



AMBIENT ASSISTED LIVING, AAL

JOINT PROGRAMME

ICT-BASED SOLUTIONS FOR ADVANCEMENT OF OLDER PERSONS'
INDEPENDENCE AND PARTICIPATION IN THE "SELF-SERVE SOCIETY"

D3.2 System Architecture

Final Version

Project acronym: **ProMe**

Project full title: **ProMe – Professional Intergenerational Cooperation and Mentoring**

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TERMINOLOGY & ABBREVIATIONS

Nr. Crt.	Abbreviation	Definition
1.	API	Application Programming Interface
2.	CAPTCHA	"Completely Automated Public Turing test to tell Computers and Humans Apart")
3.	CMIS	Content Management Interoperability Services
4.	CMS	Content management system
5.	CSRF	Cross-Site Request Forgery
6.	CSS3	Cascading Style Sheets
7.	DMZ	Demilitarized zone
8.	DTS	Data Transformation Services
9.	HTML	HyperText Markup Language
10.	JSON	JavaScript Object Notation
11.	LDAP	Lightweight Directory Access Protocol
12.	REST	Representational state transfer
13.	SOA	Service Oriented Architecture
14.	SSO	Single Sign On Authentication
15.	WCAG	Web Content Accessibility Guidelines
16.	XSS	Cross-Site Scripting

1. EXECUTIVE SUMMARY

1.1 Link with the objectives of the project

The purpose of this deliverable is to model the technical architecture of the ProMe system, addressing topology, hardware and software requirements, standard of communication to be used, security protocols, and performance requirements. The functional architecture of the system is modeled based on functional system requirements assessed in D3.1 System Technical Requirements.

1.1.1 State of the art

The System Architecture is based on the technical requirements described in D3.1. The result of this deliverable is the “depiction” of the ProMe architecture.

1.2 Structure

The Deliverable is structured as follows: The first section illustrates the methodology, i.e., it is explained how the requirements in Deliverable 3.1 were used to drive and describe the system architecture. In Section 2 the categories of the Technical Requirements that have been collected and taken into consideration when defining the system architecture are presented. In Section 3 we provide a detailed description of the architecture of ProMe and finally in Section 4 the conclusions of the document are being given. This deliverable is part of WP3 of the project dealing with system architecture. Figure 1 demonstrates the role of the present deliverable within WP3. Furthermore, it illustrates the overall methodology adopted in relation to D3.1 deliverable.

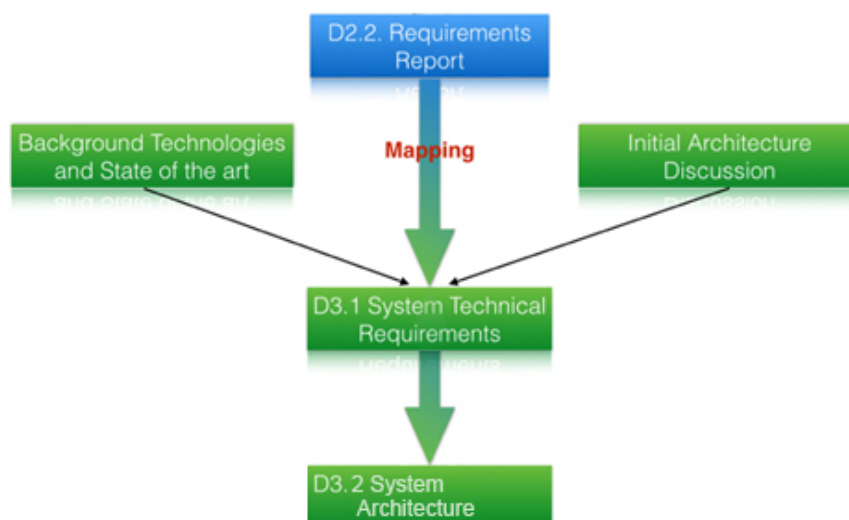


Figure 1: Mapping System Architecture

Deliverable 3.2 will serve as the main input for producing Deliverable 3.3. The later will illustrate a basic ProMe engine prototype description.

2. PROME TECHNICAL REQUIREMENTS

The ProMe architecture was designed by taking into consideration a series of constraints and requirements described in the previous deliverables (see D3.1). The technical solution ensures the following major functionalities:

- Real time easy access to information of interest
- Organization of events in a calendar with the possibility of synchronizing them with the ones of other users
- Chat
- Webinar sessions
- Extended configuration capacity
- Scalable, interoperable
- Advanced security solution
- Flexible and modular SOA architecture

2.1 Security related requirements

- Users have access to different tools of the portal after the authentication and after the authorization for each tool was validated
- The ProMe platform will reduce any known risk related to filling in the forms in the portal.
- The forms from the ProMe platform will use a CAPTCHA or similar type of mechanism to avoid spam or automatic records.
- The recommendation system will also offer additional protection from malicious users or spammers

The ProMe platform will include preventions against the following threats related to web-sites:

- Injection
- Cross-Site Scripting (XSS)
- Broken Authentication and Session Management
- Insecure Direct Object References
- Cross-Site Request Forgery (CSRF)
- Security Misconfiguration
- Insecure Cryptographic Storage
- Failure to Restrict URL Access
- Insufficient Transport Layer Protection
- Invalidated Redirects and Forwards
- Search box cross scripting: search forms will not allow queries containing a form of programming language (jss, xml, sql, sparql, etc.)
- ProMe platform has to ensure confidentiality of the users' personal data.
- ProMe platform has to ensure data integrity.

2.2 Availability related requirements

The system's availability has to be of at least 99%, 24h/24h, 7d/7d, irrespective of other applications' performance.

2.3 Performance related requirements

- ProMe has to operate under normal conditions ensuring the traffic requirements for:
 - 4 million visits or 12 million page views throughout a year.
 - Up to 300 concurrent requests.
 - Up to 60 concurrent users for video conferences
- The response time of a static page shall not exceed one second
- The page load time for the results of search based on indexing mechanisms of the database shall not exceed 2 seconds

2.4 Accessibility related requirements

- The ProMe portal has to be compliant with the Web Content Accessibility Guidelines (WCAG) 2.0 Level AA

2.5 Reliability related requirements

- The ProMe platform will be designed so that any error should not generate irreversible loss of data.
- The ProMe platform will have an available error management mechanism.

3. PROME ARCHITECTURE

3.1. Methodology

The methodology used to describe the technical solution’s architecture, the technologies and tools to be used are based on Agile principles.

- The System architecture was approached through: Use-cases
- Logical dimension
- Implementation dimension
- Installation dimension

3.2 Use-cases

3.2.1 Actors

The ProMe actors are users with different roles on the platform, i.e., portal users and registered users.

Portal users

- Guest /Anonymous users may access public sections of the portal without prior authentication, i.e., the homepage with the following information: success stories and details about the project.
- Registered users are users, who provide their credentials when accessing the portal page. They may access restricted content and may use the tools available on the ProMe platform considering each one’s role: There are three types of registered users, i.e., users, who act as providers, users who act as receivers and administrators. Moreover, users can take over different roles on the platform, i.e., Mentors/Mentees and Advisory/Advisee (see Table 1).

Provider	Receiver
Mentor	Mentee
Advisor	Advisee

Table 1: Roles on the platform

Registered users

- **Provider:** Everyone who is willing to share professional knowledge and/or personal experience acts as a provider on the platform. According to its previous professional experience this type of user takes over (a) suitable role(s), i.e., mentor (long term support), advisor (short term support). In order to find an appropriate user, the recommendation system (see section 13) matches users according to their expertise (mentor) and needs (mentee) and personal preferences. Moreover, the mutual agreement tool supports provider and receiver to figure out if they actually “fit together” and facilitates and supports them to talk about their obligations and expectations.

- **Receiver:** Everyone who is seeking for support from an experienced person acts as a “receiver” on the platform. According to personal needs the user can make use of long term support (mentee) or short term support (advisee).
- **Administrators:** Users administering the system

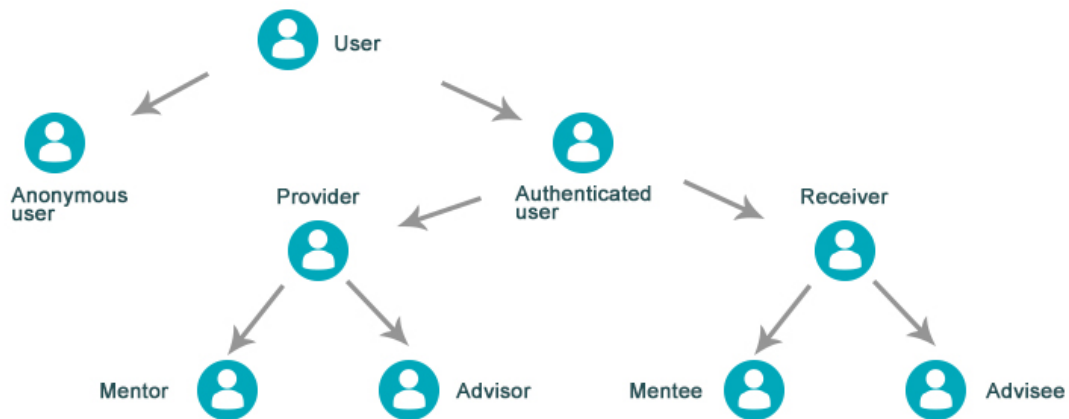


Figure 2. ProMe platform users

The access to the platform’s private area is managed by associating specific roles to users. A user may have several roles associated in the portal. The roles and the permissions of users are managed by the ProMe administrators. The rights and settings associated to a user are elements that describe its profile on the platform.

3.2.2 Use-cases

ID	Name	Description	Pre-requisites
UC-001	Search in portal	The user may search and navigate through all portal’s pages. The types of search available are full-text and based on metadata. The results are displayed as links.	<ul style="list-style-type: none"> – The front-end layer will provide the elements allowing search and advanced search. – Integration services will ensure correct interrogation of the search server. – A service to transform the response received from the search server.
UC-002	Single Sign On (SSO) Authentication	SSO allows user to enter the same id and password to logon to different applications	<ul style="list-style-type: none"> – Frontend services will provide Single Sign On authentication Management of users who connect on the platform – Server client response for authentication

UC-003	Posting content	One user may add comments to the posts on the forum or blog, may add posts on the forum or blog, or may upload other educational materials.	<ul style="list-style-type: none"> - Front-end services will expose functionalities for content posting (adding comments, adding posts on the forum/blog, upload of educational materials). - Cron1 services ensure correct display of the newly added content.
UC-004	Creating an account	An anonymous user may create an account on the platform and thus, becoming a registered user	<ul style="list-style-type: none"> - Frontend services exposes functionalities for creating an account - User management services will assign the data to the newly created user - Notification services shall send the user a notification regarding the account's creation and activation - Cron services will delete the users were not activated in period of time determined by administrator .
UC-005	Calendar of events	Users can plan an event and may invite others to join	<ul style="list-style-type: none"> - Front end services expose functionalities for event planning and for inviting other users to participate in the event. - Notification services sends a notification to users considering the newly created event
UC-006	Alerts	A user may subscribe in order to receive notifications	<ul style="list-style-type: none"> - Frontend services exposes functionalities for subscribing to notifications /alerts to users - The notifications services sends notifications /alerts to affected users regarding the events they are interested in.
UC-007	Video-conference	Users may interact via audio and/or video means	<ul style="list-style-type: none"> - The portal exposes the specific functionalities to the webinar module (video-conference, chat, whiteboard) <ul style="list-style-type: none"> • Services for video streaming ensure the transmission of the information flow based on communication protocols.
UC-008	Management of web pages		<ul style="list-style-type: none"> - Frontend services expose the functionality for web pages' management - Workflow services publish only approved content - Services for content management are CMIS compatible.
UC-009	Evaluation tests	Users may create opinion assessment / poll tests for other users	<ul style="list-style-type: none"> - Frontend services s expose the functionality of creating opinion assessment / poll tests - Notification services send a notification to affected users regarding the newly created test
UC-010	Managing the	User settings are stored and	<ul style="list-style-type: none"> - Frontend services expose the functionality for consulting/modifying profile associated

¹ [Cron \(crond\) daemon or service](#) is use to execute scheduled commands or scripts. Cron wakes up every minute, examining all stored crontabs, checking each command to see if it should be run in the current minute.

	user profiles	are available for administrator role	data – Service of active backend that ensures the data persistence and return of the data associated to the profile
UC-011	Maintaining the elements processed in cache		– A service that automatically cache common queries in memory to substantially lower latency. – A service that will regenerate the cache after a certain amount of time.

3.3 Logical dimension

ProMe provides users with a unique way to communicate and exchange learning materials. The following figure illustrates the architecture based on the logical levels of ProMe platform.

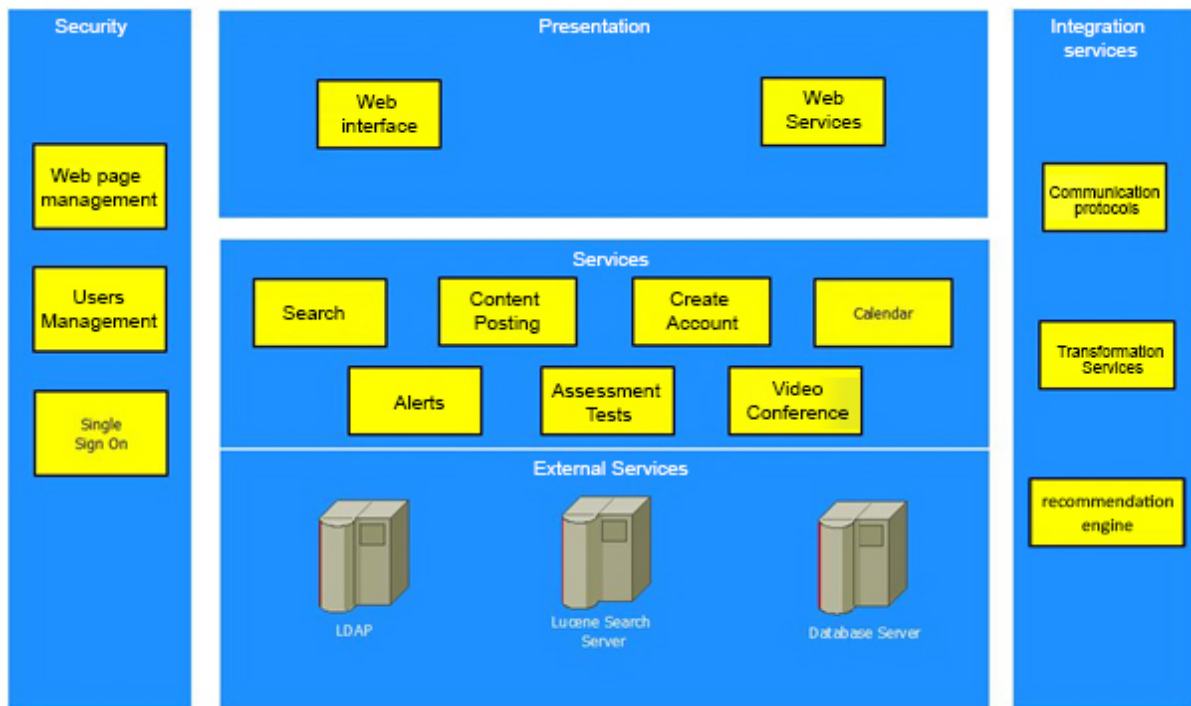


Figure 3. Levels of architecture

The **presentation level** reveals the components needed in the ProMe platform order provide services to users. The two components represent the graphic interface used by users to access the portal, and portal information that allows external systems to access the ProMe services.

The graphic interface is based on new technologies such as HTML5 or CSS3. The inheritance elements are also provided for compatibility with the browsers not supporting HTML5 or CSS3.

The users may access the ProMe platform using the following browsers, without installing plug-ins:

- Internet Explorer version 9.0 and subsequent.

- Firefox version 10 and subsequent.
- Safari version 5.1 and subsequent.
- Chrome 17.0 and subsequent.
- Opera 11.0 and subsequent.

For mobile devices, ProMe platform is available using any browser with significant market share:

- Safari Mobile iOS 4.2 and subsequent.
- Android Browser 3.1 and subsequent.
- Blackberry Browser 5.0 and subsequent.
- Opera Mini 4.2 and subsequent.
- Internet Explorer 9.0 for mobile on Windows Phone 7.5 and subsequent.
- Chrome 17.0 and subsequent.

Web services are exposed using REST.

The service level includes services for implementation of the business flow, in accordance with correspondent specifications. These services are used by the integration and presentation services to provide the functionalities corresponding to end-users.

- **Search in portal:** The user may search and navigate through all portals' pages. The types of search available are full-text and based on metadata. The results are displayed as links.
- **Posting content:** Users may add comments to the posts on the forum or blog, may add posts on the forum or blog, or may upload other educational materials.
- **Creating an account:** An anonymous user may create an account on the platform and thus, becoming a registered user
- **Calendar of events:** Users can plan an event and may invite others to join
- **Alerts:** Users may subscribe in order to receive notifications
- **Video- conference:** Users may interact via audio and/or video means one-to-one or one-to-many communication. The solution chosen for the ProME platform is Big Blue Button. It meets the needs identified in heuristic evaluations.
- **Evaluation tests:** Users may take some evaluation tests on the platform
- **External services** include applications through which ProMe will provide specific services to external users.
- **Web interface:** Web interface represents the interaction between a user and software running on a Web server. The user interface is the Web browser and the Web page it downloaded and rendered.
- **Web services:** A software system is designed to support interoperable machine-to-machine interaction :via a network. (Ex: FaceBook API, GoogleMap Api)

Integration services include additional services necessary to the ProMe platform in order to interact with external services. These integration services include APIs and third party services that provide communication between the platform and the external systems.

- **Communications protocol:** Communicating systems use well-defined formats (protocol) for exchanging messages. Each message has an exact meaning intended to elicit a response from a range of possible responses pre-determined for that particular situation.
- **Transformation services:** Data Transformation Services, or DTS, is a set of objects and utilities to allow the automation of extract transform and load operations to or from a database. The objects are DTS packages and their components, and the utilities are called DTS tools.
- **Level of security:** taking into account that users authentication is also ensured at of external services level, the platform's security solution may endure potential exposures due to access of previously mentioned users.
- **Management of web pages:** Admins of the portal can manage web page content with CMS specific functions
- **Single Sign On (SSO):** SSO allows user to enter the same id and password to logon to different applications
- **Users profile management:** Admins can enable or disable a user account.

3.4 Recommendation Systems in ProMe core engine

We will develop a recommendation system technology using trust, similarity, and reputations for online communities. The recommendation system could be either a stand-alone software component that can be parameterized to be integrated into an existent online platform or can be built on, on a new platform. Trust, similarity, and reputation are three basic ingredients for more accurate recommendations in online communities. Trust of a user indicates his trustworthiness, similarity between two users indicates their proximity, and reputation of a user indicates the opinion of the other users about that user. By using these three components, we provide recommendations on products that user might be interested in, e.g., users can provide to other users mentorship on specific subjects, etc. Trust, similarity and reputation answer on the following questions: What is the validity of a user that provides a review? Is this user similar with you? How well is he reputed on the online community?

ProMe offers reliable recommendations to users by handling the information overload in online communities, and protects them from spamming, malicious users and misreporting. This is being achieved by using in house implemented algorithms for Internet data crawling, Internet data analysis, user behaviour analysis and algorithms for recommendations/predictions. The basic functionality of ProMe recommendation engine is presented in Figure 4. A user asks for recommendations through a query, which passes to the recommender system. Using past user interactions, the recommender system computes the three basic components: their trust, similarity and reputation. Using those components, ProMe returns to the end user a set with the computed recommendations.

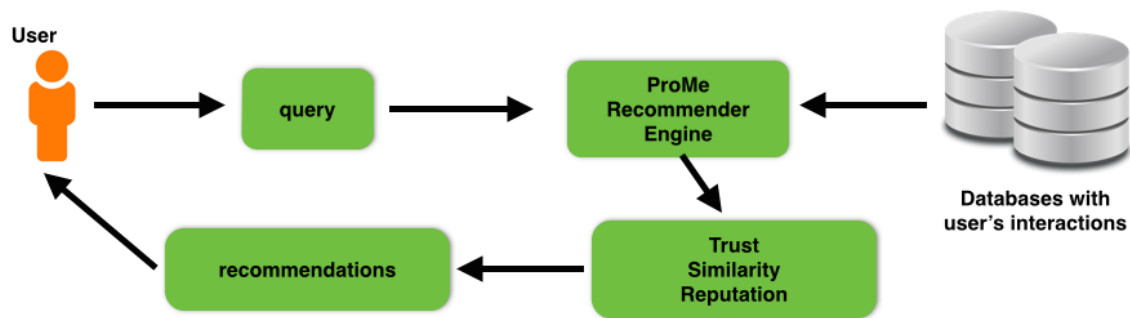


Figure 4. Functional Architecture of ProME recommendation engine

The ProMe recommendation engine is based on the community structure. A community is represented as a graph where users and items are the nodes and their relationships are the edges. The edges can be weighted and have several features e.g. time of creation, number of interactions with other nodes, etc.

The method of ProMe is “walking” across the edges of the graph. The length of a walk between two nodes represents the level of their trust. When there is no path between two nodes, our recommendations are based on reputations. The model is represented in Figure 5, where we present several walks between two nodes, node i and j.

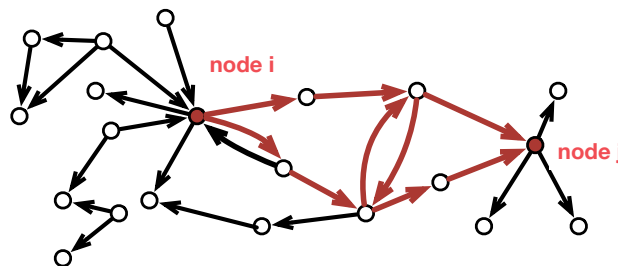


Figure 5: The model of ProME recommendation engine

The competitive advantages of this principle are that it:

1. is lightweight and scalable due to the lower complexity of the algorithm. Exploiting the proximity of similar and trustworthy users, this technique performs short walks on the graph.
2. effectively faces scarcity problems while classical approaches for recommendation systems, such as collaborative filtering, cannot scale or deal with scarcity.
3. is flexible to include several features on the edges of the graph. We develop our system designing extendable and adaptable components.

3.5 Implementation dimension

The approach regarding implementation refers to the logical architecture and describes the process of communication between components and their mode of installation.

3.5.1 Implementation of logical levels

The level of presentation is based on the HTML5 standard, as well as JavaScript, XML and CSS. Alternatively, the HTML4 graphic components are included in order not to affect the experience of users using browsers that do not support HTML5 standard.

The level of services and the level of integration are implemented using appropriate interfaces and patterns, so that a controllable approach should exist for handling the requests for service, identifying the context and accessing the appropriate service. The business logic is implemented using Drupal 7 CMS. The implementation of services is based on Agile methodology ensures loose coupling between services and reusable components.

The level of external services embeds data connections and provides a data overview. Data transfer is achieved by using specific communication standards (REST with JSON data format).

3.6 Installation dimension

This chapter presents how the components are installed and communicate with each other.

3.6.1 Installation Diagram

The installation of ProMe solution assumes the communication between different components:

- **External area (Internet)** – contains the body of information conveyed for external users or systems accessing the portal.
- **Internal area** – contains the restricted area, including the authentication service, the server for the portal, the server for video-conference, the server for indexing and search as well as the database. In the internal area we notice:
 - DMZ (demilitarized zone) which acts as a barrier for external users and represents the first line of defense through firewall and reverse proxy
 - Intranet area – the most secured network, accessible only for internal users.

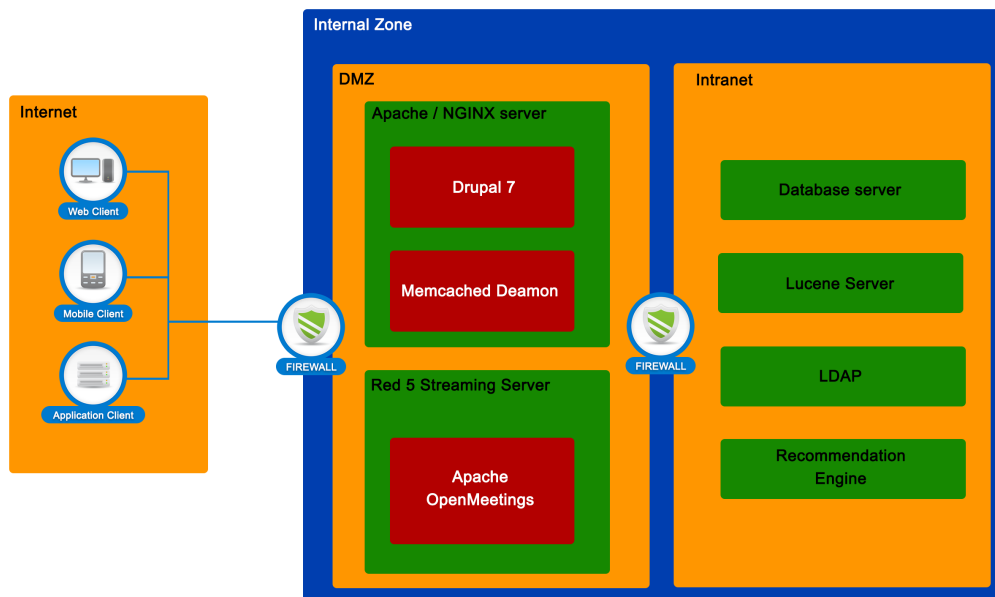


Figure 6. ProMe – Installation diagram

Short description of the diagram:

- **Web client** – a standard browser used to access the portal via graphic interface
- **Mobile client** - s a browser for mobile devices used to access the portal via graphic interface
- **Application client** – clients that access ProMe web services
- **Application Server Apache** – web server
- **Drupal 7** – powered by PHP 5.3 or higher.
- **Memcached Daemon** – demon for cache used by Drupal 7
- **Streaming Server** – Streaming application server that hosts BigBlueButton web-conferencing software
- **Big Blue Button** – makes the video conference available for users.
- **Database server** – used to store the data from entities.
- **Lucene server or similar** – used for indexing and searching the content in the platform.
- **LDAP or equivalent** – used for single sign on

4. CONCLUSION

This deliverable has described the architecture of the ProMe platform, addressing topology, hardware and software requirements, standard of communication to be used, security protocols, and performance requirements. This has been modeled based on functional system requirements assessed in D3.1 (System Technical Requirements) and provides an important step towards the basic ProMe (D3.3) and in particular towards the GUI design and development.