element. Customization and configuration was required.			

SBS Element	Description			
3.4	SBS Name:	Collaboration & Support	RTM item satisfied:	3.4.3.6, 3.4.4.9
Sub-elements	Tools for application development collaboration			
Functions	Upon initiation of a project, a team workspace was created for facilitating team collaboration. Among the resources that were enabled are project pages, issues and bugs trackers, file releases, wikis, discussions, reporting, analytics, and social tools for real-time & off-line communication within and across teams, and share documents.			
Component relationships	Application Development Subsystem (3), Application Lifecycle Management (3.1), Project Workspace (3.2) and Development Tools (3.3)			
Technology used	GitHub components.			
Computing resources	Medium computing resources requirement depending on software development activities.			
Development status	GitHub provided the core function for this SBS element. Customization and configuration was required.			

SBS Element	Description			
3.5	SBS Name:	Revision Control Management	RTM item satisfied:	3.4.3.2-5, 13, 3.4.4.2
Sub-elements	Source code management tools			
Functions	Revision control management was integrated with the ASE and was used to provide control over changes, not only to source code, but also maintains documentation and configuration files as well. It offers both centralized and distributed revision control. Revision Control Management also provided support for a <i>fork</i> operation and <i>release management operation</i> .			
Component relationships	Application Development Subsystem (3), Application Lifecycle Management (3.1), Project Workspace (3.2) and Collaboration & Support (3.4)			
Technology used	GitHub components.			
Computing resources	Low computing resources requirement depending on software development activities.			
Development status	GitHub provided the core function for this SBS element. Customization and configuration was required.			

SBS Element	Description		
3.6	SBS Name:	Test Lab Management	RTM item satisfied:
Sub-elements	Build tools, test configurations		
Functions	Test Lab Management is a cloud-enabling service, integrated with other ASE components, providing self-service provisioning of software profiles and servers (physical and virtual) for distributed development, test, and build. Lab management accelerates application development with on-demand build and test tools, application stacks, and servers available directly from the web browser. Access from a pool of standardized development, build, and test resources.		
Component relationships	Application Development Subsystem (3), Application Lifecycle Management (3.1), Project Workspace (3.2) and Collaboration & Support (3.4), Revision Control Management (3.5)		
Technology used	GitHub components.		
Computing resources	Low computing resources requirement depending on software development activities.		
Development status	GitHub provided the core function for this SBS element. Customization and configuration was required.		

SBS Element	Description		
3.7	SBS Name:	Bug & Issue Tracker	RTM item satisfied: 3.4.2.9, 3.4.2.13, 3.5.3.2
Sub-elements	Bug report fields, format		
Functions	Issue and Bug Trackers track anything that functionally needs to be addressed or delivered within a product release cycle. It is a set of tools for creating, updating, and resolving application development issues. An issue tracking system often also contains a knowledge base containing information on issues, resolutions to common problems, and other such data. An issue tracking system is similar to a "bug tracker". The main benefit of a bug-tracking system is to provide a clear centralized overview of development requests including both bugs and improvements, and their state. The prioritized list of pending items (often called backlog) provides valuable input when defining the product road map, or maybe just "the next release".		
Component relationships	Application Development Subsystem (3), Application Lifecycle Management (3.1), Project Workspace (3.2) and Collaboration & Support (3.4), Revision Control Management (3.5)		
Technology used	GitHub components.		
Computing resources	Low computing resources requirement depending on software development activities.		
Development status	GitHub provided the core function for this SBS element. Customization and configuration was required.		

SBS Element	Description			
3.8	SBS Name:	Search & Discovery	RTM item satisfied:	3.4.3.7-10
Sub-elements	Index, revision control management system			
Functions	Search and discover artifacts, code, discussion and documents, within and across projects in the ASE. The search results are aware of role-based access control and maintains privacy and security for the content.			
Component relationships	Application Development Subsystem (3), Application Lifecycle Management (3.1), Project Workspace (3.2) and Collaboration & Support (3.4), Revision Control Management (3.5), Test Lab Management (3.6), Bug and Issue Trackers (3.7)			
Technology used	GitHub components.			
Computing resources	Low computing resources requirement depending on software development activities.			
Development status	GitHub provided the core function for this SBS element. Customization and configuration was required.			

SBS Element	Description			
4.1	SBS Name:	Access Control	RTM item satisfied:	3.3.1.4,7,11,15,16,17, 3.4.4.9, 3.6.1.2, 4.1.2.1
Sub-elements	Authentication, role-based access control			
Functions	Access Control facilitates access for different users based on their roles. Application Users only have access to Public and Community Portal areas, while Application Developers have access the same resources that Application Users have, plus the Application Staging Environment (ASE). Challenge-response tests may be used to authenticate and prevent unauthorized access and machine-generate access attempts. LDAP was utilized to map access privileges of all users in a common security access database. The System Administrator can review login history and activity logs for unusual pattern of activities.			
Component relationships	User Registration (1.1.2), User Login (1.1.3)			
Technology used	GitHub components, Joomla CMS and LDAP			
Computing resources	Low computing resources requirement depending on software development activities.			
Development status	Integration of CollabNet, Joomla CMS access database was done during the development phase.			

SBS Element	Description			
4.2	SBS Name:	User Account Maintenance	RTM item satisfied:	3.3.1.16, 3.6.1.1, 3.6.1.2
Sub-elements	Change of Password, Edit User's Profile			
Functions	This module allows users to update their account information and maintain changing authentication information such as password, email address for email token verification, and other information about the user. Users can access it once logged in and then edit the user account content.			
Component relationships	User Registration (1.1.2), User Login (1.1.3)			
Technology used	GitHub components, Joomla CMS and LDAP			
Computing resources	Low computing resources requirement depending on software development activities.			
Development status	Integration of CollabNet, Joomla CMS access database was done during the development phase.			

SBS Element	Description			
4.3	SBS Name:	Data Protection	RTM item satisfied:	3.3.1.1,10, 3.5.2.1,3.5.3.1, 3.5.3.3, 4.1.2.1
Sub-elements	Anti-virus, malware scanning			
Functions	Information is protected during transition as well as at rest. Various anti-virus and malware detection tools was configured to run to detect the present of malicious virus and worms that can infect data in the portal system. Security for physical server, network firewall, and other intrusion detection is provided by selected cloud infrastructure provider.			
Component relationships	Data Protection covers all subsystems of the portal system.			
Technology used	Enterprise anti-virus application such as Symantec. Cloud physical and network access control and protection.			
Computing resources	Low computing resources requirement depending on software development activities.			
Development status	Integration of CollabNet, Joomla CMS access database was done during the development phase.			

SBS Element	Description			
4.4	SBS Name:	System Administration	RTM item satisfied:	3.3.1.2,5,6,12,13, 3.5.2.2, 3.7.1.1-2, 3.7.2.1
Sub-elements	System administrative tasks: configuration, report generation, log review, security patches, etc			
Functions	<p>System Administration is a set of tasks performed by the System Administrator on a regular basis and as needed to provide maintenance and operational routines to ensure the system functioning at its best condition.</p> <p>With root access system administrators can perform system maintenance routines for the whole portal system and subsystems.</p>			
Component relationships	System administration does not involve business operations but only focuses on the back-end system operations for all subsystems. The System Administrator can also work with the Cloud provider's technical reps to acquire or procure infrastructure resources.			
Technology used	Command line, control panels, administrative scripts			
Computing resources	Low computing resources requirement.			
Development status	N/A			

SBS Element	Description			
5.1	SBS Name:	Data Backup	RTM item satisfied:	3.4.1.20, 3.5.2.3, 3.5.2.4
Sub-elements	Data backup utilities and remote data			
Functions	<p>Data Backup makes copies of data and information and recovers data after its loss, be it by data deletion or corruption.</p> <p>For data backup repository, various models or data storage media was offered to balance between accessibility, security and cost, including on-line, near-line, and remote and cloud-based backup site.</p>			
Component relationships	Data Protection covers all subsystems of the portal system.			
Technology used	Enterprise anti-virus application that has been integrated into cloud hosting services such as Symantec Endpoint Protection, AVG's Anti-virus, and MacAfee's Anti-virus			
Computing resources	Low to medium computing resources requirement depending on software development activities.			
Development status	Integration of CollabNet, Joomla CMS access database was done during the development phase.			

SBS Element	Description			
5.2	SBS Name:	Data Protection (physical & network)	RTM satisfied:	item 3.3.1.14,3.5.2.3,3.5.2.4,3.5.3.1
Sub-elements	Firewall settings, intrusion detection, DDOS attack prevention, secured server room			
Functions	Information is protected during transition as well as at rest. Security for physical server, network firewall, and other intrusion detection is provided by selected cloud infrastructure provider.			
Component relationships	Data Protection covers all subsystems of the portal system.			
Technology used	Physical security Network intrusion detection, firewall policies and settings			
Computing resources	None			
Development status	To be provisioned by Cloud provider.			

Performance Estimates

Performance bottlenecks can occur at various parts of the portal system. Hardware related bottlenecks can be addressed by scaling-up (more CPU's, memory or cache) or by scaling-out (additional servers). The system is running on a cloud provider's computing infrastructure, on virtual machines, therefore allocating additional resources to meet load demand can be authorized and put in effect within minutes. Selected subsystem software solutions discussed in prior sections have been proven to work with thousands of users simultaneously.

Initially, the portal system is anticipated to support 100 concurrent users performing various low to high load of typical activities. Decisions to scale up or out will be made when the performance is anticipated to be an issue.

Interface Design

In this section, several graphic user interfaces (GUI) are presented as representative layouts. These are not the final designs but examples to show how the human user can interact with the system functions.

Public Portal GUI

The main webpage facing the public is simple. Its goal is to provide sufficient information to visitors about the DMA program without divulging any protected data and information. This webpage provides an unobstructed call-to-action statement such as a paragraph detailing the program's goals and encourage visitors to participate by signing up. A few applications may be highlighted on this GUI as shown in Figure 6-2.

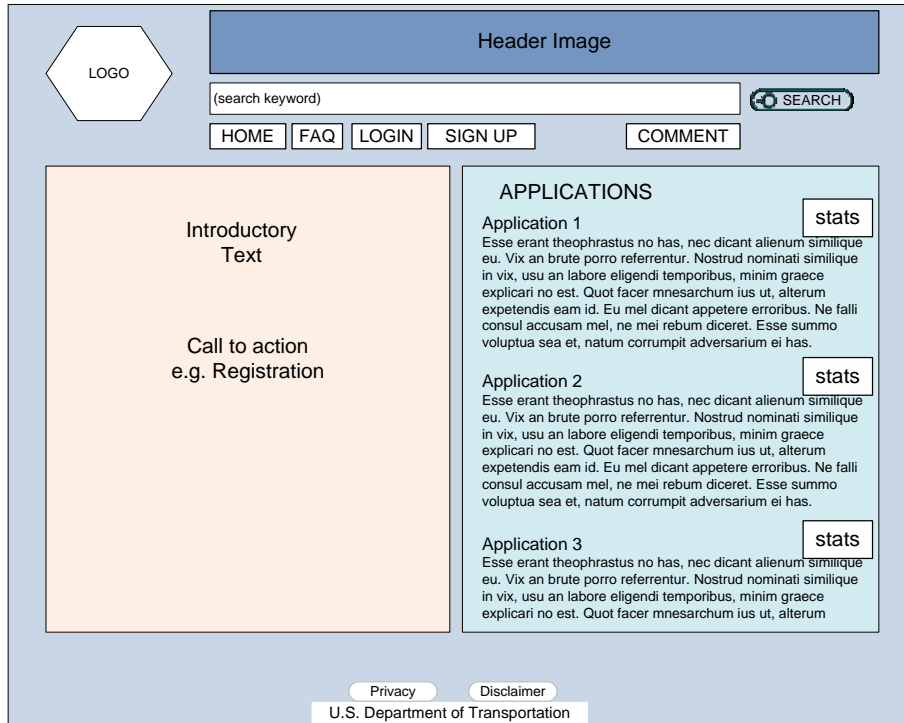


Figure 6-2. Public Portal GUI Mock-up

Community Portal GUI

The Community Portal is the first landing page of the community environment. Important and significant events bubble up to the top. Statistics are updated in real-time and shown on the Dashboard. The user can search for an article or any snippet of information that exists within the community environment including the Community Portal and the discussion forum. Navigation is presented in the form of buttons, menu items, and hyperlinks. Recognition and attribution for individuals or teams is prominently shown on the portal. Links to policies, terms, privacy, and disclaimers are included as an element of every page's footer. The content of the subsequent pages may change, but some elements of the GUI stay unchanged as part of a template used for every page of the portal. Figure shows a mock-up view of the Community Portal GUI which may change and get rearranged as contents are being populated on the page.

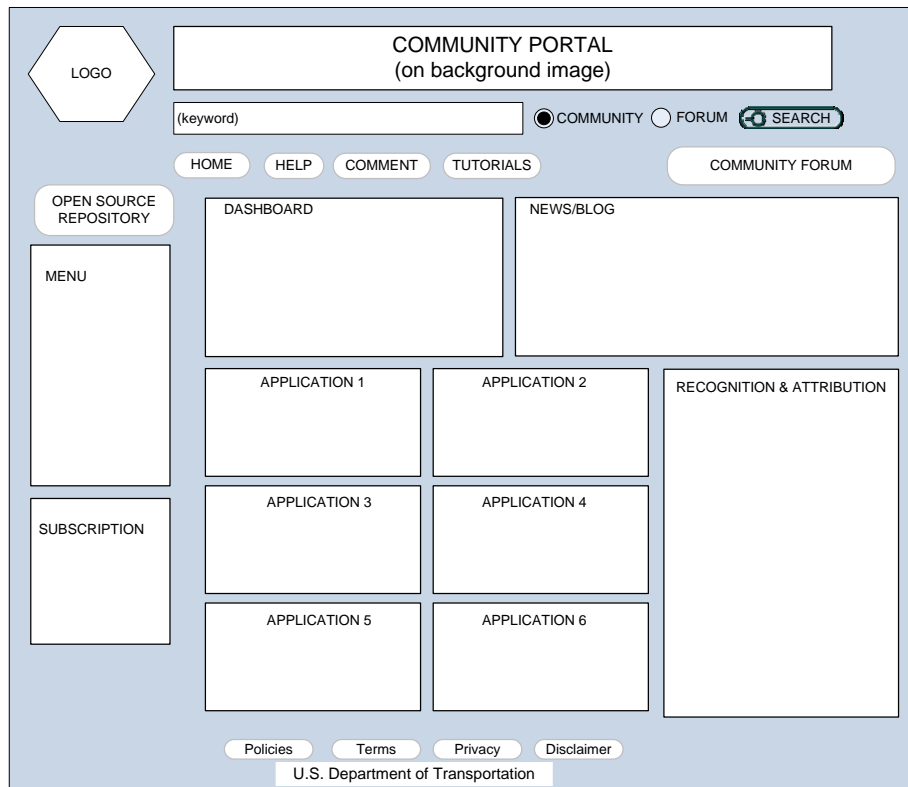


Figure 6-3. Community Portal GUI Mock-up

Discussion Forum GUI – Forum Main View

As the main communication forum for the community members, many topics and subjects can be discussed and expanded on the discussion forum. The goal of the discussion forum GUI design is to encourage collaboration and idea sharing. Figure 6-4 and Figure 6-5 show two different views of a template mock-up designed for Kunena Discussion Forum. These are representative templates of many that are available from a larger selection. Customization and configuration can transform the look and feel as well as enabling the functions to meet the system requirements.



Figure 6-4. Community Discussion Forum GUI - Main Forum View

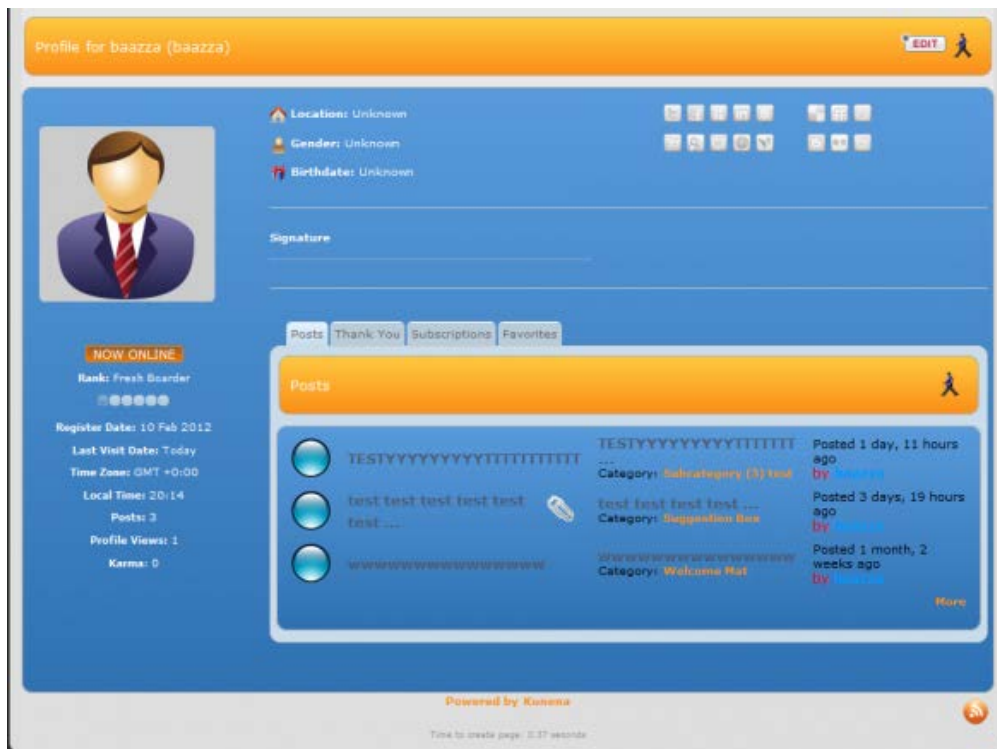


Figure 6-5. Community Discussion Forum GUI - User Profile View

Application Staging Environment GUI – Project View

The application development environment is an integrated solution with the ALM functions and capabilities that can be enabled or disabled to meet the needs of DMA system. Figure 6-6 illustrates the project view.

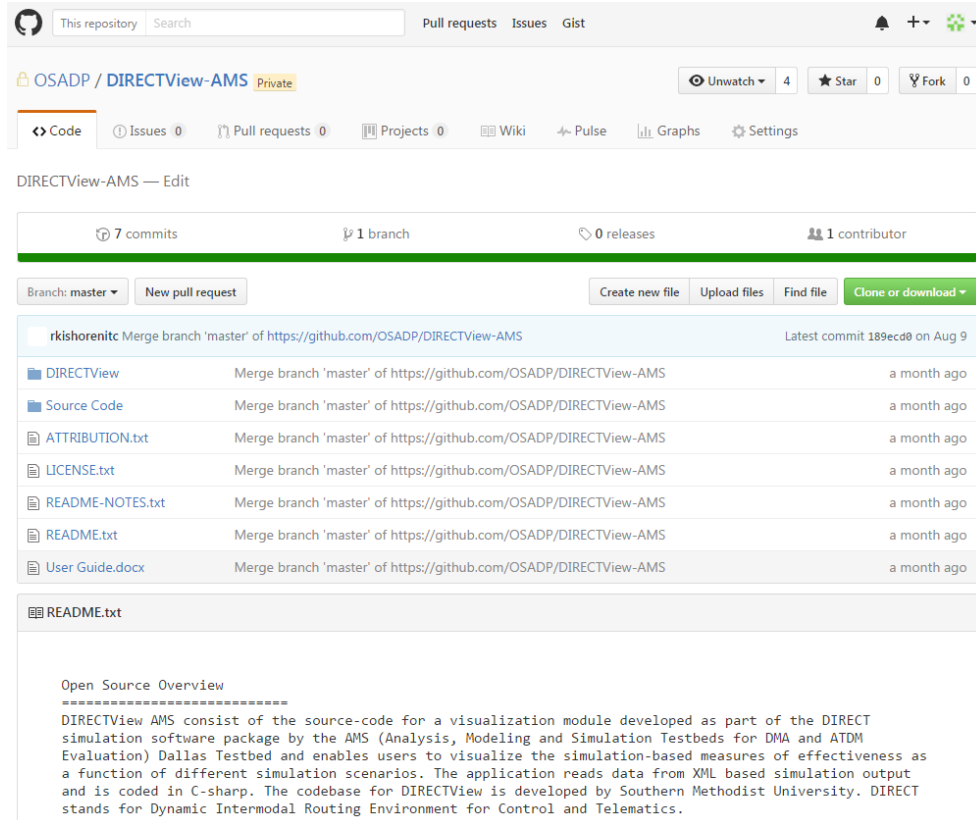


Figure 6-6. GitHub - Project View

Application Staging Environment GUI – Issues and Bug Tracker

Figure 6-7 illustrates the Issues and Bug Tracker view for the GitHub solution.

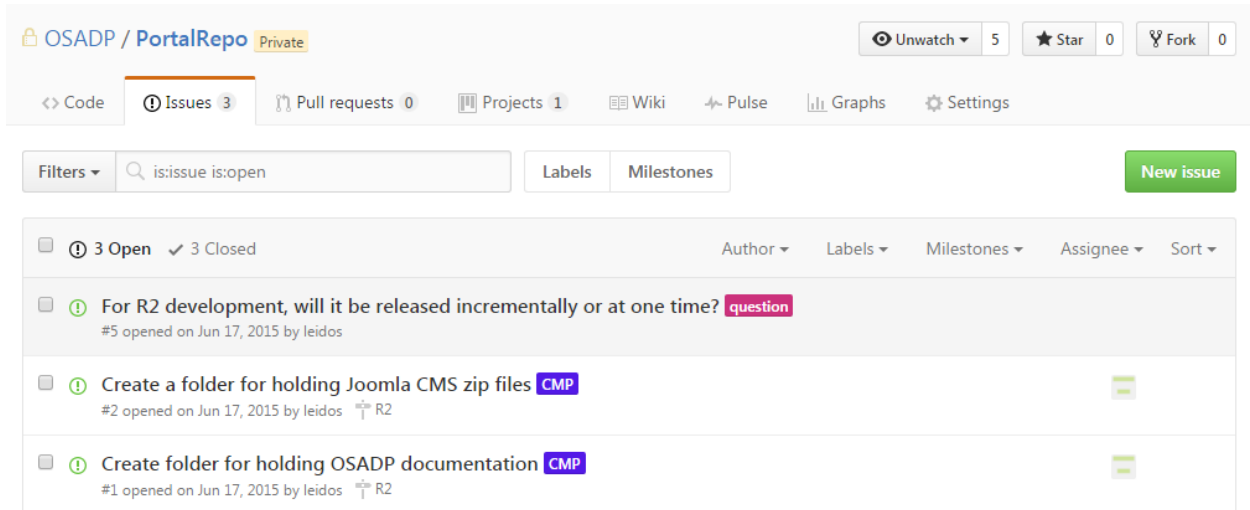


Figure 6-7. GitHub - Issues/Bug Tracker View

Chapter 7. Requirements Traceability Matrix

The Requirement Traceability Matrix (RTM) developed in the SyRS task was updated with a new column containing SBS node identifiers. Every requirement associates with at least one SBS node and some have more than one association. The multiple associations indicate that the requirement was met by multiple subcomponents or that multiple SBS elements share the same requirements. The RTM-SBS view helps the design process track implementation of the portal system requirements.

If a SBS element is not associated with any particular requirements, it could mean that the system feature is deemed important in the design but it was not identified in the early requirements analysis. If reviewed and deemed necessary, the requirement baseline was updated to include them.

The RTM was used as the basis for verifying the system requirements during development phase.

Chapter 8. Requirements in Initial Architecture and High-Level Design

Based on the discussion in previous sections, most of system requirements identified in RTM was included in the initial architecture and high-level design, with a few exceptions as described below:

1) Test Lab Management

All software applications developed in the ASE needed to be tested before being released to the ROSR. Application testing can be done on separate, independent, and offline computing resources or it can be done directly from the ASE. For the latter approach, virtual Test Lab resources, i.e. computers with sufficient computing resources, and testing management tools, need to be provisioned on the cloud and be integrated with the ASE. This requirement was not identified in the original set of requirements and it can be added if deemed necessary. Since Test Lab Management, described in SBS 3.6 above, has been considered for this architecture and design but it was not included in the SyRS document, this capability was not be included in the Initial Architecture and High-Level Design.

2) Unified single account login for Application Developers

In previous deliverables, the idea of having a unified user access database for all user types including Application Developers was discussed. While this idea was deliberated during the design process, it was found that fusing the application staging environment with the community environment may present more security risks to the overall portal system. The ASE can consist of users who may or may not wish to be community members and focused strictly on development tasks (e.g. contractors of a procured project). The ASE can operate independently as a stand-alone system; therefore, the ASE user account is kept segregated from the Community environment. There were cases where a community member may wish to be on the ASE yet has not qualified for some reason. Based on the above rationale, the initial architecture and design keeps the Application Developers separated from Application Users for security reasons. If an Application Developer also wishes to participate in the DMA Community, he or she can simply register with the Community Portal through the user registration process.

Currently, the SyRS document does not have a specific requirement calling for a unified single user account.

In the future, if tighter integration of the Application Developer with the Community Portal is deemed important and necessary, a security solution can be implemented to allow Application Developers to log in using one username and password for all environments. Until then, Community Portal members (registered users) and ASE users have separate user accounts. In other words, a single user access database for all user types is not included in the Initial Architecture and High-Level Design.

In summary, the attached RTM reflects the list of all requirements included in Initial Architecture and High-Level Design.

References

1. USDOT Work Order with Statement of Work (SOW) for Dynamic Mobility Applications Open Source Application Development Portal
2. USDOT Modification to Scope of Work Dynamic Mobility Applications Open Source Application Development Portal
3. Deliverables from related tasks including 3.1, 3.2, 3.3, 4.0, 5.1, and 5.2
4. Application lifecycle management. (2012, March 26). In *Wikipedia, the Free Encyclopedia*. Retrieved 23:46, March 30, 2012, from http://en.wikipedia.org/w/index.php?title=Application_lifecycle_management&oldid=484017997
5. Compare Content Management Systems. (2012, February 22). In CMS Matrix. Retrieved April 02, 2012 from <http://www.cmsmatrix.org/>
6. Officer, V. K. (2011, February 08). *FEDERAL CLOUD COMPUTING STRATEGY*. Retrieved from www.cio.gov: <http://www.cio.gov/documents/federal-cloud-computing-strategy.pdf>
7. Real-Time Data Capture and Management State of the Practice Assessment and Innovations Scan - Guidelines for Selecting a Cloud Provider. www.its.dot.gov/index.htm. November 30, 2011
8. U.S. Department of Transportation, John A. Volpe National Transportation Systems Center, R. a. (2011). *Policy and Institutional Issues Analysis for the Dynamic Mobility Applications (DMA) Open Source Application Development Portal (OSADP)*. Cambridge: Federal Highway Administration (FHWA) Office of Travel Management U.S. Department of Transportation.

Appendix A: DMA OSADP User Class Profiles

User Class Profiles	Role Description	Permission and Capabilities
Unregistered user category		
<ul style="list-style-type: none"> • Unregistered user 	<p>Unregistered users are defined as visitor from the general public who may or may not have an interest in the DMA OSADP. They are not registered with the portal and therefore cannot log in. An unregistered user can view publically accessible information such as generation content about the DMA as well as other content and documents made available to the general public.</p>	<ul style="list-style-type: none"> ▪ Browsing DMA OSADP public web pages ▪ Viewing and downloading public content that do not require registration ▪ Completing and submitting online registration form that will be evaluated. Completion of user registration form is a step for qualified registered user to be considered for additional access as a registered user.
Registered user category		
<ul style="list-style-type: none"> • Registered user 	<p>Registered users are users who register with and provide information to the DMA OSADP. In addition to the privileges and access rights of Unregistered users, Registered users may have access to additional information and content. Specifically, they have access to resources that require registration.</p>	<ul style="list-style-type: none"> ▪ All privileges of Unregistered Users ▪ Being bounded by user agreement terms in the registration process ▪ Having access to discussion forums, news blog and announcements ▪ Ability to participate in online discussions ▪ Subscribing to news updates ▪ Reporting bug/error, limitation, and problems with portal content and portal software e.g. broken links ▪ Having access to released source code repository to view, download, test, and make changes to application open source ▪ Reviewing and updating their personal profile ▪ Submitting or proposing new and innovative ideas ▪ Reviewing and commenting on other approved projects ▪ Discussing related project ▪ Submitting source code or data o the community to use ▪ Viewing other registered user’s public profile

User Class Profiles	Role Description	Permission and Capabilities
Contributor		
<ul style="list-style-type: none"> • Project sponsor 	<p>Project sponsor is a person designated by USDOT to provide oversight for funded projects. The sponsor involves in the process of funding and giving high level guidance to the project as it relates to the DMA program. Not expected to be involved intimately with the project in detailed level, the project sponsor interfaces with the project manager for project related status and updates.</p>	<ul style="list-style-type: none"> ▪ Representing USDOT as the main contact for the project ▪ Approving funding and resources ▪ Providing guidance to project manager relating to the DMA program overall direction ▪ Interfacing with project manager for status and updates ▪ Providing final approving for staff addition and reduction proposed by project manager ▪ Providing advisory role in open or incubation projects
<ul style="list-style-type: none"> • Project manager 	<p>A special project member who has project leadership responsibilities including directing application development effort, working with project sponsor, and making decisions relating to the well-being of project including staffing and resource issues.</p>	<ul style="list-style-type: none"> ▪ All privileges of Registered Users ▪ Ability to vote on project decisions ▪ Access to all in-development source code repository ▪ Working with project sponsors to secure resource and support ▪ Providing project leadership and direct application development effort ▪ Responsible for project management including scope and schedule management ▪ Leading system engineering process ▪ Evaluating and deciding on readiness of application ▪ Collaborating with other project manager as necessary ▪ Access to all project source code and resources
<ul style="list-style-type: none"> • Developer 	<p>A developer is a contributor who is directly involved in developing the project applications. Developers can play multiple roles.</p>	<ul style="list-style-type: none"> ▪ All privileges of Registered Users ▪ Access to all in-development source code repository ▪ Participating directly in the application development effort in many different project roles including designing system components, creating source codes, developing software, troubleshooting and fixing bugs, writing documentation, etc. ▪ Participating in online discussions ▪ Performing peer review of codes, provide suggestions, and criticism ▪ Active developer may be promoted to a Committer who has specific privileges in version control of codes ▪ Attending project meetings and discussions and collaborate with other project team members regularly

User Class Profiles	Role Description	Permission and Capabilities
<ul style="list-style-type: none"> • Committer 	<p>A Committer is an active project member who has all privileges that a Developer has with several additional access rights for configuration management, code build, and managing the Released Open Source Repository.</p>	<ul style="list-style-type: none"> ▪ All privileges of Registered Users and of Developer ▪ Committing code changes in configuration branches to the main trunk in code repository ▪ Initiating code build and compilation ▪ Preparing source code for release ▪ Ability to vote on certain project decisions ▪ Collaborating with other project team members regularly
<ul style="list-style-type: none"> • Tester 	<p>A Tester verifies functionality and features of an application or system per design document and test plan. Testing may occur at various phases of the development process.</p>	<ul style="list-style-type: none"> ▪ All privileges of Registered Users ▪ Access to application or target system ▪ Documenting bugs and issues and track them to resolution ▪ Building and compiling source code ▪ Collaborating with project team as required
<ul style="list-style-type: none"> • Reviewer 	<p>A reviewer reviews and provides technical opinions and critic comments on engineering products including designs, codes and documentation, etc as needed.</p>	<ul style="list-style-type: none"> ▪ All privileges of Registered Users ▪ Reviewing system engineering and other documents ▪ Reviewing source code designs, source code, and test results ▪ Collaborating with project team as required
Administrator category		
<ul style="list-style-type: none"> • Portal manager 	<p>Portal manager is responsible for the look-and-feel and content of the portal and the Registered User Environment including portal news blogs, announcement bulletin and overseeing the discussion forums</p>	<ul style="list-style-type: none"> ▪ All privileges of Registered Users ▪ Responsible for user experience of public portal and the Registered User Environment including usability, navigation and search as well as the overall look-and-feel of these environments ▪ Producing and editing blog articles ▪ Managing moderators of discussion forums and bulletins including removal of unwanted information or messages ▪ Adding, updating, and deleting data files ▪ Working with Governance manager in adding, updating, and deleting terms of use, governance, license, policies and legal related content. ▪ Portal Manager manages all content on the portal, but consults with Governance Manager and Project Managers for their respective content areas. ▪ Working with Project Manager who is responsible for project specific content in the Application staging Environment.

User Class Profiles	Role Description	Permission and Capabilities
<ul style="list-style-type: none"> • Governance manager 	<p>Governance manager oversees the practice of governance policies and ensure that they are implemented properly and is also responsible for preparation and revision of license agreement, disclaimer, and other legal statements to be posted on portal.</p>	<ul style="list-style-type: none"> ▪ All privileges of Registered Users ▪ Leading the practice all governance policies, regulations, compliance, and disclaimer statement, etc ▪ Providing oversight and management of risks ▪ Performing auditing of license agreement terms ▪ Enforcing proper insertion of open source license statement in source code and monitor open source content for compliance and compatibility ▪ Having read-only access to both Released Open Source Repository and in-development source code repository for inspection purposes
<ul style="list-style-type: none"> • Portal moderator 	<p>Portal moderator monitors discussion forums, instant chat, social networking, and other collaborating tools in the Registered User community and has ability to remove or delete content if deemed inappropriate based on governance and portal policies. Portal Manager may promote and demote Registered Users from the Community to become Moderators. Moderator may be assigned to specific communication tools or an area within the community communication forums.</p>	<ul style="list-style-type: none"> ▪ All privileges of Registered Users, with limited read/write access within the Community communication tools ▪ Enforcing governance and policies ▪ Reporting inappropriate activities to Portal manager

User Class Profiles	Role Description	Permission and Capabilities
<ul style="list-style-type: none"> • System administrator *If SaaS or PaaS is used, some of these services may be provided 	<p>System administrator is in charge of installing, supporting, and maintaining servers and other computer systems, and planning for and responding to service outages and other problems. Other duties may include scripting or light programming, project management for systems-related projects, supervising or training computer operators, and being the consultant for computer problems beyond the knowledge of technical support staff.</p>	<ul style="list-style-type: none"> ▪ All privileges of Registered Users ▪ Having system root access and be able to allocate system resources as needed ▪ Responsibility for system access security ▪ Adding, removing, and updating user account information resetting passwords, etc ▪ Assigning access rights to project content based on project manager's direction ▪ Ensuring network infrastructure is up and running ▪ Troubleshooting any reported technical problems ▪ Analyzing system logs and identifying potential issues ▪ Installing and maintaining software applications and tools for the application staging environment ▪ Auditing performance of systems and software applications ▪ Planning system capacities and disaster recovery ▪ Performing data backups and restoring system from backup after a problem or disaster occurs ▪ Applying operating system updates, patches, and ▪ Monitoring the sharing of data, metadata, or other information ▪ Removing unwanted information or messages ▪ Testing and checking new data sets ▪ Adding new data sets ▪ Adding, updating, and deleting history/context information within the portal environment. ▪ Answering technical queries. ▪ Responsibility for documenting the configuration of the system.
<p>Infrastructure provider category</p>		
<ul style="list-style-type: none"> • Infrastructure provider *If IaaS or PaaS is used, this function may be included by the service 	<p>Infrastructure provider delivers computer infrastructure environment that support advanced data acquisition, data storage, data management, data integration, data mining, data visualization and other computing and information processing services distributed over the Internet for enabling DMA OSADP virtual collaboration.</p>	<ul style="list-style-type: none"> ▪ Access to the computing resources including processing capabilities, network resource, data security and data storage system, etc for provisioning infrastructure services, but no access to the Application staging Environment ▪ Working with System administrator to provide requested infrastructure resources and services for DMA OSADP

Appendix B: Requirement Traceability Matrix (RTM) of DMA OSADP System

SyRS ID	Description	SBS Elements	User Needs ID	Use Case ID	Req. Ref
3.2	PERFORMANCE REQUIREMENTS	-	-	-	-
3.2.1.1	The Community Subsystem shall provide the capability to support a minimum 100 concurrent users.	1.0, 2.0,3.0,4.0, 5.0		UC2.2,UC3.2 ,UC3.3	IEEE
3.2.1.2	The Community Subsystem shall provide initially the capability to host at minimum 40 concurrent applications and associated documents in the ROSR, with the ability to scale up storage capacity to accommodate additional applications.	3.0		UC2.4,UC2.5 ,UC3.9,UC4.1	IEEE
3.2.1.3	The Application staging Subsystem shall provide scalable computing resources including CPU, memory, network access and bandwidth, data storage capacity, etc within 5 working days after the request is formally submitted.	3.0		UC4.9,UC4.10	IEEE
3.3	SECURITY REQUIREMENTS	-	-	-	-
3.3.1	Data Security	-	-	-	-
3.3.1.1	The Security Subsystem shall provide the capability to immediately detect, eliminate or quarantine viruses from infected uploaded items before storing them into the ROSR.	4.3	UN5.3	UC4.1	
3.3.1.2	The system shall be upgraded to include all critical security patches within 5 business days after they are available.	4.4		UC4.1	IEEE
3.3.1.3	The Security Subsystem shall provide the capability for Portal Manager to review and approve all content added to the ROSR.	1.2.5, 3.1, 3.5	UN8.5	UC4.1	
3.3.1.4	The Security Subsystem shall provide System Administrator the capability to see login history for users of the portal.	4.1, 4.4	UN8.8	UC1.3,UC1.6 ,UC1.7,UC2.1	
3.3.1.5	The Security System shall provide the capability to prevent unauthorized access into computers and computer networks via all access points with strong security validation and authentication.	1.1.3, 4.1, 4.2, 4.4	UN8.3	UC4.1,UC4.7	

SyRS ID	Description	SBS Elements	User Needs ID	Use Case ID	Req. Ref
3.3.1.6	The Security Subsystem shall provide the capability to comply with PCI Security Standard Council recommendations and security best practices.	1.1.3, 4.1, 4.2, 4.4		UC4.1,UC4.7	IEEE
3.3.1.7	The Security Subsystem shall provide the capability to display an audit trail of modified files and history of major changes to application source code and files.	4.1	UN8.1	UC3.4	
3.3.1.8	The Security Subsystem shall provide the capability for system administrator to notify all registered users of any identified threats or vulnerabilities relating to any elements of the ROSR.	1.2.3, 4.4	UN8.2	UC4.4	
3.3.1.9	The Security Subsystem shall provide the capability system administrator to notify all users under Contributor Category of any identified threats or vulnerabilities to a specific application and corresponding benchmark data sets, documentation, etc.	1.2.3, 4.4	UN8.2	UC2.6, UC2.7	
3.3.1.10	The Security Subsystem shall provide the capability for weekly website and system scan and sweep to ensure the environments are clear of injected malware or viruses that could transmit malicious viral agent to portal user's computer.	4.3, 4.4	UN8.4	UC4.1	
3.3.1.11	The Security Subsystem shall provide the capability to prevent automated (non-human) user registration.	4.1, 4.4,		UC1.3	
3.3.1.12	The Security Subsystem shall provide the capability for encrypted data transfer via HTTPS for protection of private information such as the user registration process via 128-bit SSL certificate.	1.1.2, 4.1, 4.4		UC1.1,UC1.3 ,UC1.6,UC1.7,UC2.1	
3.3.1.13	The Security Subsystem shall provide the capability for recording and storing all system administration access activities in system logs.	4.4		UC4.1-UC4.11	
3.3.1.14	The DMA OSADP System servers shall be hosted in a physically secure location	5.2			IEEE
3.3.1.15	The Security Subsystem shall automatically log out a user session after 30 minutes of inactivity.	4.1, 4.4	UN8.3		
3.3.1.16	The Security Subsystem shall provide the capability to enforce "strong" passwords requirements; passwords rated "medium" or lower can be locked or banned.	4.1, 4.2, 4.4		UC1.6, UC1.7	IEEE
3.3.1.17	The Security Subsystem shall provide the capability to enforce immediate lock down for at-risk users, which effectively shuts down all system resources access upon activation.	4.1, 4.4		UC1.6, UC4.11	IEEE
3.3.1.18	The Security Subsystem shall provide the capability to force user to review site Security Policies every twelve months.	1.2.6, 4.1			IEEE
3.4	FUNCTIONAL REQUIREMENTS	-	-	-	-
3.4.1	Portal Subsystem	-	-	-	-

SyRS ID	Description	SBS Elements	User Needs ID	Use Case ID	Req. Ref
3.4.1.1	The Portal Subsystem shall provide the capability to store and share source code for a hosted application on the portal and allow registered users to access and download them.	1.2.5	UN1.1	UC3.8, UC3.9	
3.4.1.2	The Portal Subsystem shall provide the capability to store and share algorithms for a hosted application on the portal and allow registered users to access and download them.	1.2.5	UN1.2	UC3.8, UC3.9	
3.4.1.3	The Portal Subsystem shall provide the capability to store and share pseudo-code for a hosted application on the portal and allow registered users to access and download them.	1.2.5	UN1.3	UC3.4-UC3.9, UC4.9	
3.4.1.4	The Portal Subsystem shall provide the capability to store and share benchmark data sets for a hosted application on the portal and allow registered users to access and download them.	1.2.5	UN1.4	UC4.10	
3.4.1.5	The Portal Subsystem shall provide the capability to store and share benchmark data sets and associated metadata for a hosted application on the portal (<u>UN1.3</u>) and allow registered users to access and download them.	1.2.5	UN1.5	UC4.10	
3.4.1.6	The Portal Subsystem shall provide the capability to store and share documentation for a hosted application on the portal and allow registered users to access and download them.	1.2.5	UN1.7	UC3.8,UC3.9	
3.4.1.7	The Portal Subsystem shall provide the capability to store self-contained, self-validating, and executable formal specifications of test cases to be applied to one or more target modules of hosted projects.	1.2.5		UC4.9	
3.4.1.8	The Portal Subsystem shall provide the capability to store governance document for a hosted application on the portal and allow registered users to access and download them.	1.2.5, 1.2.6	UN1.8	UC3.8,UC3.9	
3.4.1.9	The Portal Subsystem shall provide the capability to store data interface standards for a hosted application on the portal and allow registered users to access and download them.	1.2.5	UN1.13	UC3.8,UC3.9	
3.4.1.10	The Portal Subsystem shall provide the capability for registered users to perform searches against open source contents by type.	1.2.7, 2.3	UN13.9	UC2.4	
3.4.1.11	The Portal Subsystem shall provide the capability for visitors to perform searches on the DMA portal public website.	1.1.5		UC1.2	
3.4.1.12	The Portal Subsystem shall make the hyperlink to User Registration visible on the public website.	1.1, 1.1.2		UC1.3	DOT
3.4.1.13	The system shall provide a method for visitors to communicate with the portal manager.	1.1.6	UN13.10		
3.4.1.14	The Portal Subsystem shall provide online user training and tutorial on how to use the portal in Community and Application staging environment specifically.	1.2, 1.2.3, 2.4	UN13.10		

SyRS ID	Description	SBS Elements	User Needs ID	Use Case ID	Req. Ref
3.4.1.15	The Portal Subsystem shall provide registered users the capability to sort project by application category and show related items.	1.2.5	UN13.12	UC4.1,UC3.3	
3.4.1.16	The Portal Subsystem shall provide the capability to have a common terminology reference and acronym lookup table accessible by registered users and visitors.	1.2, 1.2.3	UN4.4		
3.4.1.17	The Portal Subsystem shall provide the capability to allow registered users to configure and customize the primary web user interface screen for emphasizing features of interest to them via pre-defined templates.	1.2	UN4.6		
3.4.1.18	The Portal Subsystem shall provide the capability to automatically confirm e-mail address of registering users on the portal via User Registration function.	1.1.2	UN8.6	UC1.3, UC1.7	
3.4.1.19	The Portal Subsystem shall provide the capability to host open source applications and source code from other federal agencies per authorization from the Portal Manager.	1.2.5	UN12.1	UC3.8, UC3.9	
3.4.1.20	The Portal Subsystem shall provide the capability to recover, in case of an outage, all portal functionality and contents within 1 week after loss of service.	5.1	UN8.9	UC4.7, UC4.8	
3.4.1.21	The Portal Subsystem shall provide the capability for meeting Section 508 requirements.	1.1, 1.2	UN4.5		
3.4.1.22	The Portal Subsystem shall display to registered users usage statistics for shared items including user visit, hits, downloads, uploads to registered users.	1.1.4, 1.2.4	UN13.13		
3.4.2	Community Subsystem				
3.4.2.1	The Community Subsystem shall provide the capability that allows registered users to subscribe for notifications when a specific element of the ROSR is changed.	1.2.3	UN9.8		
3.4.2.2	The Community Subsystem shall provide the capability that allows registered users to share developer community news for a hosted application.	3.2	UN9.1	UC4.2	
3.4.2.3	The Community Subsystem shall provide the capability that allows registered users to obtain online help from other community members and the portal administrators.	2.4	UN9.2	UC1.5	
3.4.2.4	The Community Subsystem shall provide the capability that allows registered users to communicate with project contributors regarding a hosted application via a community discussion forum.	2.1, 2.2	UN9.5	UC2.2	
3.4.2.5	The Community Subsystem shall provide the capability that allows registered users to subscribe to receive email notifications on updates to a hosted application.	1.2.3	UN9.6		
3.4.2.6	The Community Subsystem shall provide the capability that allows registered users to participate in email discussion via community mailing lists.	2.1	UN9.7		

SyRS ID	Description	SBS Elements	User Needs ID	Use Case ID	Req. Ref
3.4.2.7	The Community Subsystem shall provide the capability for registered users to collaborate on writing and editing online documents.	3.1, 3.3, 3.4	UN9.9	UC2.2	
3.4.2.8	The Community Subsystem shall provide the capability for registered users to be notified in advance on interesting community events.	1.2.2, 1.2.3	UN9.17		
3.4.2.9	The Community Subsystem shall provide the capability for registered users to document application specific resolution for technical issues such as API, objects, libraries and GUI of hosted applications.	3.7	UN5.4	UC4.10	
3.4.2.10	The Community Subsystem shall provide the capability for registered users to credit and acknowledge the original creator and subsequent contributors of the shared source code or application by displaying their names visibly in association with the shared item, in the ROSR.	1.2.1	UN6.4	UC4.5	
3.4.2.11	The Community Subsystem shall provide the capability for registered users to download application source code and associated files, in the ROSR.	1.2.5	UN7.3	UC4.2, UC2.5	
3.4.2.12	The Community Subsystem shall provide the capability for registered users to simultaneously upload multiple files into the ROSR.	1.2.5	UN7.2	UC3.9, UC4.1, UC4.3, UC2.5	
3.4.2.13	The Community Subsystem shall provide the capability for registered users to submit bug reports specific to each DMA-hosted application into a threaded discussion viewable by other users.	3.7	UN3.5	UC2.6	
3.4.3	Application staging Subsystem				
3.4.3.1	The Application staging Subsystem shall provide the capability to host multiple open source applications during all phases of development	3.0	UN11.1	UC2.4, UC2.5, UC3.9	
3.4.3.2	The Application staging Subsystem shall provide the capability to track and control changes to hosted projects' source code.	3.5	UN2.1	UC3.4-UC3.8	
3.4.3.3	The Application Development Subsystem shall provide the capability to track and control changes to hosted projects' files such as documentation and web pages.	3.5	UN2.2	UC3.4-UC3.8	
3.4.3.4	The Application Development Subsystem shall provide the capability to save, version control, make searchable and share-able to authorized users, electronic documents and images of printed documents related to projects e.g., blueprints of street layouts or bridge structure designs.	3.5	UN2.4	UC3.4-UC3.8	
3.4.3.5	The Application Development Subsystem shall provide the capability to track and control changes to hosted projects' benchmark data and supporting metadata.	3.5		UC3.4-UC3.6	DOT
3.4.3.6	The Application Development Subsystem shall provide the capability for project members to create a custom home page for hosted applications through the use of a WYSIWYG editor.	3.2, 3.4	UN4.3	UC3.2	

SyRS ID	Description	SBS Elements	User Needs ID	Use Case ID	Req. Ref
3.4.3.7	The Application Development Subsystem shall provide the capability for Project Manager to assign defects associated with a hosted application to project members (Developer, Committer, Tester, and Reviewer).	3.8	UN5.1	UC2.6	
3.4.3.8	The Application Development Subsystem shall provide the capability for project members to track defects associated with a hosted application.	3.8	UN5.1	UC2.6	
3.4.3.9	The Application Development Subsystem shall provide the capability for project members to track issues associated with a hosted application.	3.8	UN5.2	UC2.6	
3.4.3.10	The Application Development Subsystem shall provide the capability to access hosted application data and files from any location with Internet access. Notes: The intention of this user need statement is to make clear that no special network location is required specifically as the source of access to reach the Application Development Subsystem. For some systems, users are required to access them from a particular originating network due to firewall and network access policies.	3.8, 5.2	UN11.2		
3.4.3.11	The Application Development Subsystem shall provide the capability to provide information about a hosted application in a Wiki format.		UN6.1		
3.4.3.12	The Application Development Subsystem shall provide the capability that requires contributors to include a user's guide for the shared application or source code.		UN6.8	UC3.3	
3.4.3.13	The Application Development Subsystem shall provide the capability to collect and display metadata describing the contents and context of a shared item such as purpose of the shared item, means of creation, time and date of creation, creator or author of shared item, and standards used.	3.5, 3.8	UN6.9	UC3.4	
3.4.3.14	The Application Development Subsystem shall provide the capability to fork a project or creating a similar project based on an existing one, with approval from Portal Manager.	1.2.5, 3.1, 3.5		UC4.10	
3.4.4	DMA OSADP system				
3.4.4.1	The System shall provide the capability for developers who use the shared item to provide updated information on its usage (e.g., name of project, role of the application in the project, etc.).	2.1, 3.7	UN12.6	UC2.6	
3.4.4.2	The System shall provide the Project Manager the capability to specify which open source agreement for releasing the open source applications into the ROSR.	3.5	UN1.9	UC3.8	
3.4.4.3	The System shall provide the capability for visitors to read FAQ (frequently asked questions) with answers.	1.1.1	UN9.4	UC3.3	
3.4.4.4	The System shall provide the capability for registered users to read description of applications in ROSR.	1.2.5		UC2.4, UC3.1	DOT

SyRS ID	Description	SBS Elements	User Needs ID	Use Case ID	Req. Ref
3.4.4.5	The System shall create and store application source code and associated files in zip archive format and make them available on ROSR.	1.2.5	UN7.4	UC2.4	
3.4.4.6	The System shall provide the capability to recognize and make attribution to application developers and contributors visibly on the application in the ROSR.	1.2.1, 1.2.5	UN10.1		
3.4.4.7	The System shall provide the capability to recognize and make attribution to contributors of core assets visibly on the asset items in the ROSR.	1.2.1, 1.2.5	UN10.2	UC4.5	
3.4.4.8	The System shall provide the capability to store metadata for a hosted application on the portal.	1.2.5	UN1.5	UC4.6,UC4.7	
3.4.4.9	The System shall provide the capability to assign privileges at a granular level to users.	4.1, 3.4	UN8.7	UC4.9, UC4.10	
3.5	System operations	-	-	-	-
3.5.1	System human factors (see section 3.3.1)	-	-	-	-
3.5.2	System maintainability	-	-	-	-
3.5.2.1	The System shall provide the capability to patch software defects and upgrade system functions of the Portal Subsystem.	4.3, 1.0	UN3.1		
3.5.2.2	The System shall provide the capability for System Administrator to perform website maintenance routines per portal manager's direction.	4.4	UN3.2	UC4.2	
3.5.2.3	The System shall provide the capability to back up the portal and all hosted applications on the portal to offsite server.	5.1, 5.2	UN7.1	UC4.6	
3.5.2.4	The System shall provide the capability for System Administrator, in case of content loss, to recover a version of backed up application source code and files to operating condition within 24 hours.	5.1, 5.2	UN7.5	UC4.7	
3.5.3	System reliability	-	-	-	-
3.5.3.1	The System shall maintain average of 99.9% uptime excluding scheduled downtime for maintenance.	5.0, 4.3, 5.2			IEEE
3.5.3.2	The System shall provide registered users the capability to submit technical issue or system bug report with detailed problem description and a severity level of 1-5, via a web browser interface.	3.7		UC2.6	DOT
3.5.3.3	The System shall not exceed 24 hours during a scheduled maintenance period.	4.3, 4.4			IEEE
3.6	Policy and regulation		-	-	
3.6.1.1	The user registration process shall require the registrant to agree to the terms and conditions set forth in the user agreement.	4.2, 4.4		UC1.3	DOT

SyRS ID	Description	SBS Elements	User Needs ID	Use Case ID	Req. Ref
3.6.1.2	The system shall provide the capability to invite registered members to join the application Staging environment.	4.1, 4.2, 3.0	UN1.8	UC3.9, UC4.2	
3.6.1.3	Users shall comply with the portal governance and operation policies.	1.2.6	UN1.8	UC4.2	
3.6.1.4	Systems, procedures, and all registered users shall comply with required standards for data privacy.	1.2.6		UC4.10	IEEE
3.6.1.5	Systems, procedures, and all registered users shall comply with required standards for data security.	1.2.6, 4.3	UN8.1, UN8.2, UN8.4	UC3.5	
3.6.1.6	Systems, procedures, and all registered users shall comply with required standards for quality.	3.1		UC3.5	IEEE
3.6.1.7	Systems, procedures, and all registered users shall comply with required standards for authorized access.	1.1.2, 1.1.3, 4.1	UN8.6, UN8.1, UN8.8	UC1.6, UC1.7, UC2.1	
3.6.1.8	Attribution to authors and co-authors of source code shall be shown visibly when possible, next to the person's contribution.	1.2.1	UN10.1, UN10.2	UC4.5	
3.6.1.9	The Portal Manager shall enter into a service level agreement (SLA) with the hosting service provider and other computing service providers to ensure prompt and high-quality services and support.	5.0			DOT
3.7	System life cycle sustainment	-	-	-	-
3.7.1	System operational statistics	-	-	-	-
3.7.1.1	The System shall provide the capability of collecting system statistics regarding usage, performance and user access.	4.4	UN13.13		
3.7.1.2	The System shall provide System Administrator the ability to review and analyze collected system statistics on usage, performance and user access.	4.4	UN13.13	UC4.7-UC4.10	
3.7.2	Maintenance routines				
3.7.2.1	System administrator shall be allowed to perform: Daily log review for security and system functionality issues; Daily user submitted reports and requests review; Daily review of system usage and analytic reports; Annual system review including reports of system capacities and functionality.	4.4	UN7.1-UN7.5, UN8.1-UN8.8	UC4.1-UC4.11	
3.7.2.2	System scheduled maintenance downtime notice shall be announced 15 days in advance to all users via email and on portal public news bulletin.	1.2.3, 4.4	UN3.1, UN8.9		
3.7.2.3	Emergency system shutdown shall be broadcasted to all users via email and on portal public news bulletin.	1.2.3, 4.4	UN8.9		

SyRS ID	Description	SBS Elements	User Needs ID	Use Case ID	Req. Ref
4	INTERFACE REQUIREMENTS	-	-	-	-
4.1	User interface	-	-	-	-
4.1.1	Web browsers	-	-	-	-
4.1.1.1	The DMA OSADP System shall support the following four most popular Internet browsers including Microsoft Internet Explorer, Mozilla Firefox, Safari, and Chrome, and shall stay compatible with at least the latest two versions of the browser releases.	1.0, 2.0, 3.0	UN13.8		
4.1.2	System Administrator access path		-	-	
4.1.2.1	The System shall provide System Administrator a special access path for accessing the back-end system instead of going through the typical user login page. This access path provides additional security protection.	4.1, 4.3, 4.4		UC4.1-UC4.11	
4.2	System interface	-	-	-	-
4.2.1	Developer's system connectivity	-	-	-	-
4.2.1.1	The System shall provide developers the ability to connect to the Application Development Environment via web browser.	3.0		UC3.1	IEEE

Appendix C. List of Acronyms

ASE	Application Staging Environment
ALM	Application Life-cycle Management
API	Application Programming Interface
CAPTCHA	Completely Automated Public Turing test to tell Computer and Humans Apart
COTS	Commercial-Off-the-Shelf
CMS	Content Management System
CPU	Central Processing Unit
CS	Community Subsystem
DDoS	Distributed Denial-of-Service Attack
DMA	Dynamic Mobility Applications
DOT	Department of Transportation
EC2	Elastic Compute Cloud
FAQ	Frequently Asked Questions
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
GB	Gigabytes
GHz	Giga Hertz
GSA	Government Service Administration
GUI	Graphical User Interface
HTML	Hyper Text Markup Language
HTTPS	Hyper Text Transfer Protocol Secure
IPS	Integrated Portal System or Portal System
IT	Information Technology
LDAP	Lightweight Directory Access Protocol
OSADP	Open Source Application Development Portal
PaaS	Platform-as-a-Service
PCI	Payment Card Industry
PM	Portal Manager
PS	Portal Subsystem
RAM	Random Access Memory
RITA	Research and Innovative Technology Administration
ROSR	Released Open Source Repository
RTM	Requirement Traceability Matrix
SA	System Administrator
SBS	System Breakdown Structure
SLA	Service Level Agreement
SOW	Statement of Work
SS	Security Subsystem
SSL	Secure Sockets Layer
SyRS	System Requirements Specifications
UN	User Need
USDOT	United States Department of Transportation
WYSIWYG	What You See Is What You Get editor

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