Social Networking Healthcare

Leigh Griffin[1], Eamonn de Leastar[1]

[1]*TSSG, Waterford Institute of Technology*
Cork Road, Waterford, Ireland.
lgriffin@tssg.org
edeleastar@tssg.org

***Abstract*— The world of "Social Networking", a cultural phenomenon of recent years, has evolved an application paradigm, Instant Messaging (IM), into a feature rich, highly interactive and context sensitive service delivery environment. Terms such as buddy lists, presence and IM-bots have emerged as building blocks for services that significantly enhance the user experience. Mapping this paradigm to healthcare can deliver a highly innovative communication platform for information sharing, monitoring and care plan execution. Buddy lists become care groups, presence becomes patient context (e.g. blood sugar level) and IM-bots become E-heathcare services, capable of delivering appropriate contextual information to the care groups. Consider the following scenario: A pharmacist and a local health nurse are both monitoring the blood sugar level for a diabetes patient - the patient appearing as a "buddy" in one of their care groups. Through an IM application, the health nurse first notices a heightened blood sugar level for one of her patients. The nurse messages the patient immediately to ascertain his general status. The pharmacist is also alerted, and the nurse and the pharmacist discuss medication types and levels. A revised prescription is agreed and the patient collects it on his next visit to the pharmacist.**

I. Introduction

The Social Networking paradigm of recent years has brought about a fundamental change in how people use technology in their daily lives. Changes to peoples attitudes , social interactions and general expectations, particularly among the young adult demographic, has brought modern computing into the lives of a whole new generation. This change of attitude was facilitated by and large by the advancement of technology in recent years. Devices became smaller, faster, portable and more powerful. Broadband networks reached out and connected most major cities providing an effective base to launch communication based services that were not feasible before. Businesses and domains began to offer more online services and the healthcare industry was not an exception. This paper proposes an architecture for enabling a social networking healthcare platform, offering tailored medical services in a familiar and friendly way. This paper is divided up as follows; this section serves as the introduction; section two examines the world of social networking; the third section introduces the changing state of healthcare and peoples expectations. The fourth section looks at a potential mapping between healthcare and social networking. Section five is the proposed architecture and and section six explains it; The seventh section identifies some of the major challenges to be addressed; the final section is the future work and conclusion sections.

II. Social Networking

The term social network has been in use for almost a century. Originally it was used to describe complex relationships between members of social systems. Terms such as bounded "groups" and social "categories" were used to describe elements of the systems, such as families and ethnicity respectively. The tern in it's modern incarnation is used to describe the online communities that people build up. These communities are centred around common interests, hobbies and more importantly a means to stay in touch with others. Here, we acknowledge three of the leading Social Networking mediums.

Facebook [1], is one of the most popular social networking sites on the internet. Facebook users register with the site and create a profile page. This page can be set to public or private, limiting the visibility of their online profile. The profile page contains basic information about the user such as age, what city they are living in and what jobs they worked at. It also includes other data such as hobbies and interests, political affiliations and religious beliefs. The information submitted is used as a means to connect people via special interest groups. Groups can be created to facilitate discussions, file and photo sharing and organise events among the group members. Users of the site can leave comments through wall posts, a feature with it's origins firmly rooted in message boards. These posts can be left on other users public profile pages, on public or private groups or indeed mailed privately among users.

The usage of Facebook is astonishing [2]. Facebook has more then 200 million active users, 30 million of which are mobile users. An average of 100 million unique logins a day occur. Each member of this site has an average of 120 online friends . 660,000 developers have contributed to over 52,000 applications currently available. Applications and services offered over social networking sites such as Facebook have a large, ready made base of customers and the demand for innovative new services is high. Facebook is just one of a number of similar social networking sites. MySpace [3] and Bebo [4] being two other prominent sites with large membership bases.

Twitter [5] is another social networking medium that has gained prominence in recent years. It is a micro blogging site, allowing users to communicate with others what it is they are doing at the current moment in time. The updates, known as

"tweets" are text based posts displayed in the persons profile area and delivered to those who subscribe to the updates, quite like a standard blog update. Updates can be limited to friends only or broadcast publicly allowing anybody interested to see updates. The site can be accessed through mobile devices. A user sends an SMS with their update text, allows it to be broadcast, potentially allowing for real time updates from anywhere within mobile coverage. The technology has also been adopted as a means for public service announcements, most famously used by the Los Angeles Fire Department [6] during wild fires in 2007. It has been continuously used since then, providing subscribed users with information ranging from traffic crashes, to house fires, to patient updates.

Instant Messaging is another popular medium for social networking and has recently been integrated with sites such as Facebook and Bebo, providing another means for communication among the users of such sites. Instant Messaging is a form of near real time, primarily text based conversation between two or more users. Audio and Video conversations are possible with more advanced clients, such as the Windows Live Messenger [7], also known as MSN messenger [8]. Microsoft's messenger suite has evolved in recent years from being a simple text based medium for instant messaging to being a fully feature rich service platform. The latest incarnation is an advanced client, offering feature rich services ranging from weather updates to horoscopes to custom services defined by the user. A full range of the services offered under the Live service suite banner can be found at [9]. Instant Messaging has derived a new vocabulary. A user has a number of online friends, called "buddies". These buddies are stored by the server in a list known as a "buddylist". The user can organise their buddies into certain "groups". The grouping feature allows the user to logically manage their buddylist by placing buddies into groups with a similar theme, such as friends, family, colleagues etc. A user can also share their online "presence" - their willingness to be seen and contacted online – with others in their buddylist. The presence mechanism allows for custom services to broadcast updates from context enabled devices to the persons buddylist. A persons current location, what they are listening to and even their current activity can be broadcast through the presence mechanism to their online world.

III. Healthcare

Healthcare is a multi billion dollar industry and a vital service within society. A new model for healthcare has emerged in recent years with a shift in emphasis from attending hospitals and local doctors surgeries to looking at self monitoring and health awareness. This shift has by an large come about by the expense in attending such practices and looks set to continue with the current worldwide economic situation. Many patients with long term illnesses such as diabetes, high blood pressure and heart complaints are on long term medications. It is often the case that these patients will self test their condition using devices such as an insulin pen, a sphygmomanometer or a portable ECG respectively. Advances in medical research have allowed devices such as these to be developed, refined and made affordable, minimising the need for contact between healthcare professionals and patients. As a result of their self testing, many patients adjust their own level of medication without the need for a consultation from their doctor or pharmacist . This comes about as patients try to strike up a balance between work/life activities and handling their illness. For example a long term athletic diabetes sufferer knows how to regulate their medication to strike up a balance between intense caloric exercise and maintaining a health balance. Adjusting medication levels can have consequences for patients. Similarly not revealing ones leisure activities which could have a major impact on the treatment being administered can also have a far reaching consequences.

This change in attitude has led patients to expect more from their healthcare professionals. Often, pharmacists fill the role once held by doctors, not only dispensing medication but dispensing vital advice and instruction. The pharmacist is the free point of contact that patients interested in self monitoring and general information go to, as outlined in the research project at [10]. The work proposed in the rest of this paper takes the small community pharmacy model as the inspiration and domain for this research.

IV. Healthcare Mapping

Taking some of the terminology from social networking and mapping them to healthcare, we define the following terms:

- Care Group: A group within a buddylist comprising of healthcare professionals and the patients they are treating.
- Patient Context: An adaptation of the presence mechanism to convey patient context derived from smart devices.
- E-Heathcare Services: Instant Messaging "bot" [12] buddies that sit in the care groups offering pre-defined services to the users of the group.

The following is a small scenario to show the integration of social networking terms into the work of a community pharmacist.

A pharmacist and a local health nurse are involved in the care of 50 customers/patients as part of a pilot technological healthcare scheme. The patients are split logically into care groups associated with the kind of illness that they suffer from. Group names such as "respiration", "cardiac" and "diabetes" are some of the groups visible on the pharmacists and nurses care group list. The patients within the diabetes group each have a blood sugar level monitoring device. At regular intervals the blood sugar level is monitored and displayed through the presence mechanism. An E-Healthcare Service bot has been set up to monitor the patients presence changes. When a predefined threshold has been breached, the service contacts the nurse with an Instant Message alert delivered

to the nurses mobile phone, providing information of the status change. The nurse immediately contacts the patient to ascertain if they are ok and in need of assistance. Having informed the nurse that his heightened blood sugar level was down to his exercise regime, the nurse starts up an IM conversation with the pharmacist and they discuss medication levels and types with the patient. An agreed update to the patients prescription is decided upon and the prescription service bot sends a message to the patient informing them that a new prescription is available for collection from the nurses clinic.

V. Proposed Architecture

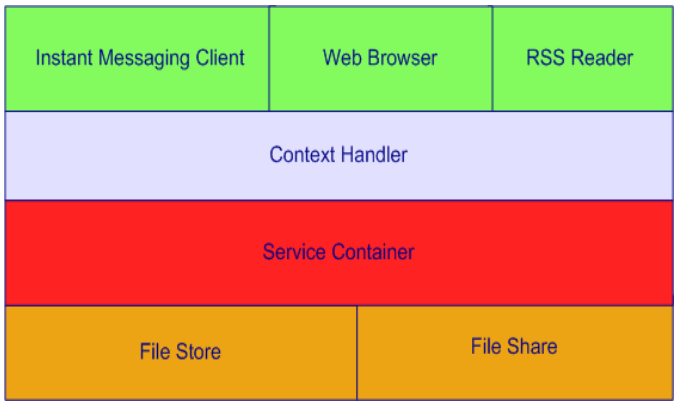

Fig. 1 Client Architecture

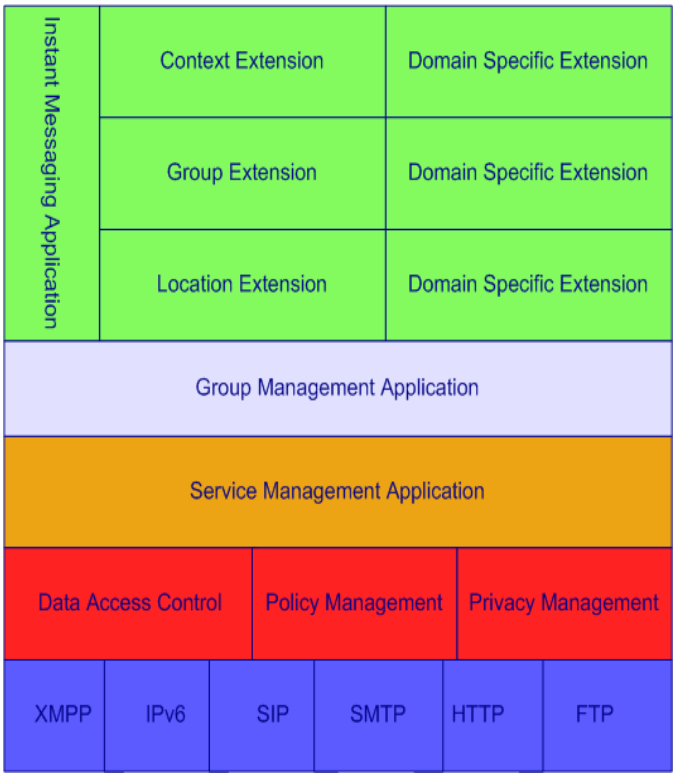

Fig. 2 Server Architecture

VI. Explanation of Architecture

The architecture outlined in figures 1 and 2 show the proposed components that will make up the client and server respectively. The client architecture will be examined first:

- An Instant Messaging Client – This will be used to provide a means of near real time communication with other users of the system. Access to buddies, buddy lists and groups will be facilitated through this IM client.
- Web Browser – A web browser will be provisioned for allowing access to the World Wide Web and also as an interface to some web enabled services. The browser would be customisable for mobile and desktop variants of the client device.
- RSS reader – RSS [11] is a web feed format for reading subscriptions. A reader integrated into the device would allow for blogs and updates from services and applications to be delivered to the device.
- Context Handler – This component would be responsible for handling context aware devices that would be integrated into the client. Devices that record and capture events such as location and activity among others will integrate with this component.
- Service Container – The service container component of the client architecture allows the hosting of remote software components or services. The deployment and execution of services within the client architecture would be handled within the container.
- File Store/Share – The File storage and sharing components of the architecture allows the client device to store files both privately and publicly respectively.

Server Architecture:

- Instant Messaging Application – An instant messaging application would be at the heart of the servers architecture. This application would be a customised version of a standard XMPP based IM server. The customisation lies in the current and future extensions that have been developed for the protocol. Extensions such as Context, Group and Location would be three core extensions that could be extended into the application. Room for domain specific extensions (such as medical device monitoring) are provisioned for within the architecture.
- Group Management Application – This component will be responsible for the formation, management and life-cycle of groups within the system.

- Service Management Application – Service requests comprising of aggregation and composition of services would be handled by this component.
- Data Access Control – Access to data is an important issue within any system. This component manages the access rights of users and groups and ensures that the correct access rights are delegated and revoked from users when necessary.
- Policy Management – The policy management component within the architecture is a linking module which will store and manage the policies utilised throughout the architecture. Group formation, service provisioning and data access are some of the examples where policy's would be required.
- Privacy Management – An important aspect of a group related architecture is managing the users privacy. Contextual information, group membership, file ownership, file visibility and your online footprint are among an ever growing list of concerns regarding privacy. This component would be responsible for ensuring the privacy policies deployed within the system are functioning as intended.
- Bottom Layers – The architecture diagram includes a list of well known protocols that would be used and integrated within the application.

VII. Potential Challenges

The proposed architecture has many interacting components which need to be looked at in separation to understand the challenges involved in designing such an architecture. This section looks at some of the major components and presents current issues and potential solutions to the challenges that arise. A comprehensive overview of the known issues and challenges with the components and technology driving them would be beyond the scope of this paper.

- Group Communication Management: The formation and maintenance of groups is going to be a pressing challenge that would need to be tackled at the architectural level. How groups are formed, the lifespan of the group and the footprint the group leaves behind among others are some of the more pressing challenges for a group communication management component. The groups being formed would need to be dynamic, with fluctuating membership levels in an often ad hoc manner. The access rights to the groups would thus need to be strong enough so that an ex member of a group was no longer privy to messages and content of that group. Similarly a new member joining the group should not have access to old files and messages that may have been sent around before their membership became active. A lot of research into this area has occurred [13][14] but no definitive group management model has emerged.
- Privacy: The presence mechanism would be central to contextual information being distributed to the group. Controlling the broadcast and use of this contextual information is going to be crucial to the success of the system. Patients location, heart rate, mood, current activity and several other pieces of contextual activity would be broadcast to members of a group and potentially stored by services. The reason for keeping some of the data may be for testing or other genuine medical usage which the design of the architecture needs to be aware of. There are several techniques for ensuring privacy which would need to be factored into the design of the system.
- Group Membership. Determining how groups are populated with members is an important question. Membership from a users perspective should be relatively straightforward. Groups however can be formed and populated semantically, be predefined, be defined by location, be defined by demographics or countless other means. Membership being forced on a person because of some of the criteria outlined above can cause issues when the people are added or excluded from groups automatically. The system also needs to be address the potential for some groups to merge with others thus populating a new group. If the system is dealing with different users from a broad medical domain such as hospitals, pharmacies, clinics and other medical institutions, each with their own group membership criteria and in built systems you have a federated groups scenario. A common definition of terms would need to be established to handle federated groups and the overall security of data exchange and ownership among the federated groups.
- Digital Rights Management: The ownership of content created within the groups is a tricky area. Services and files created and shared by the users have the potential to migrate to other groups. Ensuring that the digital rights and security mechanisms employed in one group or "sphere of trust" is obeyed and followed in another group is a key challenge to be addressed.

VIII. Future Work and Conclusion

To realise such an architecture a number of steps would need to be taken to ensure the success and stability of the system. Further investigating into the inner workings of social network technologies and their users would need to be performed. It is important that the system designed would capture the core characteristics and usability of the existing technology. An interdependent web of technology exists in each of these domains which would also need to be modelled and examined to get a complete picture of the domain. The test domain in which the architecture would be deployed is the healthcare domain, more specifically a small community setting. Research as part of an Irish funded project tackling future healthcare issues has been performed on the role of community pharmacists [10] and an investigation into a proposed technological solution to some of the challenges facing them. More in field research will be required ,working closely with those responsible for the provision of care for patients in small communities so that a pilot architecture could

be created and tested. The core challenges facing such a systems architecture has been touched upon. Only by building a pilot system will the full extent of the challenges emerge.

This paper presented an overview of the social networking domain, highlighting three key social networking domains and their usage. The world of healthcare and it's changing needs and demands was looked at and a potential mapping between social networking terms and healthcare was examined. A small scenario was elaborated on to show how simple social networking technologies could be adapted into a system that users would find useful, easy to use and more importantly beneficial to their healthcare. A proposed architecture containing the core components of social networking sites was put forward and the significant challenges that it presented identified for future work..

Acknowledgment

Parts of the research presented in this paper were funded by the Irish HEA through the PRTLI cycle 4 project "Serving Society: Management of Future Communication Networks and Services".

References

[1] Facebook [online] Available at http://wwww.facebook.com [Accessed 20-May-2009]
[2] Facebook Statistics [online] Available at http://www.facebook.com/press/info.php?statistics [Accessed 20-May-2009]
[3] MySpace [online] Available at http://www.myspace.com. [Accessed 20-May-2009]
[4] Bebo [online] Available at http://www.bebo.com. [Accessed 20-May-2009]
[5] Twitter [online] Available at http:///www.twitter.com [Accessed 20-May-2009]
[6] Los Angeles Fire Department Twitter Page [online] Available at http://twitter.com/LAFD [Accessed 20-May-2009]
[7] Windows Live [online] Available at http://home.live.com/ [Accessed 21-May-2009]
[8] MSN Web Messenger [online] Available at http://webmessenger.msn.com/ [Accessed 21-May-2009]
[9] Windows live Service List [online] Available at http://en.wikipedia.org/wiki/Windows_Live#Windows_Live_services [Accessed 21-May-2009]
[10] Serving Society: Management of Future Communication Networks and Services. Website: http://futurecomm.tssg.org/
[11] RSS information [online] Available at http://en.wikipedia.org/wiki/RSS_(file_format) [Accessed 21-May-2009]
[12] What are Internet Bot s? [online] Available at http://www.tech-faq.com/internet-bots.shtml Accessed 21-May-2009]
[13] Hallberg, J., et al. Creating Dynamic Groups using Context-awareness. MUM 2007 conference, Oulu, Finland.
[14] Minder, D,. et al. On group formation for self-adaptation in pervasive systems. Autonomics conference 2007, Rome, Italy.