Social Software Integration: How We Made Social Software Services Accessible

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1 Executive Summary

For supplying elderly people with an activity and content feed that offers information on what is happening in their community and local environment, an information and communication infrastructure has to be provided that integrates Social Networking Services (SNS) including Social Networks, photo sharing sites, address book services, personal blogs, web feeds and mailing lists. In this section, we present our approach to integrating existing SNS and facilitating social interaction for the elderly.

2 Main Results

In the AAL project SI-Screen/Elisa, our core goal was to support social interaction by making services from the Social Web available to the elderly. As part of the Social Web, Social Network sites (e.g. Facebook™, Google+™ etc.) and photo sharing communities (e.g. Flickr™, Picasa™, etc.) are web-based platforms for building online communities by establishing social ties between individuals (Boyd and Ellison 2007). In the following, we use the broader term Social Networking Services (SNS) to also consider Web 2.0 websites like blogs or wikis that enable individuals to publish and share content as well as interact with each other.

Figure 1 shows the current state of how tablet devices like the Apple iPad™ or Android™ tablet computers can be used to participate in the Social Web. Third party companies develop so-called rich client applications (apps) that handle the access to SNS in the Web. The advantage of this approach is that missing software components and functionalities can be added over time. The drawback of this

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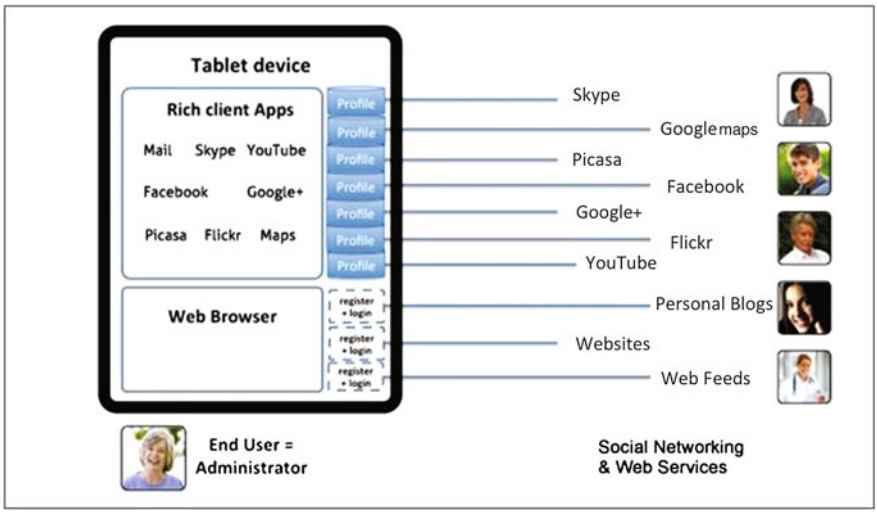

Fig. 1 Current state of tablet computer—for every SNS, a separate rich client app exists. Photos licensed by Fotolia

solution is that every app has its own non-consistent graphical layout and for access to most services the end user has to register and login separately to access each service. Apart from that, a web browser can be used to access services—again with inconsistent user interfaces and separate user accounts.

Eventually, an elderly user would have to take over the administrative tasks like registering user accounts as well as installing and updating applications on their own. In our focus group sessions we found out that elderly people hesitate to create an account to participate in online communities of SNS (Burkhard and Koch 2012). These findings are also supported by (Brucks and Reckin 2012), pointing out that apps on existing tablet devices are too difficult to be understood and used by elderly users. Moreover, currently users of one online community are not able to easily participate in the community of another web platform (Burkhard and Koch 2012).

The main result of this part of the project is giving elderly people universal access to SNS without the need to deal with the underlying technical details. For this purpose, we introduced the Social Software Integration Layer (SSIL, Fig. 2) that uses CommunityMashup (Lachenmaier et al. 2012) to provide every elderly Elisa user with a combined information stream of consolidated contact profiles and aggregated activity and content streams originating from different SNS platforms (see Sect. 4). The advantage of a combined information stream for the elderly users is that instead of maintaining several dispersed online communities, the single information stream will give them the impression of taking part in only one homogeneous community (Burkhard and Koch 2012). And due to a consistent layout of the Elisa frontend, the various information sources will remain hidden to the (elderly) users (Nutsi et al. 2013). In addition to the already existing

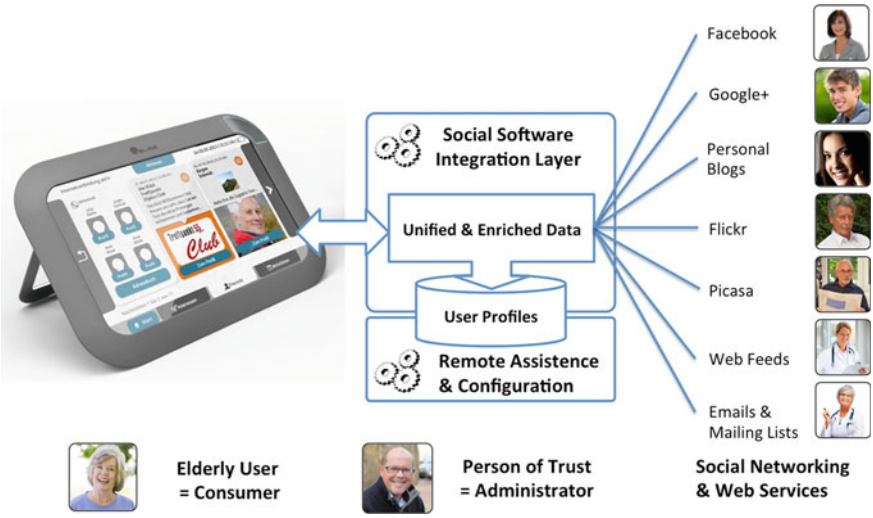

Fig. 2 Elisa—the Social Software Integration Layer provides elderly Elisa users with universal access to SNS. Photos licensed by Fotolia

CommunityMashup adaptors for Facebook and email servers, we also added support for the integration of different sources for contacts, images, events and blogs.

Within the scope of the SI-Screen/Elisa project, we created two web applications to relieve the Elisa users from administrative tasks such as account registration or social network management required by every SNS: The Profile Admin User Interface (Profile Admin UI, see Fig. 5) that enables the delegation of administrative tasks to a person of trust; and the Channel User Interface (Channel UI) that provides an interface for friends and family contacts of the elderly Elisa users to proactively give access to their activity and content streams.

3 Storyline

Social Networking Services (SNS) like Facebook, Google+ and Flickr serve as platforms for fostering social networks with relatives and friends or for establishing social relationships with new people online. In the last years, people worldwide started sharing their real-life activities and feelings via status messages and photos, finding like-minded people and learning about events in the vicinity. Elderly people, however, are still often excluded from these interactions as they face several technical barriers.

The first obstacle of becoming a member of an online community is the mandatory registration process that usually requires an existing email account and a memorable password. This registration is often followed by the set-up of a personal profile by providing personal information like date of birth, gender, location, as well as personal information on family and friends.

Another obstacle is the missing interconnectivity of SNS platforms. While members of online communities form connected groups within one SNS platform, they are unable to connect and communicate with online communities on other SNS platforms. Thus, the same registration process and the continuous management of one's identity and personal network have to be performed for every SNS all over again. This administrative overhead is not just a burden for elderly people with low technical affinity, but also outweighs the unacquainted benefits.

Another aspect is the growing concern regarding privacy in SNS. Elderly people are well aware of ongoing debates in media about privacy and security issues in social networks (see the paragraph on "Data privacy and information security"). This often discourages them from registering at SNS. Consequently, avoiding a direct registration in SNS and gaining and keeping the elderlies' trust by protecting their personal data is key to the success of the Elisa product.

In summary, elderly people could profit from the advantages of SNS by overcoming the barriers outlined. As a result of the SI-Screen/Elisa project, our contribution regarding this issue was to make SNS more accessible for elderly people by abstracting from the underlying technology and delegating administrative tasks to a person of trust. As a consequence, the Elisa users do not even have to register and maintain a profile to take part in existing online communities. How this is achieved is explained in more detail in the following paragraphs.

Technological challenges

Throughout the project, we faced the technological challenge of integrating activity and content streams from heterogeneous SNS, which usually have proprietary data structures, vary in authentication and authorization methods, and offer Web application programming interfaces (Web APIs, see Sect. 4) that change over time. So instead of integrating SNS directly into the Elisa tablet client software, we opted for a distributed client server approach which has the advantage that the integration of new SNS or changes in existing SNS APIs only result in server-side adaptions, while the Elisa tablet client remains unaffected. In other words, elderly Elisa users benefit from new content and SNS support without having to update their tablet devices.

Social Software Integration Layer

Our solution for the server-side part of Elisa was the Social Software Integration Layer (SSIL). For building the SSIL, we had to find a scalable middleware solution that is capable of aggregating user profiles and combining activity and content streams from several sources, thus producing personalized results (mashups). Ideally, the SSIL should synchronize data with SNS and other non-social third-party web services using pluggable components allowing on-the-fly adaptions without maintenance shut-downs. Moreover, the SSIL solution has to support filtering operations and do secure synchronization with mobile devices.

The analysis of existing solutions for the implementation of the SSIL and the possibilities for integrating semi-structured information residing on web sites can be found in the Scientific Excursion (Sect. 4). The Social Software Integration Layer (SSIL) is software that runs on a server computer on the Internet. The server

Table 1 External Social Networking Services (SNS) integrated by the Social Software Integration Layer (SSIL)

Service	Integration contents	Service type
Google Contacts	Profile data (name, e-mail, address, photo, Skype-account)	Contacts service
Facebook	Profile data (name, e-mail, photo), status messages (text, photo)	Social community service
Google+	Profile data (name, e-mail, photo), status messages (text, photo)	Social community service
Google Picasa	Images	Image service
Yahoo! Flickr	Images	Image service
Elisa Magazine	Text, images, categories, tags	Syndicate feed
Event web sites (RSS)	Text, images, start, end, location	Syndicate feed
Personal blogs	Text, images	Blog service/syndicate feed
Mailing lists	Text, images	Email service

enables end user software on mobile devices to access several SNS and other data sources in a unified way. For this purpose, the SSIL unifies the profile data, activity streams (status updates) and content streams (comments, recommendations, photos) of existing SNS (Facebook, Google+), social content sharing platforms (Flickr, Picasa), contact management (Google Contacts™) as well as web feeds (events, articles), mailing lists and personal blogs. The complete list of services integrated in the Elisa prototype with some more details is shown in Table 1.

Figure 3 shows that the SSIL serves several users at once but still maintains strictly separate instances for every user. The SSIL does not have a particular user interface. Instead, the SSIL provides end user applications on mobile devices with a secure, unified bi-directional access to unified and enriched data via an application programming interface. To this end, the SSIL uses an individual configuration for each Elisa user containing user account information and authorization information for access to the activity and content streams of integrated SNS. The set-up of new user account profiles can be managed by a system administrator using the MashupConfigurator, as can be seen in Fig. 4. As part of the SSIL, the Profile Admin UI (Fig. 5) offers a remote support web interface which enables a person of trust (e.g. a family member or friend) to assist in case of problems or take over the administrative tasks from the elderly user. These administrative tasks include the management of the user's profile, personal contacts and device settings:

- Start: overview of opened and closed help requests.
- Elisa User Management: Adapt contact details of the Elisa user like address, telephone and hobbies.
- Contact Management: Add or edit contacts and assign them to contact groups.
- Settings: Adjust tablet-specific settings remotely.
- Filter Categories: Modify user's interests by remotely filtering content of the "interests" and "activities" sections.
- Password Management: Reset the password of an Elisa user.

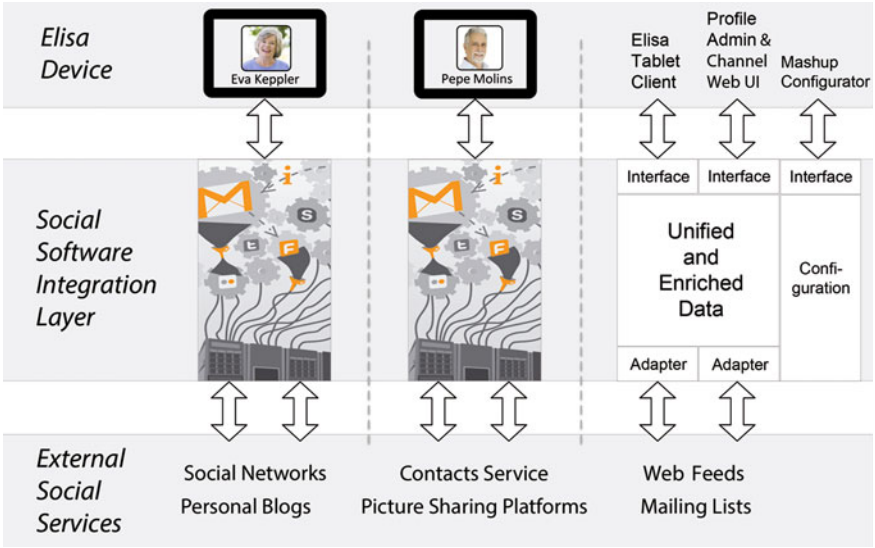

Fig. 3 Elisa Architecture—Elisa tablets, the Social Software Integration Layer and external SNS integration. Image based on Lachenmaier et al. (2012). Photos licensed by Fotolia

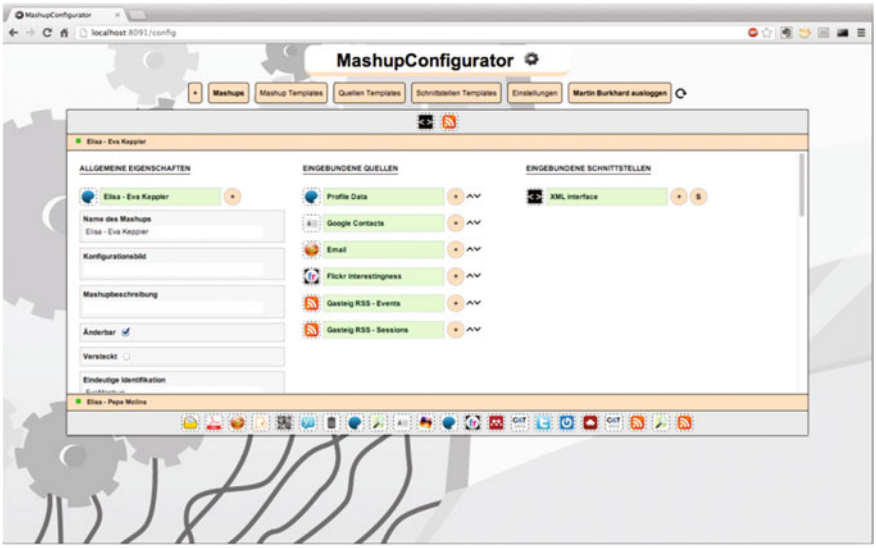

Fig. 4 MashupConfigurator—Managing the SNS source components for every user

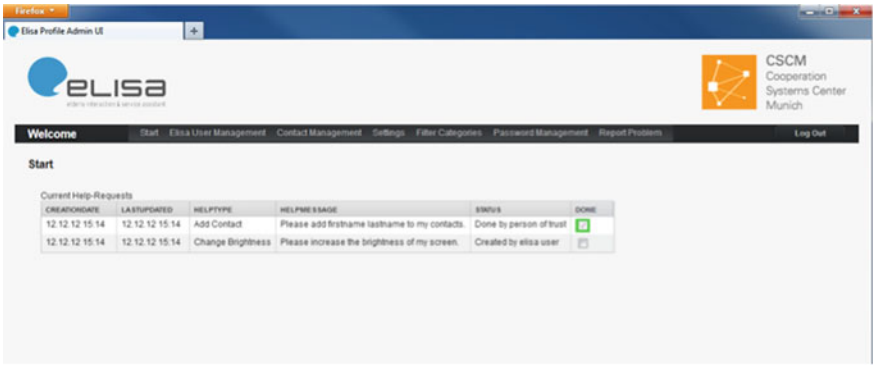

Fig. 5 Elisa Profile Admin UI—Menu and overview listing help requests

Moreover, the person of trust can use the Profile Admin UI to invite family members and friends to authorize Elisa users to access their personal Facebook, Google+, Flickr and/or Picasa activity and content streams. As part of this invitation, the email contact receives a personalized link to the Elisa Channel UI web interface and a one-time password. Subsequently, the invitee uses his or her email address and the one-time password to log into the Channel UI forcing them to select a personal password after their first authentication.

After the successful login, the main screen of the Elisa Channel UI provides an overview of supported SNS channels from which the invitees can select the channels they would like to share with a single Elisa user. Selecting a SNS channel starts an authorization process, during which the invitee authenticates and approves the SNS access. This authorization is valid for a given amount of time depending on the SNS. At any time, the invitee can log in again and either withdraw previous authorization or grant access to additional channels.

In the end, the Elisa user has access to all authorized activity and content streams without being a member of the underlying SNS. Moreover, the SSIL ensures bi-directional communication between the mobile tablet client and the external service (see Figs. 3, 8 and 9).

Backend filtering

Combining activity and content feeds from (highly) active online communities and information services results in an increasing amount of information delivered to the Elisa user. In order to prevent the risk of information overload (Hiltz and Turoff 1985) and considering the limited bandwidth of mobile clients, the SSIL provides filtering mechanisms controlling what content is processed from external SNS and what information is forwarded to the user.

On the one hand, the MashupConfigurator allows system administrators to configure the frequency, kind and amount of information collected from various external SNS sources. On the other hand, the Elisa client can pass combinable filter criteria to the synchronization point (REST interface, see Lachenmaier et al. 2011, 2012) to narrow down the search results.

For example, during the field test, the email adapter checked for new messages every five minutes. The messages were then checked by a spam filter before their contents were aggregated and forwarded to the tablet client. The address book was synchronized with Google Contacts every 15 min. Due to our limited amount of articles for the field test, every day up to three articles from the Elisa magazine and up to three activities were shown to the elderly user. Each article and activity was assigned to one out of five categories. These categories serve as selectable filter criteria for the elderly user in the Elisa frontend enabling adjustment of the information provided according to their personal interests.

For the Elisa product, an increase in amount of articles and information from SNS is to be expected. To accept this challenge our intention is to combine the individual selected filter criteria and browsing behavior to derive a filtering profile for information filtering (Belkin and Croft 1992). This filtering profile is collected in the Elisa client device and transferred to the SSIL to prioritize and filter content of integrated information streams of external SNS. For this purpose we looked into recommender systems (Resnick and Varian 1997) and ranking algorithms (Koroleva and Bolufé Röhler 2012) currently used by Social Network sites.

Data privacy and information security

Processing personal data requires compliance with data privacy laws and regulations of Germany and Spain in which the Elisa clients are located and the SSIL server is hosted. Accordingly, the European Data Protection Directives (95/46/EC,[1] 2002/58/EC3,[2] 2006/25/EC[3]), the German Federal Data Protection Act and the Telecommunications Act, as well as the Spanish Royal Decree 1720/2007 apply.

Against this background, the Organization for Economic Co-operation and Development (OECD) defined the "Basic Principles of National Application".[4] In the following we summarize the main aspects:

- Collection Limitation Principle: The amount of collected data should be limited.
- Data Quality Principle: Personal data should be relevant, necessary, accurate and complete.
- Purpose Specification Principle: The purpose of the collected data should be specified.
- Use Limitation Principle: Personal data should not be disclosed or made available.

[1] European Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and on the free movement of such data.

[2] European Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications).

[3] European Directive 2006/24/EC on the retention of data generated or processed in connection with the provision of publicly available electronic communications services or of public communications networks and amending.

[4] OECD—Basic Principles of National Application. Available: http://www.oecd.org/internet/ieconomy/oecdguidelinesontheprotectionofprivacyandtransborderflowsofpersonaldata.htm.

- Security Safeguards Principle: Personal data should be protected by security measurements.
- Openness Principle: general policy of openness with respect to the existence and nature of personal data, the purpose of their use and the identity of the data controller.
- Individual Participation Principle: the right of individuals to get confirmation in time if the data controller has data related to them and to have data erased, rectified, completed or amended.
- Accountability Principle: The data controller should be accountable for complying with data privacy measures.

Following the collection limitation principle, the SSIL server only stores authentication information required to access the personal email account and external SNS of the Elisa user in the CommunityMashup configuration file. In addition, we store the email address, a hashed password and SNS authentication information for the person of trust and every invitee. Personal data collected from the email server and external SNS is processed but not stored on the server's hard disk.

In the SI-Screen/Elisa project, we use a combination of information security measurements in compliance with the Security Safeguards principle to protect personal data against unauthorized disclosure or access:

- For every Elisa user we run a strictly separated SSIL server instance and offer individual Profile Admin and Channel UI web sites (Fig. 3).
- Communication between the Elisa tablet client and the SSIL backend is protected by the HTTPS protocol for secure communication.
- OAuth 2.0 authentication and authorization infrastructure ensures that only Elisa users have access to their personal synchronization endpoint.
- At the operating system level, we rely on secure hosting services (e.g. encryption, firewall) of the hosting Internet service provider.

4 Scientific Excursion

In the next sections, we present the web application programming interfaces (Web APIs) and content aggregation technologies we analyzed for the design of the Social Software Integration Layer (SSIL) and the types of data sources we integrated.

Web APIs

A prerequisite for integrating external Social Networking Services (SNS) is that SNS providers allow third-party developers to use their web-based services by offering a machine-to-machine communication interface, also known as Web API. A Web API specifies how the server processes requests and responses as well as the structure of the data exchanged during communication.

Table 2 Selected Web APIs for common social services including their authentication models, protocols and data interchange formats

Web API	Authentication/authorization models	Communication protocols	Data interchange formats
Facebook Graph API	OAuth 2.0, OpenID	REST	JSON
Google Contacts API	AuthSub, ClientLogin, OpenID, OAuth, (OAuth2.0[a])	GData, Atom	GData, Atom, JSON
Google Plus API	AuthSub, ClientLogin, OpenID, OAuth, (OAuth2.0[a])	GData, Atom	GData, Atom, JSON
Google Picasa API	AuthSub, ClientLogin, OpenID, OAuth, (OAuth2.0[a])	GData, Atom	GData, Atom, JSON
Wordpress API	OAuth 2.0	REST, XML-RPC	XML, JSON
Yahoo! Flickr API	API key, OpenID, BBAuth, OAuth	REST, SOAP, XML-RPC	XML, JSON

[a] Experimental implementation

Today, an increasing number of SNS platforms provide a publicly available Web API. However, due to missing standards these Web APIs differ in extensiveness and quality. As a consequence, we had to analyze existing Web APIs against end-user requirements. Table 2 presents the examined Web APIs of supported SNS and gives an overview of the common authentication and authorization methods, the communication protocols and the formats used for data interchange. For implementation, we preferred the most common OAuth 2.0 authentication standard in combination with Representational State Transfer (REST) communication protocol and the data interchange format JavaScript Object Notation (JSON).

Content aggregation technologies

To realize the SSIL, we analyzed existing aggregation technologies, including available mashup services with regard to their matching of the requirements of Elisa. Table 3 lists the examined content aggregation technologies for mash-up solutions supporting the integration of external web services or feeds. The applied categorization is based on the classification model by Hoyer and Fischer (2008). Let's have a look at them.

Yahoo! Pipes™ service is a visual web tool that enables the combination of heterogeneous web services into a mash-up solution. Web resources, e.g. web feeds, are added as data source components which are linked by "pipes" for data aggregation and manipulation, see also Fig. 6. The data processing wiring by "pipes" is comparable to the UNIX shell pipeline concept. In principle Yahoo! Pipes could serve as solution for realizing the SSIL. However, this service leaves no control of where and how the private data would be processed by its servers. Most probably the location of the servers is outside of the European Union.

Yahoo! Dapper™ is a Software-as-a-Service (SaaS) tool for generating dynamic web feeds (e.g. RSS, Atom, JSON, XML, iCal). Dapper allows the extraction of dynamic content from any web site to be used as dynamic feed, see also Fig. 7.

Table 3 List of analyzed content aggregation technologies for Elisa backend service integration

Aggregator	Functionality/property	Target group	Features	Platform
ARIS MeshZone™	Presentation, adapter	Enterprise	Charts and diagrams based on Excel, CSV, XML data	Local web application
CommunityMashup	Transformation/aggregation, adapter	Consumer/ Enterprise	Middleware, person-centric data aggregation	Equinox (OSGi) solution, EMF editor
IBM Mashup Center™	Adapter, repository	Enterprise	Integrates with Infosphere and Lotus Notes	Local web application
JackBe Presto™	Transformation/aggregation, presentation	Enterprise	Service definition based on *EMML*, *jQuery*	Remote web application
Serena Business Mashups™	Presentation	Enterprise	Process-based IT Service Management	Local desktop application
Yahoo! Pipes™	Transformation/aggregation, repository	Consumer/ Enterprise	Unix pipe like aggregation of data provided by web feeds	Remote web application
Yahoo! Dapper	Adapter, repository	Consumer/ Enterprise	Web site data mapper and feed publisher	Remote web application

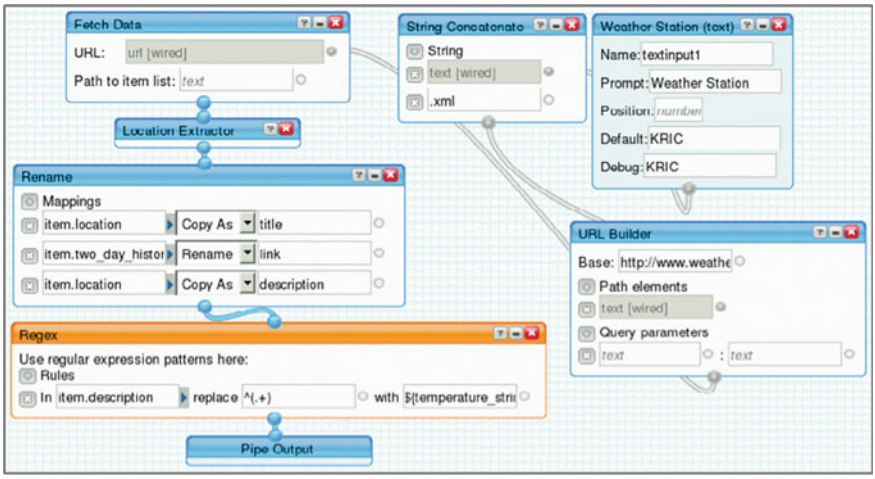

Fig. 6 Yahoo! PipesTM—enables the visual composition and aggregation of web resources. *Image source* Yahoo! PipesTM

Fig. 7 Yahoo! DapperTM—produces dynamic web feeds based on web site content. *Image source* Yahoo! DapperTM

This includes web search results and dynamic table elements. In fact, Yahoo! Dapper does not fulfill the needs for creating the SSIL. Nevertheless, this service is very useful for extracting semi-structured data, for example from event web sites that do not offer a web feed or API.

CommunityMashup[5] is an open source social software middleware solution developed by Peter Lachenmaier et al. (2011, 2012). It provides a people-centric

[5] CommunityMashup—available: https://github.com/soziotech/CommunityMashup

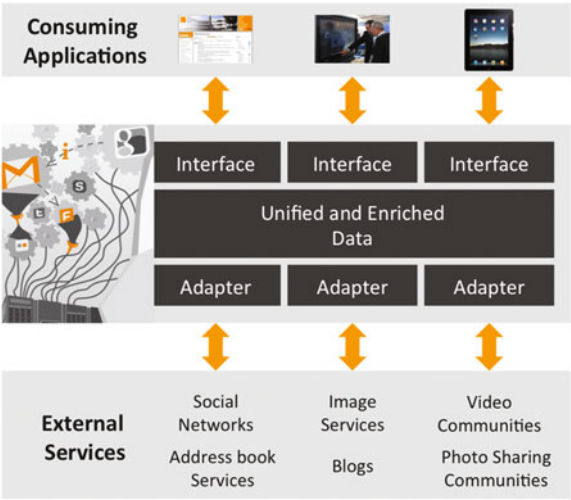

Fig. 8 CommunityMashup—aggregates data from Social Networking Services using a person-centric approach. *Image source* (Lachenmaier et al. 2012)

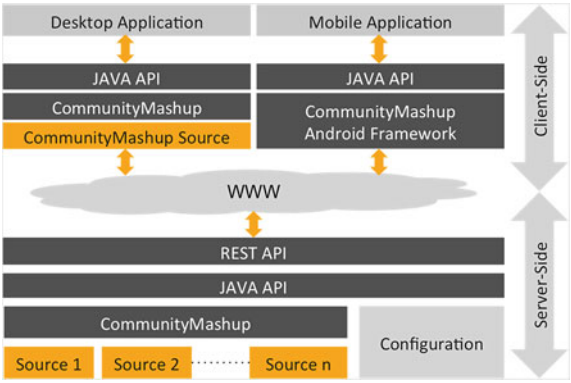

Fig. 9 CommunityMashup—Distributed environment with source components handling communication with Web APIs of external services. *Image source* (Lachenmaier et al. 2012)

approach for aggregating data from SNS and uses a service-oriented architecture (SOA) to integrate existing SNS and web feeds as pluggable service components (Figs. 8 and 9). In addition, the CommunityMashup framework supports common desktop, Web and mobile client platforms including Android™, iOS™, Windows Phone™ as well as HTML and JavaScript. CommunityMashup uses Equinox,[6] an

[6] Equinox—an implementation of the OSGi R4 core framework specification. Available: http://www.eclipse.org/equinox/

OSGi[7] runtime environment. As a consequence, new functionalities and data sources can be added as Java™-based OSGi plug-ins on-the-fly[8] without the need to update the client code or shutting down the server for maintenance.

Our findings showed that ARIS MeshZone™, IBM Mashup center™, JackBe Presto™ and Serena Business Mashups™ do not meet our requirements as they lack the integration of the Web APIs of existing SNS. They mainly support XML and/or web feeds and focus on enterprise-specific business needs, like generating charts, diagrams, or workflows.

In the end, we decided to use CommunityMashup as the core of the Social Software Integration Layer in combination with Yahoo! Dapper™ in order to extract semi-structured content from web sites without public Web API.

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[7] OSGi™—a dynamic module system for Java™. Available: http://www.osgi.org/

[8] New functionalities can be added to/removed from the backend system during runtime.