Introduction to Personal Communication on the Internet

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Index words: personal communication, buddy list, Internet presence, non real-time and real-time communication

ABSTRACT

This paper focuses on the burgeoning field of Internet Personal Communication Channels/Services. Even though e-mail has been with us for a long time, it is only now with the increasing acceptance of the Internet by a broader spectrum of the population that the true potential of the Internet as a personal communication medium is starting to be explored. The paper discusses a number of existing personal communication channels/services and the applications that utilize them.

Real-time communication channels such as instant messaging, text chat and audio/video streaming and non real-time channels such as e-mail, newsgroups and shared spaces are described with respect to their use in personal communication. Furthermore, personal communication applications such as buddy lists, virtual communities, and others are discussed. Also mentioned are the common problems faced by these applications. And finally, a standards-based solution to solve existing interoperability problems is called for.

More specifically, a class of applications known as buddy lists is discussed. Buddy lists are currently the most popular communication application for real-time personal communication over the Internet. Today's buddy lists do not interoperate. They use proprietary technology to detect when users go online and real-time communication between users is possible. Hence, communication is only possible when all communicating parties use the same buddy list client software; that is, the same fixed and proprietary set of communication channels (e.g., instant messaging, text chat, etc.) is used.

In order to realize a greater degree of innovation in the field of Internet personal communication and to make it easier for existing and new communication channels to gain acceptance and be used ubiquitously, it is necessary to develop a standards-based framework for Internet-based personal communication. Standards necessary to achieve full interoperability of communication applications and tools include Internet-scale standards for publishing, finding, and activating personal communication channels or services, as well as standards for the communication channels themselves.

INTRODUCTION

The Internet marks a dramatic shift in how people acquire information. Much of the success of the Internet has been due to the fact that it provides up-to-date information at your fingertips. However, information access is only part of the Internet's potential. Electronic commerce or e-commerce, business-to-business communication, and personal communication are all areas where the Internet is gaining acceptance and is transforming our society.

Today more and more people are using the Internet for personal communication. In this paper, a number of real-time and non-real-time communication channels for personal communication over the Internet are presented. Existing classes of applications incorporating personal communication channels are also discussed.

PERSONAL COMMUNICATION CHANNELS

All communication channels described below use the Internet as the underlying communication medium and are suitable for Internet-based personal communication, i.e., personal human-to-human interaction via the Internet.

Real-Time Channels

Real-time communication channels are channels in which communication is highly interactive, and all of the communicating parties are simultaneously present.

Instant Messaging

Instant messaging is a relatively new communication channel. It has been popularized by buddy lists, which are described later. Instant messaging allows for the sending of messages from one party to one or more other parties. Currently, instant messages consist of short text messages, although one could imagine an instant message

containing sound, graphics, and other types of media.

Instant messaging and e-mail differ primarily in their real-time nature and delivery mechanisms. Whereas e-mail uses a potentially lengthy store-and-forward delivery mechanism, an instant message is delivered immediately from sender to recipient. Hence, using instant messaging, the sender knows that messages will be delivered to the receiver almost "instantaneously." Furthermore, due to the fact that instant messages tend to be very short and unobtrusive, they usually demand little attention from the recipients.

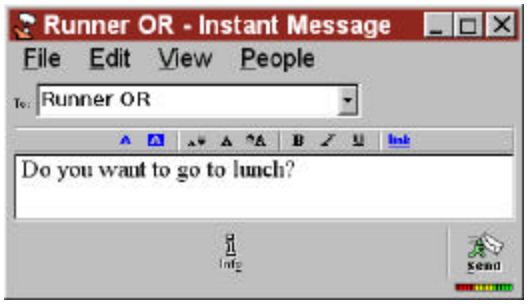

Figure 1: Composing an Instant Message using the AOL Instant Messenger*

Figure 1 shows an example of composing an instant message using the AOL Instant Messenger BuddyList*. Currently, no standard exists for sending and receiving instant messages. However, the Instant Message and Presence Protocol IETF working group is working toward a standard for both instant messaging and for detecting the online presence of users.

Text Chat

Text chat is very similar to instant messaging, except it is better suited to a higher degree of interactivity. Usually the text chat client application transmits every character typed in real-time or a complete message that is terminated by the user pressing the *enter* key. Even though the separation between text chat and instant messaging can become blurred, as both are used to exchange short text messages interactively between two or more parties, text chat is intended for two-way communication and tends to show a higher degree of interactivity and involvement between its users. Some instant messaging programs such as the one offered by PeopleLink allow for conversion of an instant message into a two-way text chat.

* All other brands are the property of their respective owners.

Figure 2: Text Chat client

Figure 2 shows PeopleLink's Text Chat* applet. There is currently no standard for small group text chat, as employed by most buddy lists. However, there is an IETF standard for establishing topical chat for large groups of people. This standard is known as Internet Relay Chat (IRC) [6]. IRC uses chat rooms, which are "chat areas" for people to meet and discuss topical issues related to the overall theme set by the room. IRC may be thought of as the real-time equivalent of newsgroups. Many IRC-compliant chat clients are in existence today.

Internet Phones (Audio/Video Streaming)

Internet phones support real-time communication over the Internet by sending and receiving audio and video streams. They are able to provide a very rich and engaging real-time communication channel.

A set of standards for call setup and control, as well as audio and video compression and streaming, is described within the H.323 standard as approved by the International Telecommunications Union (ITU) in 1996. A number of H.323-compliant Internet phones are available today, including Microsoft NetMeeting* and the Intel® Internet Phone.

Although a description of the H.323 standard is not within the scope of this paper, it should be noted that H.323 is more than just a standard for Internet phones. It aims at being the standard framework for most, if not all, real-time communication including video, audio, and data sharing over the Internet.

Whiteboard

A whiteboard allows communicating parties to share textual and graphical information in real time. It is typically used in the context of some other primary communication channel such as an audio/video phone call or a presentation. The whiteboard communication channel imposes little or no structure on the communication other than the context or theme provided externally. Whiteboards have not been used heavily for personal communication mainly because they often rely on a

primary communication channel to be established first. Furthermore, the user interfaces of current whiteboards have not been geared towards small group personal communication; rather, they have been geared towards professional data-sharing activities.

Within the T.120 protocol family that is part of the H.323 standard, the ITU has defined an application layer protocol for the real-time exchange of screen data and annotations called the Multipoint Still Image and Annotation Protocol (T.126). This protocol provides a standard way for whiteboards to exchange information in real time.

Comparison of Real-Time Communication Channels

Real-time communication channels differ in their bandwidth requirements and user engagement requirements.

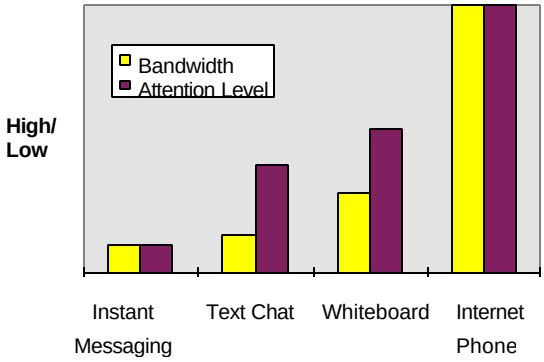

Figure 3: Relative bandwidth and level of engagement/attention requirements for the different communication channels

Figure 3 highlights the major differences between the different types of real-time personal communication channels. One of the major differences is the bandwidth requirements for a particular communication channel. Instant messaging is in part very popular because of its low bandwidth requirements. It allows for other communication or PC activities to occur with negligible impact on performance. Internet phones, on the other hand, require more bandwidth but they provide a much richer and more engaging personal communication channel.

The level of engagement between the communicating parties also varies significantly between the different communication channels. Even though instant messaging is considered a real-time channel, it is typically done as a background task. On the other hand, text chat is geared towards two-way communication with a slightly higher degree of engagement between the communicating parties. Finally, Internet phones provide a rich, highly engaging, communication channel most suitable to be the primary channel at the time of use.

Non Real-Time Channels

Non real-time personal communication channels, as discussed below, are channels in which the message delivery requirements are relaxed. Messages may still be considered useful even if they take days to reach the recipient(s).

The asynchronous nature of non real-time communication channels accommodates differences in the availability of users to communicate. Any messages can be consumed at the reader's leisure, rather than the convenience of the sender. Furthermore, since most non real-time communication channels, including all those discussed here, require an always-connected server of some sort, message archiving and the mobility of the communicating parties can be easily supported.

E-mail

E-mail is still the most widely used Internet communication tool for business as well as personal communication. The standard for e-mail message exchange known as the Simple Mail Transfer Protocol was written by John Postel in 1982 [1]. E-mail is considered non real-time because the sender and recipient do not need to be simultaneously present to communicate. Instead, e-mail utilizes a store and forward architecture where messages are passed from mail server to mail server and finally to the recipient with no strict bounds on delivery time. The biggest strength of e-mail is the fact that it has been so widely adopted. Also, many tools such as e-mail filters and mailing lists are available that allow users to customize this communication channel.

Newsgroups

Like e-mail, newsgroups have been around for a long time. In fact, long before the Internet became mainstream, USENET newsgroups were primarily used by many people to exchange technical information.

The format of newsgroup messages and the transport were standardized in 1983 by the "Standard for Interchange of USENET Messages" [2] and in 1986 by the "Network News Transfer Protocol" [3], respectively.

Like e-mail, newsgroups enjoy tremendous widespread usage. However, as an intimate small group communication channel, USENET newsgroups have become less useful. This is partly due to their growing success, which has resulted in a lot of posting of unrelated messages (i.e., spamming), but also due to their lack of access controls. Without access controls, newsgroups are best suited for non real-time

communication between medium to large groups of people.

Shared Spaces

Non real-time shared spaces are the persistent counterparts of real-time shared spaces such as whiteboards. For example, a family Web page might be considered a primitive shared space for small group personal communication. A better example is a persistent whiteboard with access controls allowing only a well defined group of people to view/modify the contents of the whiteboard. This whiteboard is analogous to a refrigerator door with Post-it* notes.

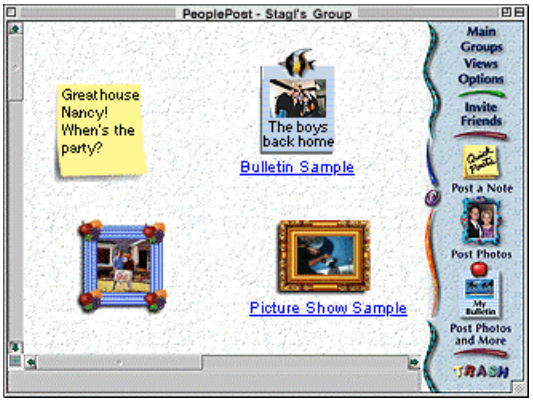

Figure 4: Secure small group shared space example

An example of a shared space is PeoplePost* (http://www.peoplepost.com). Communication within the shared space centers on one theme, such as the life of a particular family.

No standard for exchanging information in small group shared spaces exists. However, a related standard for distributed authoring of documents has just reached RFC status. The "HTTP Extensions for Distributed Authoring" or WebDAV [4] standard describes a set of HTTP extension headers to be used for distributed authoring of documents. WebDAV may be used as the foundation for an application layer protocol to define a standard for small group shared spaces.

Comparison of Non Real-Time Communication Channels

One way to compare non real-time communication channels is by their degree of generality. The degree of generality is determined by the amount of pre-determined structure and context built into the communication channel. The more structure that is provided by the channel the less general it becomes.

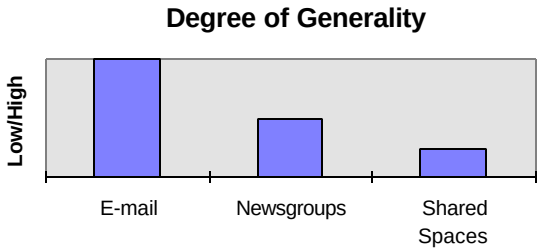

Figure 5: Relative degree of generality of non-real time communication channels

As illustrated in Figure 5, e-mail is the most general of the illustrated non real-time communication channels, since it makes no assumptions as to the topic or theme of the communication. Newsgroups typically limit themselves to specific topics or themes and it is up to the communicating parties to provide structure to the conversation. Finally, shared spaces usually have a theme to guide the communication and often impose structure on the type of information that is to be exchanged.

APPLICATIONS

All communication occurs with a certain amount of context. This context may be provided through pre-existing personal relationships, through common interests, or simply by being in the same place at the same time. For example, buddy lists, which are described next, are most useful when the communicating parties have already established a relationship by some other external means.

Buddy Lists

In order to understand buddy lists, it is important to first understand what problem they are helping to solve.

When the Internet transitioned from an academic network consisting of computer networks in universities and government agencies to include millions of computers in people's homes, it started to become a viable platform for real-time personal communication. Like many technological advances, buddy lists were born out of a need to solve a particular problem, namely, facilitating person-to-person real-time communication in a world of transiently connected users.

The main problem that buddy lists are helping to solve is being able to detect when users log on to the Internet and become available for real-time communication. This problem is compounded by the fact that the addresses used to identify hosts on the Internet, namely Internet Protocol Version 4 (IPv4) addresses, are in short supply.

Due to the enormous growth of the Internet, the supply of unassigned IPv4 addresses has been shrinking

dramatically. Therefore, most Internet service providers (ISPs) implement a scheme in which they can make efficient use of their IP address pool.

Many users connect to the Internet through dialup connections and are dynamically assigned an IP address out of the ISP's address pool for the duration of the dialup connection. After a user disconnects, their IP address may be re-used for another user that subsequently connects to the ISP. This scheme allows an ISP to support a large number of transiently connected dialup users with a smaller pool of IP addresses.

Unfortunately, this means many users get assigned different IP addresses every time they dial up to their ISPs and log on to the Internet. Furthermore, since IP addresses are needed to find endpoints on the Internet, it makes it difficult for users to find each other for real-time communication over the Internet. Buddy lists solve this problem by providing a dynamic directory that maps a user's unique static identifier unique within the particular directory service to the IP address currently in use by the user. In addition to keeping track of users assigned IP addresses, buddy lists may also keep track of other pertinent information such as when the user is busy or away from his/her PC.

Hence, one of the most significant features of buddy lists is their ability to detect the Internet presence and willingness/ability of users to communicate, as well as to determine the IP addresses currently assigned to those users. This enables them to become facilitators of real-time communication, even when the communicating parties are only transiently connected to the Internet. Most buddy lists provide users with the choice between a number of real-time and non real-time communication channels. Instant messaging and text chat are commonly used.

Figure 6: Tribal Voice's PowWow buddy list

Figure 6 shows PowWow*, a buddy list developed by Tribal Voice (http://www.tribal.com). Other examples of buddy lists include Mirabilis' ICQ* (http://www.mirabilis.com), AOL's Instant Messenger* (http://www.aol.com), Activerse's Ding* (http://www.activerse.com), and the Yahoo! Messenger* (http://www.yahoo.com). Some of these buddy lists employ highly scalable peer-to-peer presence detection solutions, such as Activerse's Ding. Others, such as AOL's Instant Messenger, have opted for a more centralized solution for routing presence and content information. This gives them centralized logging capabilities and control to enforce access policies. However, all buddy lists solve the problem of indicating when a buddy is logged onto the Internet and therefore available to communicate.

Finally, some applications also embed a presence technology solution, as employed by buddy lists. For example, Fashion>>Trip* by ModaCAD is an application targeted at teenage girls that allows two friends to shop for clothes in a virtual shopping mall and to do so collaboratively (e.g., while talking on a video phone). Fashion>>Trip embeds a presence solution that allows for two or more users to detect each other's online presence, and it enables them to communicate and collaborate while shopping for clothes in the virtual mall.

Internet Phones

Internet phones such as Microsoft NetMeeting* and the Intel® Internet Video Phone are standalone applications that allow real-time communication over the Internet between two parties using audio, video, and data streams. Since Internet phone applications incorporate real-time communication channel(s), they must, just like buddy lists, deal with the problem of detecting when users are logged on to the Internet and how they may be reached.

To address this issue, Microsoft's NetMeeting* and the Intel Internet Video Phone provide a dynamic directory service based on Microsoft's Internet Location Service. In the future, Internet phone applications may benefit from a standard for the detection of Internet presence.

As mentioned previously, the communication channels provided by H.323-compliant Internet phones have already been standardized through the International Telecommunications Union's H.323 standard. However, finding the endpoints that one wants to communicate with is outside the scope of the H.323 standard and has yet to be addressed.

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Virtual Communities

While buddy lists and Internet phone applications for personal use focus on people who want to communicate in real-time with a small set of people that they know, virtual communities are often organized around interests and topics. In fact, virtual communities are providing meeting grounds on the Internet for establishing and fostering relationships.

Virtual communities often make use of real-time communication channels such as text chat or multi-party audio chat, as well as non real-time communication channels such as message boards or newsgroups. The Well (http://www.well.com) is an example of a prominent virtual community. It was started in 1985 as a BBS based community in New York city and transitioned to the Internet in 1992. It has become an early success story for virtual communities.

Other Internet-based virtual communities include Web sites such as Geocities (www.geocities.com), Tripod (www.Tripod.com), and iVillage (www.iVillage.com); game aggregation sites such as the World Opponent Network (www.won.net) and Mplayer (www.mplayer.com); and audio chat communities such as hearme.com and Talkcity (www.talkcity.com).

Virtual Shared Spaces

Virtual shared spaces allow for private sharing of information between a small group of people that want to communicate within a particular context or theme. The context could be based on relationships such as a family or extended family, on interests or hobbies, or on specific tasks such as planning and/or collaborating on a particular project.

Virtual shared spaces are a relatively new genre on the Internet. Examples of virtual shared spaces include FamilyShoebox (http://www.familyshoebox.com), PeoplePost (http://www.peoplepost.com), eCircles (www.eCircles.com), Visto (www.visto.com), and eGroups (www.egroups.com).

Although virtual shared spaces may incorporate some real-time elements or communication channels, they do not tend to focus on real-time communications. Instead, they typically provide a shared space for storing and viewing messages, files, pictures, drawings, and other multimedia content. Most also offer individual and/or shared calendar scheduling and address books.

Some virtual shared spaces provide an overall theme or context for group communications. For example, for FamilyShoebox the theme is communication within a family or extended family. Other virtual shared spaces such as Visto allow the context to be set by the group and can support task-based activities including task-related planning, scheduling, and communication.

Multi-User Virtual Worlds

Multi-user virtual worlds are two- or three-dimensional graphical environments that allow people to meet and communicate in a graphical virtual space. They are often referred to as MOOs. A MOO is an Object-Oriented version of a text-based multi-user virtual world, commonly referred to as Multi-user Dungeon or MUD. In a MOO, users can typically define their personal two- or three-dimensional representations called avatars. Users interact and communicate with each other through their avatars.

Current multi-user virtual worlds employ real-time communication channels such as multi-user audio chat, text chat, and other real-time channels to allow for communication between users. Examples of multi-user virtual worlds include the Palace (www.thepalace.com) and the OnLive Traveler (www.onlive.com).

The virtual reality modeling language (VRML) defines a standard file format for representing three-dimensional multimedia contents. In particular, a VRML file describes a graphical space containing three-dimensional and/or aural objects and ways to interact with them.

VRML version 1.0 was based on the Open Inventor* file format from Silicon Graphics. In December 1997, VRML97 became an international standard (ISO/IEC 14772) for describing interactive 3D multimedia on the Internet. VRML97 is based on VRML 2.0. More information about VRML is available at www.vrml.org.

CURRENT BARRIERS

One of the biggest barriers for personal communication over the Internet today is the fact that many of the standards necessary to ensure compatibility between the various communication applications are missing. For example, buddy list applications use proprietary presence detection protocols. The Instant Messaging and Presence Protocol (IMPP) IETF working group is trying to solve this problem by working towards a standard for presence detection and instant messaging.

However, creating a standard for detecting a user's Internet presence alone is not sufficient. In order for buddy lists and other communication applications to be truly interoperable, they need to be able to determine in a standard way what communication channels are supported and available between the parties that wish to communicate. Hence, there is a need for a standard for publishing the availability of real and non real-time personal communication channels. Such a standard is necessary to allow communication applications from

different vendors to establish common communication channels.

The communication channels themselves may or may not have agreed-upon standards for information exchange. Widely used channels such as instant messaging would benefit from a standard that allows for the creation of multiple interoperable clients. For other channels, such as those employed by most multi-player games, there may be little or no incentive to create multiple interoperable clients. Hence, they need not be standardized.

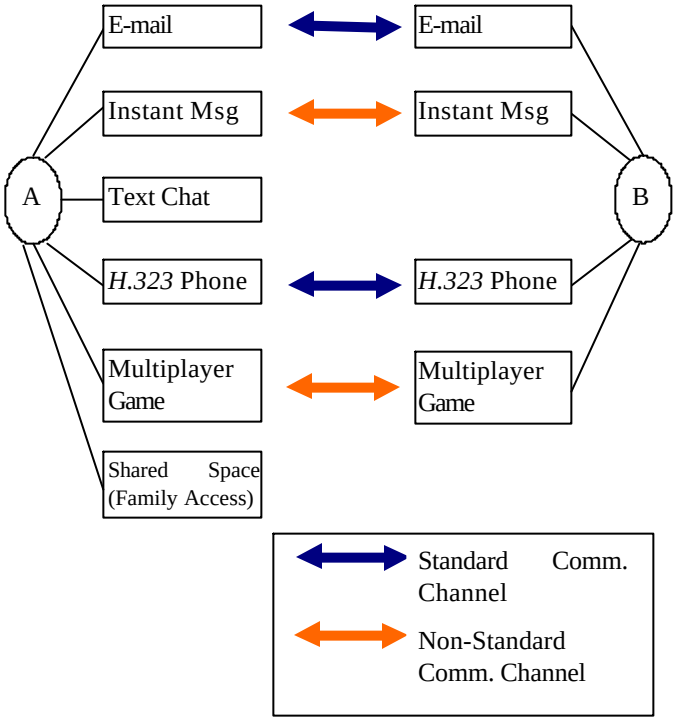

Figure 7: User A and user B determine that they have four communication channels in common

Figure 7 demonstrates user A and user B dynamically matching on four common communication channels. Having detected a common match, user A and user B may then proceed to choose the appropriate channel(s) from the common set, i.e., e-mail, instant messaging, H.323 Internet phone, and/or a particular multiplayer game, to satisfy their communication needs.

In order to facilitate interoperability of various personal communication applications and tools, the following standards are needed:

1. *Detection of real-time and non real-time communication channels and their availability for a particular person, group of people, or endpoint(s).* This involves creating a standard for publishing communication channels and their current availability status, as well as being able to retrieve such information given proper access permissions.
2. *Activation of communication channel(s).* This involves creating a standard for setting up communication channels. For example, activating a particular communication channel may result in launching the application that can handle the particular channel. Hence, activation of an H.323-compliant communication channel may result in a launch of a communication application such as an H.323-compliant phone. Having been launched, the phone application starts to listen for incoming connections or connects to a specified endpoint as needed.
3. *Communication via the channel(s).* This involves creating standards for the communication channels themselves. Some already exist, such as e-mail for non real-time communication, or H.323 for real-time audio, video, and data sharing. Others have yet to be defined such as instant messaging and shared virtual spaces. Furthermore, as mentioned previously, for some communication channels there may be little or no reason to create multiple interoperable clients. Most multi-player games fall into this category. Those communication channels may not benefit from standardization and need not be standardized.

A number of related standards efforts and protocols are worth mentioning here.

1. *Instant Messaging and Presence Protocol (IMPP) working group.* The IMPP IETF working group's charter includes standardization of presence detection and instant messaging protocol(s). Being able to determine the availability of endpoints or users and the IP addresses currently assigned to them will help in determining the availability of communication channels for a particular person, group of people, or endpoint(s). However, being able to enumerate the personal communication channels available for a particular person, group of people, or endpoint(s) is not within the current scope of the IMPP working group. It will have to be addressed separately.
2. *Service Location Protocol (SLP) [5].* The Service Location Protocol allows for the publishing of services. It could be used to publish available communication channels. The first version was standardized in July 1997 and work is currently proceeding on a second version. It also has an existing implementation. However, it is not meant to be Internet scale, and it only deals with finding a service on an Intranet. Service activation is not handled by the protocol.

3. *H.323 standard for real-time multimedia communication*. *H.323* defines a standard for initiation and setup of real-time multimedia communication channels, as well as content transfer between two or more participants over the Internet. Within the *H.323* standards framework, a number of standards for the real-time exchange of audio, video, and data have been defined.

   For example, *H.323* addresses call setup (Q.931), call and media control (H.245), real-time media transmission (RTP), network statistics gathering (RTCP), audio codecs (G.711, G.723, G.729), video codecs (H.261, H.263), and data sharing (T.120). Furthermore, T.120 defines an extensible framework that applications can use to define and standardize their own real-time data-sharing capabilities.

   H.323 was approved by the International Telecommunications Union (ITU) in 1996. It has broad support from the industry, including support from Microsoft, Intel, and (formerly) Netscape.

4. *IDentity Infrastructure Protocol (IDIP)*. The IDentity Infrastructure Protocol, as described in a current IETF draft and white paper by Shingo Fujimoto and Dave Marvit from Fujitsu Laboratories (http://idi.fla.fujitsu.com), advocates IDentity Objects that represent users on the Internet whether they are logged on to the Internet or not. The protocol describes the communication between IDentity Objects to control the initiation of applications and services between users.

   The protocol is in an early draft stage and has not gained much support at this point in time, but the ideas behind it are applicable to the enumeration and activation of personal communication channels or services.

CONCLUSION

Personal communication over the Internet is an emerging field. Today, various real-time and non real-time communication channels exist. Much work has gone into providing standards for real-time communication over the Internet, including the standardization of real-time audio, video, and data sharing through the *H.323* standard. Although non real-time personal communication is dominated by e-mail and newsgroups, it has recently seen a flurry of activity within the area of virtual shared spaces.

Buddy lists, one of the most popular communication applications on the Internet, do not interoperate. They use proprietary protocols for their communication channels and to detect when users become available for communication.

Work is underway at the Instant Messaging and Presence Protocol IETF working group to standardize the way transiently connected users and their IP addresses can be found. However, this is not enough. There is also a need to standardize the discovery of personal communication channels or services, proprietary or not, as well as a need for standardizing their activation.

History has shown that flexible standards promote interoperability and innovation and are key to realizing the potential of Internet communications. Hence, there is a need to provide a standards-based infrastructure that new communication channels or services can plug into, allowing easier deployment and rapid acceptance amongst users. This can be done by providing standards for publishing, finding, and activating personal communication channels or services for users or endpoints.

In establishing new standards, there is a need to build on the work that has already been done in other related standards efforts. In particular, there is a need to leverage the *H.323* standard, as well as existing standards for real-time and non real-time communication channels such as e-mail, newsgroups, and IRC-based text chat. Furthermore, there is a continuing need to standardize communication channels for which there are currently no standards, including instant messaging and virtual shared spaces.

In summary, personal communication over the Internet can greatly benefit from Internet-scale standards for publishing, finding, and activating personal communication channels or services. Such standards should co-exist with and build on existing standards as much as possible. Furthermore, these standards should be lightweight and flexible enough to embrace all personal communication channels, including real-time and non real-time, as well as standard and proprietary channels.

ACKNOWLEDGMENTS

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REFERENCES

[1] Postel, J., "Simple Mail Transfer Protocol," RFC-821, USC/Information Sciences Institute, August, 1982.

[2] Horton, M., "Standard for Interchange of USENET Messages," RFC-850, USENET Project, June, 1983.

[3] Kantor, B. and Lapsley, P., “Network News Transfer Protocol,” RFC-977, 1986.

[4] Goland, Y. et. al., “HTTP Extensions for Distributed Authoring – WebDAV,” RFC-2518, February, 1999.

[5] J. Veizades, E. Guttman, C. Perkins, and S. Kaplan. Service Location Protocol, RFC 2165, July, 1997.

[6] Oikarinen, J., Reed, D., "Internet Relay Chat Protocol," RFC-1459, May, 1993.

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