ConNexus: Instant Messaging for the Workplace

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ABSTRACT

ConNexus is a research prototype of an Instant Messaging (IM) system that is designed for use in the workplace. The ConNexus interface reflects how the needs of workplace users differ from what current commercial IM systems offer. ConNexus provides more awareness of others' activities to help find opportune times to contact them. It integrates with other workplace communication resources (phone, e-mail, on-line calendar, and desktop conferencing) to facilitate making contact through the appropriate channel(s). The ConNexus interface provides the interactional cues needed to help gracefully start, maintain, and end IM conversations. Preliminary use experience with a working prototype affirmed many of the design concepts and suggested future development in the user interface.

Keywords

instant messaging, awareness, use-centered design, distributed collaboration, computer-mediated communication.

INSTANT MESSAGING IN THE WORKPLACE

Instant Messaging (IM) systems enable computer users to stay aware of a selected list of users and immediately start an interactive text chat with anyone on the list. The popularity of IM has been reflected by the number of IM systems offered recently (e.g., AOL Instant Messenger, Lotus Sametime, MSN Messenger Service, ICQ). More interesting is the growing number of people that have been counted as IM users. AOL Instant Messenger currently boasts 50 million registered users and a peak usage of over 2.4 million simultaneous users [1]. The strategic value of IM in the computer industry was demonstrated in the summer of 1999 when Microsoft and AOL clashed over access to users of their respective IM systems [11].

IM use became popular primarily through services offered by Internet Service Providers (ISPs) to computer users at home. Having discovered the value of using IM to contact remote people from home, users began employing IM at work, where more and more teams are distributed across different sites. The popular press has noted this migration in IM use from home to work [7], and some research projects have begun to explore the use of IM-like capabilities in the workplace (e.g., Bradner et al. [3], Churchill and Bly [4]). Early experience with IM at work suggests that some of the advantages of IM, such as the immediacy of contact, might introduce too many unwelcome distractions at work [6].

We set out to identify the design implications for an IM system specifically tailored to the needs of the workplace. Can the benefits of shared awareness and immediate contact across distance be offered without increasing exposure to excessive distraction? Can transmitting the cues used to manage face-to-face interaction be applied to make IM conversations easier to manage? We explored these questions by studying how IM is used at work, designing an IM concept that reflects a workplace context, building a working prototype, and gathering some preliminary experience with the use of our prototype.

OBSERVING IM USE IN THE WORKPLACE

We drew upon three sources of input to understand how to reposition IM technology to better meet the needs of workplace users: previous research, visits to potential IM customers, and our own experience with current IM products.

A Study of IM Use in the Workplace

Nardi et al. [13] conducted an observational study of the use of IM in the workplace which identified some common patterns of use.

- Establishing contact—In the workplace, IM is often used to make initial contact, but the interaction often transitions to another communication channel (e.g., phone, face-to-face, e-mail).
- Parallel communication—IM is often used as a parallel channel in conjunction with the phone, especially among subsets of people in a phone teleconference. IM is also used to negotiate interruptions with people who were already on the phone.
- Lightweight communication—IM is often used for more lightweight, interactive, and expressive communications in a way that complements other communication channels (e.g., e-mail, phone, face-to-face).

Their study also revealed how concerned workplace users are about being interrupted and interrupting others when initiating contact. One reason users liked IM is because they found it to be less disruptive than the phone. Still, they did find a small percentage of users who resisted using IM because of the distracting potential of having windows automatically pop open on their computer desktops.

Visiting Potential IM Customers

We were involved with some visits to corporate customers to understand what IM features they would like. As part of each visit, they were interviewed about their current experiences with IM use. These visits confirmed many of the observations of the Nardi et al. research; IM is often used as an initiating bridge to other media and as a communication channel used in parallel with the phone.

Customers also pointed out concerns about the confidentiality of the messages. Since most of the commercial IM systems send the messages through the company firewall to a centralized IM server and back (typically in clear text), there is the potential that company-sensitive information included in IM discussions could be accessed outside the company.

Another practical issue our customers raised was interoperability with other IM systems. Companies want to maintain a secure IM system within the company, but they also want to support IM interaction with their customers, partner companies, or personal contacts. Unless everyone happens to be using the same IM system, interoperability among the different IM systems becomes an issue.

Reviewing and Using Existing IM products

Our own experience in reviewing and using some of the existing IM products also led to some design observations. Our work group is distributed between two sites (East and West Coast) with a three-hour time difference between us. These are the very conditions that make the awareness and communication features offered by IM useful. Thus we reviewed the IM systems not only as an academic exercise but with the goal of finding a tool that we might use.

AOL Instant Messenger (AIM) is representative of what current IM systems typically offer. AIM allows the user to create a list of users to monitor if they are on-line or off-line. Selecting a user's entry reveals more information about her availability (e.g., how long she has been online, the duration of any idleness). Double-clicking on a user's entry opens a text chat window. Once an initiator sends a message to a recipient, an IM window immediately opens on the recipient's computer screen. Messages appear in the chat once the user sends it by pressing carriage return.

A commonly raised issue with the increasing popularity of IM use at work is whether the messages are more distracting than productive. We found having an IM window immediately pop open on the screen on top of other windows when receiving an IM to be too distracting for use in the workplace. In the worst case, popping up a window may reveal confidential information to others who may be able to view the recipient's screen.

Also, we found the conversation dynamics in IM to be awkward. Immediately opening an IM window on the recipient's desktop felt akin to barging in to someone's office and abruptly starting a conversation. Without any sense of approach, the participants did not have an opportunity to smoothly transition from mutually recognizing an intent to make contact into opening a conversation (see Clark [5]).

Furthermore, when waiting for a reply to a message, it was unclear if the other person was busy composing a reply, or interrupted to work on other tasks momentarily. Ending conversations usually required some explicit exchange of goodbyes, much like the telephone. Typing these goodbye exchanges felt clumsy, although many abbreviated conventions have become established (e.g., "c ya", "gtg"). Also, AIM does not convey to the other IM participants when you have closed your IM window (thus ending your participation in the conversation). Without any clear indication in the interface, some users may think they are still in an IM conversation when others have already dismissed their IM window.

DESIGN IMPLICATIONS FOR IM IN THE WORKPLACE

Based on these observations from research, customer visits, and our own experience, we focused on three design implications for IM in the workplace: (1) providing the awareness to help people find opportune times to initiate contact, (2) integrating with other communication tools to afford using the appropriate tool, and (3) designing the user interface to more naturally support the process of starting, maintaining, and ending communication. We also kept in mind the practical issues of message confidentiality and interoperability requested by our customers.

One issue we wanted to address in our design was helping people find good times to make contact with others. Without the awareness of others' activities that is typically shared by co-located workers, finding opportune times to make contact with remote colleagues can be a problem. Our group frequently encounters this issue, especially with the three-hour time difference between our sites. We wanted to provide enough awareness information of others' activities to help the user answer the question "Is now a good time to try to contact her?" This awareness involves not only knowing when she is available in her office, but also when she is not already occupied in other communication activities. Much as a glance into an office door reveals whether the occupant is available for an interaction, we wanted to provide those awareness cues for distributed users connected by an IM system. Building on concepts explored in previous research (Greenberg [8] and Isaacs et al., [10]), we applied them to the IM framework.

Upon finding an opportune time to make contact, we wanted to make it easy to choose the appropriate communication channel to employ. To do that, we integrated IM with other communication resources that are typically used in the workplace: e-mail, phone, on-line calendar, on-line corporate directory, and desktop conferencing tools. Integrating IM with these tools enables the user to decide which communication channel would be appropriate to use during the course of the interaction. The CLUES work of Marx and Schmandt [12] suggested taking advantage of all the communication information that the computer knows about to help provide users with a simple and effective interface for managing their communication.

We also wanted to make the process of starting, maintaining, and ending IM conversations natural and easy to manage. In contrast to having an instant message window pop up on your screen, we wanted to create an interface that allowed both the initiating and receiving parties to feel comfortable with the amount of disruption generated by an

IM request. Maintaining a quick and lightweight flow to IM conversations was also important, especially since IM is often used together with other ongoing communications, such as phone conversations. We also wanted to provide a more natural interface for ending IM conversations. We tried to accomplish these goals by providing some of the reciprocal cues that are used to mediate face-to-face interaction in the IM interface.

Some additional practical yet important design concerns raised by our customers are the issues of message confidentiality and interoperability in the workplace setting. By building a prototype that worked *within* a company intranet, we leveraged existing security mechanisms in the company to keep IM conversations confidential. While we have not yet dealt with interoperating with other IM systems, this should be addressed by standards efforts such as the Instant Messaging and Presence Protocol (IMPP) [9] currently under development.

THE CONNEXUS USER INTERFACE DESIGN

The design implications from considering IM use in the workplace led to the design of ConNexus. ConNexus stands for ***Con***tact ***Nexus***, and is intended to be a central place to manage communication contact with other colleagues within the enterprise. (The name also lends itself to the slogan: ConNexus—it connects us!) While we describe the complete ConNexus design in this section, the working prototype that we have implemented so far demonstrates only the main features of the design (described in the Preliminary Use Experience section).

ConNexus comprises a few major components:

- Contact List—a selected list of colleagues for which awareness information about their availability and online communication activities are provided and through which you can easily establish contact with them.
- Contact Toolbar—when you select a particular colleague, this window pops up to give more detailed information about his or her activities, and enables you to access the communication channels for that person.
- IM text chat—an instant message text chat window that provides an interface for gracefully starting, ending, and managing IM chats.

Figure 1. The Contact List provides awareness for a list of users by showing any computer input device idle time and any communication activity indicators for each user.

Contact List

Figure 1 shows an example of a Contact List for a user named John. This Contact List shows the selected users of whom John can maintain awareness and with whom he can easily start communications. John specified the order in which these users appear when he set up the list. John has also chosen to show an entry for himself, which is kept separate up at the top of the list.

The appearance of the entry in the list provides more information about each user:

- is the user logged in and using ConNexus?
- have the input devices (keyboard and mouse) been idle?
- is the user engaged in any communication activities that the computer set up (shown by activity indicators)?

John's entry is in black text, which shows that he is running ConNexus and active on his computer (no idle time). Since he is not involved in any on-line communication activities, no activity indicators are displayed. Nicole's entry shows that her computer's input devices have been idle for 55 minutes, and the activity indicator shows that her on-line calendar has a scheduled appointment during this time. Thus, it is likely that Nicole is away at a scheduled appointment.

Jean's entry has an activity indicator showing that she is currently involved in an IM with another user. If a user were involved in more than one IM at the same time, a corresponding number of IM activity indicators would be shown on her contact list entry. Bo's entry shows that he is active on his computer, but not involved in any communication activities.

Janak's entry shows that he has logged out of his computer. His entry is in gray text (not black), and the icon shows that he is not logged in to a computer on the intranet. The time and date stamp indicates when he last logged out. Max's entry is also in gray, indicating that he is also not accessible through ConNexus. The icon indicates that he is logged in at a computer, but does not have ConNexus running (thus ConNexus cannot be aware of his activities). The date and time stamp indicates when he quit out of ConNexus.

Other activity indicators in the Contact List include showing if a user is currently on the phone (assuming there is an interface for integrating the computer with the telephone) or involved in a desktop conference (e.g., the SunForum application-sharing program). The awareness information conveyed in the Contact List helps the user decide whether now is a good time to attempt a contact with someone. In contrast with AIM, all this awareness information is continuously displayed in the Contact List without requiring the user to select an entry.

Note that in the workplace, users tend to stay logged in to their computers throughout the day (if not longer). The transition highlighted in AIM when a user logs on to or off from the ISP does not meaningfully indicate the availability of the workplace user. Input device idleness is a more telling indicator of whether they are actively working at their computer. Thus, ConNexus displays input device (mouse and keyboard) idle time in the Contact List, and treats becoming active (after being idle for more than 20 minutes) as a transition similar to logging on to AIM.

Contact Toolbar

Clicking on any user's entry on the Contact List brings up a Contact Toolbar for that user:

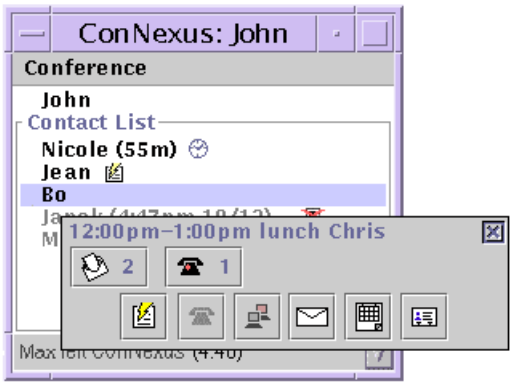

Figure 2. The Contact Toolbar provides more information on a selected user: salient appointment information, any pending incoming communication from him, and a row of buttons that activate communications resources with him.

The Contact Toolbar gives you more details about the activities of that user and gives you access to the communication resources relevant to him or her. The example in Figure 2 shows that when John selects Bo, a Contact Toolbar for Bo appears. At the top of the Contact Toolbar is one line of information about the most salient appointment for Bo—either an appointment that is scheduled to occur during the current time, or the next appointment that is scheduled to occur for the day, if there are any.

The next row of buttons shows any pending communication directed toward John from Bo which John has not yet seen or heard. The example shows two e-mail messages and one voice-mail message from Bo to John that have not yet been accessed. Attending to these pending incoming communications might be relevant before trying to contact Bo. Clicking on the associated button would bring up an interface to let John read those e-mail messages or listen to those voice-mail messages.

The bottom row of buttons presents the relevant communication resources for Bo. Proceeding from left to right, John can start an IM chat, call on the phone, start a SunForum desktop conference, open an e-mail compose window, browse the full version of Bo's calendar, or access Bo's online directory card (which provides even more contact information for him). We wanted to make it easy to choose the appropriate contact channel by integrating the various computer-mediated communication resources into the Contact Toolbar. Once any of the tools in the bottom row are selected, the Contact Toolbar is dismissed.

Getting peeked

When you select a user's entry to bring up the Contact Toolbar, that person is made aware of your interest in them by seeing a peek animation appear next to the entry for you in their Contact List and hearing an accompanying sound (sounds will be described in more detail in the Transitions section below).

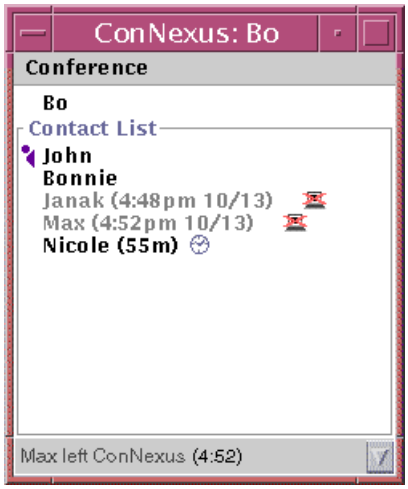

Figure 3. When John brings up a Contact Toolbar for Bo, Bo sees an animated peek icon next to John's name.

This indication restores some of the reciprocity between people trying to establish communication that is typically lost among distributed groups. Bringing up the Contact Toolbar reveals more information about a user, and often forecasts that you are about to initiate some sort of communication to that user. Thus, ConNexus conveys that "sense of approach" by indicating to the user that you are "peeking" at them.

IM text chat

In redesigning the interface for IM, we focused on the following issues:

- Reducing the potential disruption of IM by giving recipients of a message some ability to preview what the message is about, with an option to gracefully ignore it.
- Giving IM participants clear cues about when you are mutually engaged with others in an IM conversation, so you can start and end conversations more gracefully.
- Keeping the IM conversation lightweight and efficient.

The ConNexus design tries to address these issues by providing some of the reciprocal awareness cues among the participants that people use when managing face-to-face interaction.

Initiating an IM chat

Choosing to launch an IM chat from the Contact Toolbar (or, as an accelerator, double-clicking on a user's entry in the Contact List) starts an IM chat with that user. An IM window pops up and an IM activity indicator also appears beside your entry in everyone's contact list. The IM window has a region that displays the interactive chat, and a text input field below that for typing your input to the chat (see Figure 4). When the IM window first pops up, the background color of the chat region is in gray, indicating that the person you initiated the message with has not yet joined in the chat (i.e., he does not yet have the IM window open on his screen). Once the selected user joins the chat, the background of your IM chat region changes from gray to white, indicating that you are mutually engaged in an IM conversation.

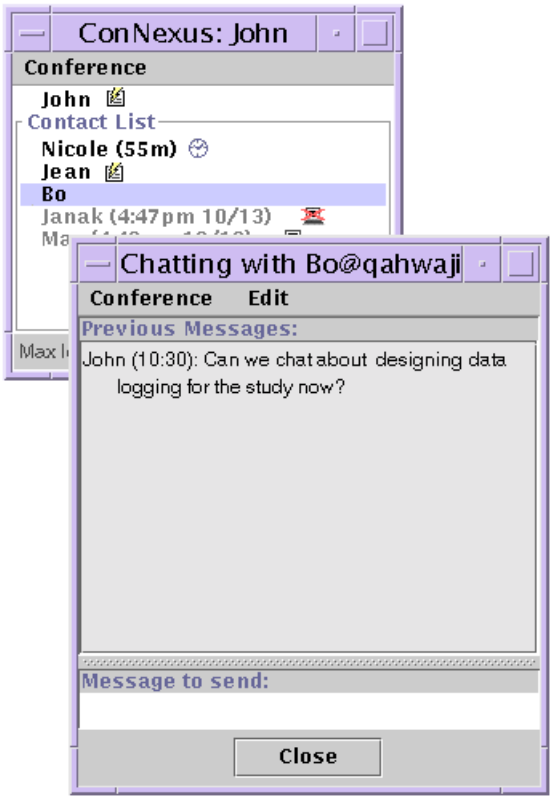

Figure 4. When John starts an IM chat with Bo, the chat region initially has a gray background until Bo joins the chat.

To enter text into the chat region, you type into the text input field at the bottom. The text gets inserted into the text chat region character-by-character, so that the others engaged in the chat see it appear in their IM windows as you are typing.

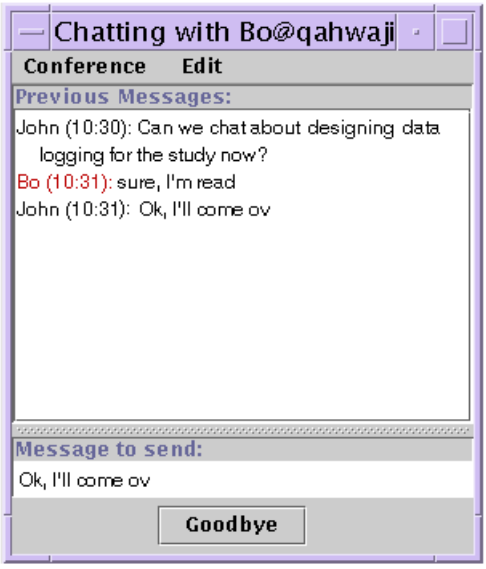

Figure 5. Once an IM chat has at least two participants, the chat region background turns from gray to white, to indicate that the participants are mutually engaged in an IM chat.

This character-by-character approach contrasts with many commercial IMs that only display your input to the text chat after you have ended with a carriage return. One problem experienced with that model is that other users cannot tell if you are in the process of responding (and should thus wait) or are attending to something else (which commonly occurs in IM conversations). Showing the text input character-by-character allows other users to see that you are in the process of composing a response and can even increase the efficiency of IM chat by allowing them to anticipate the intent of the text before it is actually completed.

This increased efficiency can be even more important in IM use in the workplace, where it is often used in parallel with the phone. Our experience is that seeing the IM responses as they are being typed helps us keep up with the real-time conversation happening concurrently over the phone.

Receiving an IM chat

When an IM chat is started with a user, he gets the peek animation from the initiator of the message (if he had not already gotten a peek) and an IM activity indicator and sound. The IM indicator (shown in Figure 6) has a red highlight around it, indicating that this IM request is directed at the recipient, and is awaiting his response to either join or ignore it. The red highlight appears as soon as the IM chat initiator has started typing some text into the message.

If the user wants to join the IM chat, he double-clicks on the entry of the person initiating the message. This brings up the IM window for him (and also turns the initiator's IM chat region background from gray to white, indicating that the IM chat has been joined). Also, the red highlight around the IM indicator goes away, as the IM request is no longer pending. Text into the IM chat region is entered in the same way as for the initiator.

The recipient can also choose to ignore the IM request. At this point, he has only gotten a peek in his contact list and heard a sound, so the potential disruption has been minimized. Alternatively, the recipient of an IM request can get a preview of the incoming message to help decide whether to respond to it.

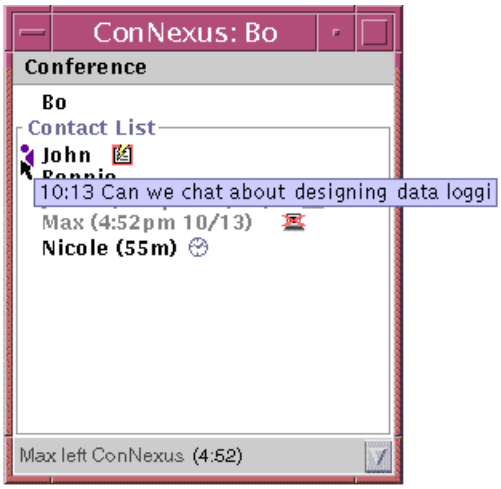

Figure 6. When receiving an IM request, the user can position the mouse over the requester's entry to get a Contact Preview of the incoming message.

By positioning his cursor over the requester's entry in the Contact List, he can get a Contact Preview—a roll-over pop-up that displays a time stamped line of the most recent text entered into the message at that point. The Contact Preview shows the text currently being entered into the text input field (up to the point that the Contact Preview was opened). If the initiator has already pressed carriage return without starting to type anything new in the text input field, then the text just entered is displayed. The Contact Preview allows the recipient of the IM chat to preview what this message is about, and thus decide whether he wants to join the IM chat or not. The user can double-click to join, or choose to ignore the IM request.

Ending an IM chat

Without the non-verbal cues that face-to-face conversants use to subtly indicate their intent to draw a conversation to a close, we found ending IM chats to be awkward. Even with the abbreviated goodbye exchanges that have developed, we found ending IM conversations to be somewhat clumsy and tedious because they had to be typed out. The ConNexus IM offers an interface to help facilitate gracefully ending chat conversations.

The IM window has a "Goodbye" button at the bottom that allows users to convey their intent to end the conversation without abruptly disconnecting the chat. When a user presses Goodbye, the "leave-taking" process begins by printing a message into the chat tailored with that user's name ("**Bo waves goodbye") followed by a series of dots of diminishing size. This starts a countdown, currently set to 7 seconds, where a new dot is displayed every second, and the decreasing size of the series of dots helps the user predict when the countdown will expire. This conveys that you would like to take leave of the conversation, but keeps the connection active during the countdown.

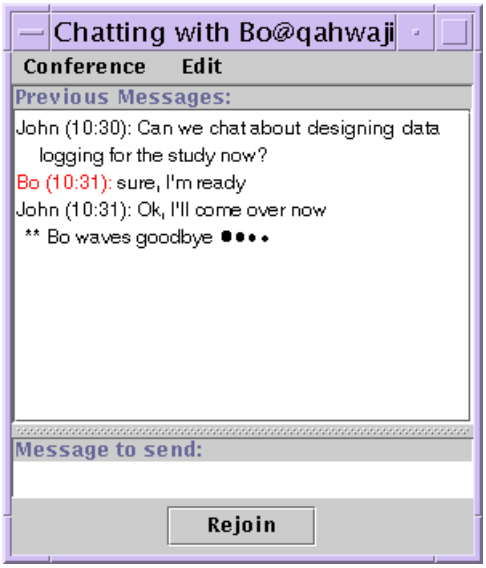

Figure 7. Pressing the "Goodbye" button starts the leave-taking process by printing a message and starting a short countdown, indicated by a series of diminishing dots.

This process affords anyone else in the chat an opportunity to raise any last-minute issues before being disconnected. If the countdown expires, a time stamp indicating what time you left the conversation is displayed in the text chat region, and after a short delay, your IM window closes.

If any of the other participants want to continue the conversation, however, they are still free to type in text, which would appear in the IM window as usual. You can abort the countdown by pressing the "Rejoin" button (which replaced the "Goodbye" button when it was pressed) or simply typing into the text input field of the IM window to resume the conversation. The system prints a message that you have rejoined the chat, and the conversation continues. This interface tries to reflect what happens when ending a conversation in face-to-face conversation where one participant can indicate their intent to end the conversation and start walking out the door. This move can effectively close the conversation, or the other person can still easily restart the conversation, diverting their partner from leaving. Our earlier experience with the Montage video glancing system (Tang et al. [14]) suggested the need for affording this leave-taking process before terminating the connection.

Note that any user also has the option of not pressing "Goodbye" to keep her IM window up, even after all other participants have left the chat. Keeping the IM window around even after everyone else has left can be helpful if there is information (e.g., URL, e-mail address) that would be useful to access later. To clearly indicate that the user is no longer connected with anyone else, the background of her chat region is changed from white to gray.

Transitions

Besides knowing the current status of each user, people often want to be aware of certain transitions in others' activities (e.g., logging in, becoming active, initiating an IM to you). In addition to the sounds that most commercial IM systems offer, these transitions are highlighted in ConNexus through animations and persistent entries in a status footer.

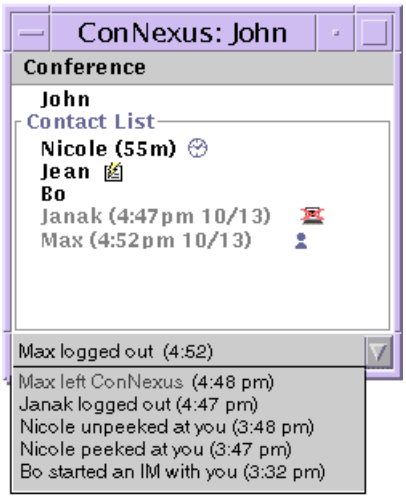

Figure 8. The status footer keeps a short history of status messages. Note the silhouette is actually an animation moving toward the right to show that Max is logging out.

For example, if Max logs out of his computer, a corresponding sound will play (indicating that a user has logged out), an animation of a silhouette "leaving ConNexus" will be shown on Max's entry, and the status footer at the bottom of the window will indicate that Max has logged out. Our experience with IM use indicates that users often become aware of these transitions from the associated sound, but may not be able to immediately see what transition occurred. Their IM window may be buried under other windows or displayed in another "virtual" desktop. Thus, it is important to have some longer-lasting indications of the transition, such as an animation that takes a few seconds, or a status message that persists. Besides the peek animation, we designed an animation for logging out (silhouette exiting to the right on the user's contact list entry) and logging in (silhouette entering from the right).

In addition to the animations, ConNexus displays a text message in the status footer describing the transition event. As shown in Figure 8, the drop-down menu widget in the status footer allows users to review a short history list of the transition messages, in case they missed one before it was overwritten by a subsequent message.

Transitions are also accompanied with a sound. A different sound is associated with:

- logging in (to both ConNexus and the computer)
- logging out (of both ConNexus and the computer)
- peeking at you
- unpeeking at you
- sending an IM to you
- becoming active after being idle for more than 20 minutes

The sound conveys what kind of transition occurred while the activity indicator, animation, and status footer message in the Contact List indicate which user is associated with the transition. We used musical sounds that were intended to be minimally disruptive.

Another concern with IM use is staying aware of any transitions that occurred while you were not attending to ConNexus (e.g., out of the office, logged out of ConNexus). If you have not been running ConNexus or have been idle for more than 20 minutes, any transition sounds that occurred during that absence that are still pending are replayed when you become active in ConNexus. Only one sound per transition type is played to signal that a certain event occurred and prompt you to visually check your ConNexus window for more details. Sounds for transitions that are no longer pending would not be played (e.g., if someone peeked and unpeeked at you while you were gone, or someone started an IM chat to you, but then canceled it).

PRELIMINARY USE EXPERIENCE WITH A PROTOTYPE

To get some early use experience with the ConNexus design concepts, we extended an academic IM system (PEPPER from Virginia Tech) to create a working prototype that demonstrated an initial set of ConNexus features. The working prototype that we have implemented so far focuses on the subset of our ConNexus design that distinguishes it from existing IM systems.

The current prototype displays logged in/logged out, idle time, and IM activity indicators in the Contact List. Transition events in the Contact List are accompanied by animations and sounds. It does not show a status footer or history list, and has no mechanism for managing who is on your contact list (any and all people who connect to the ConNexus server appear on everyone's Contact Lists).

In the Contact Toolbar, the one line of salient appointment information is implemented, as is integration with all the communication resources except the phone and voice-mail. While we did implement the unread e-mail messages indicator, this feature had to be removed because the performance was too slow and had other undesirable side effects on the user's e-mail reader.

The interfaces for peeking, starting, and ending IM text chats (with the white and gray background indicators for mutual engagement) were all implemented (except the goodbye interface only had a series of '*' characters instead of diminishing dots). IM text input was transmitted character-by-character.

Our working prototype allowed us to get early user feedback on many of the novel ConNexus design concepts before building a complete system. We have been using the ConNexus prototype among ourselves for about eight months, and have added two other research colleagues we have been working closely with for the past two months. We recently added a third research colleague, and deployed a separate ConNexus server to a group of three administrative assistants who are less closely affiliated with our research. While this should only be considered preliminary use experience (and we plan to conduct a more systematic study) we have already learned some lessons and implemented some changes to ConNexus.

Reflections on Our ConNexus Usage

Overall, we feel like we have come to depend on the awareness that ConNexus provides to help us time when to contact each other. This awareness is especially useful across the three hour time difference, to notice when people come into the office (on the West Coast), when people leave for and come back from lunch, and when people leave the office (on the East Coast).

Much of the benefit from ConNexus comes from the awareness in the Contact List, without using the IM text chat at all. We use the awareness of when people are at their desk to time when to place a phone call to them, which is still done manually by dialing the phone since it is not yet integrated into ConNexus. A telling indication of our reliance on ConNexus arises when a (yet unresolved) bug causes it to erroneously report someone as logged out, even when she is logged in and actively using her computer. We would not bother to attempt a phone call, assuming that she is not available, only to discover (by receiving e-mail or a call from her) that ConNexus is misbehaving and she is in fact available and in some cases even waiting to get a call!

We have also found the IM text chat to be a useful parallel channel during phone teleconferences. The character-by-character display of the text helps us keep up with the ongo-

ing phone conversation while “passing notes” among ourselves in a timely way over ConNexus.

While the ConNexus design aims to be the single point of contact for all workplace communication, the working prototype falls short of that goal primarily because of the lack of telephony integration. Thus, conversations that start in IM and migrate to the phone have to be dialed manually, taking us “out” of ConNexus. Consequently, any additional media transitions (e.g., adding desktop conferencing) tend to also happen outside of ConNexus. While the working prototype has enabled us to experience a workplace IM system, it has not yet given us any indication of how successful our design is at integrating all workplace communication.

We recently instrumented the ConNexus prototype to log its usage. We reviewed the logs for the three authors of this paper for ten working days that were “typical” (i.e., days where we were all in the office but were not doing demonstrations to new users or visitors). Although very preliminary data, the logs do suggest some patterns and provide some evidence for our perceptions of ConNexus use.

One overall observation is that while the three of us run ConNexus continuously, we only logged 23 IM chats among the three of us over the ten days. This relatively low usage of IM (less than one IM per person per day) is consistent with our perception that we rely largely on the awareness that ConNexus offers independent of using IM chat.

Over the ten days, John initiated ten IM chats, Bo initiated six, and Nicole initiated five. The median duration of the IM chats was 59 seconds, indicating that IM chats tended to be short conversations. The longest recorded chat was 14:33, which occurred when John started an IM chat with Bo, then called him using the phone and left the IM open (even though it was not being used). All of the IM chats that Nicole initiated occurred while she was also on the phone.

Clearly more data collection and analysis are needed, but the data do support the perceptions that the benefits of awareness can be experienced independent of IM chats, IM chats are short, and IM chats are often held concurrently with phone conversations.

Design Changes

One of the early things we learned from using ConNexus IM text chat among ourselves is that having your typing appear in the text input field while being echoed character-by-character into the IM chat region at the same time was potentially distracting. Some users became more self-conscious by seeing their typing appear in two places at once, leading to more typing errors.

To minimize this distraction, we changed the text appearing in the text chat region to a light gray color, as shown in Figure 9. Once you press carriage return in the text input field, the input field is cleared, the text in the chat area turns black, and you can no longer edit that text utterance.

Our experience with IM use indicates that some IM conversations become attended to intermittently. Thus, we plan to include an Alert button on the IM window that generates an alert signal (e.g., play a sound, flash window) at all the IM participants’ computers to regain their attention.

Figure 9. Revised IM window with grayed out text echoed in the chat region, an Alert Button, and integrated communication tools.

We have also come to realize that our integration of the communication resources into the Contact Toolbar does not fully address the issue of using IM to bridge to other communication channels. While the Contact Toolbar allows you to choose which communication tool you would like to initiate with another user, it goes away once a user selects a tool. Yet, users often start an interaction in IM chat, then move to another or additional communication channels (e.g., move to phone call, add desktop conferencing). Thus, in addition to being available on the Contact Toolbar, the buttons for those communication resources (e.g., phone, desktop conferencing, e-mail) should also be available from the IM window itself.

Our deployment to the administrative assistants demonstrated how our model of peeking was potentially confusing. They did not find it useful to know when people were simply bringing up the Contact Toolbar on them, and were confused about how someone peeking them was separate from actually receiving a communication from them. While we initially thought that such awareness was useful in managing how much access others have to more detailed information about you, we have come to reconsider that design based on our early user experience.

We have since revised the meaning of peeking to convey that the person is about to initiate some communication with you, rather than bringing up the Contact Toolbar on you. This meaning of peeking gives you a sense of approach of some imminent contact. For example, if someone initiates an IM chat with you by double clicking on the entry for you in her contact list, you will immediately get a peek sound and animation by her name (approach). Once she actually starts typing something into her IM window, you will then get an IM sound and highlighted pending IM activity indicator by her name (contact).

Similarly, if she were to use the Contact Toolbar to place a phone call to you, the peek would occur when she pressed the phone button (approach), but the phone activity indicator would appear after the phone had been dialed and the phone started ringing (contact).

This change means that you are no longer aware of when people access information about you through the Contact Toolbar. Our use experience suggests that being aware of that activity was not meaningful, and potentially confusing relative to the other activities that ConNexus monitors.

FUTURE WORK

Although we have already learned much from our experience with the ConNexus prototype, there is much more work we would like to do on this project. As mentioned earlier, we would like to do a broader deployment of ConNexus for a more systematic study. We would like to deploy it among a more detached group of people (those who would not be influenced by working affiliations that they have with our group). We would also like to get a sense of how the ConNexus concepts work in a larger scale deployment. Many issues about the use of IM may be different when more than a handful of people are using it. We would like to more systematically study people's reactions to ConNexus, assess whether it increases their effectiveness in establishing contact with others, and gain more experience with the usability of the user interface. It would be interesting to compare how people use ConNexus with earlier research on the use of existing IM systems [13].

Up to now, we have focused on designing and implementing the novel features in ConNexus. As a result, some basic functionality, such as Contact List management, configuring sounds associated with transition events, and other "do not disturb" availability states, are not yet designed. Our experience especially highlights the need to support multiway IM chat. Consistent with the research by Whittaker et al. [15], we found that many informal conversations that start with two people grow to more than two before they are completed. We need to include such basic functionality into the design of ConNexus.

Of course, we would like to implement the full ConNexus design. Before that can be done, we need to re-architect the implementation of ConNexus, both to address some reliability issues that we are currently experiencing, and to allow us to explore some features that cannot be supported in the current architecture. While we would like to reuse the infrastructure of an existing commercial IM system, we have found that characteristics of those message protocols make them impractical for our design. The main issue is that ConNexus sends messages character-by-character whereas most existing IM protocols package an entire message as a unit. While the ICQ system does offer a character-by-character mode, its protocol is not publicly available. We would rather not package each character into a "whole" message because that would waste network resources and incur processing overhead, which would degrade the immediacy of the user experience. Such costs are even more critical for implementations on wireless networks and small devices, which we plan to explore in the future.

Therefore, the protocol of our next implementation will include a *streaming* message capability that transmits messages character-by-character more efficiently than our current prototype. Support for streaming messages should also be considered in the current discussions on establishing IM protocol standards and interoperability.

We would also like to explore integrating voice communication, perhaps by some combination of computer-telephony integration and voice over data networks. We would like ConNexus to handle the range of communication channels, regardless of what underlying media or device is used to make the communication. This integration is crucial for making ConNexus much more than just a workplace IM system, but one that manages all of the communication in the workplace.

We would also like to gracefully handle multiple log-ins to ConNexus. In the workplace, we expect it to be fairly common to stay logged in to ConNexus from the computer in your office while also logging in from other locations (e.g., from home during the evening, from another terminal location, from a wireless PDA device that you take with you to meetings). We would like ConNexus to handle multiple log-ins gracefully and meaningfully, without adding multiple entries of you into others' Contact Lists. For example, if you have left yourself logged in to ConNexus from your office computer but are currently active on your computer at home, ConNexus should direct any attempts to contact you to your home computer, rather than your office computer. Furthermore, ConNexus should report awareness information (e.g., idle time, communication activities) based on your activity on your home computer, not the idle computer in your office.

Another area to explore is connection with wireless devices. Previous research by Bellotti and Bly [2] demonstrated how people's mobility gives rise to the need to collaborate with others beyond when they are at their computer desktops. We expect more usage of wireless devices that have some connection to the computer network (e.g., cell phones, PDAs, two-way pagers). We would like ConNexus to be able to manage awareness and communication to these devices. For example, a user at a desktop computer ought to be able to notice that another user is available through a cell phone and place a call to there. The ConNexus interface that appears on these wireless devices would look very different from what appears on a desktop computer. These devices have more limited screen space and are used very differently (e.g., looked at very intermittently rather than the more continuous use of desktop computers).

Furthermore, figuring out what kinds of awareness information is appropriate to transmit from wireless device users is also an interesting design issue. For example, if you are using a cell phone or wireless PDA away from your computer desktop, you may want to invoke a different filtering mechanism for who has access to you and what information about your whereabouts you make available to others. Designing appropriate ways to interact with people using wireless devices presents some interesting user interface design issues.

The ConNexus design explores ways to integrate awareness information and communication resources to help workplace users manage their contacts with other people.

- The Contact List provides awareness of others' availability and communication activities to help find opportune times to contact them.
- The Contact Toolbar integrates workplace communication resources (IM, phone, e-mail, on-line calendar, and desktop conferencing) to facilitate making contact through the appropriate channel(s).
- The IM text chat interface applies the ways people use interactional cues in face-to-face interactions to help users gracefully manage IM conversations.

Our preliminary use experience suggests that the design concepts expressed in ConNexus are promising. We are just approaching the point where we could deploy and systematically study the use of the ConNexus working prototype to gain a deeper understanding of how people use it and how its design could evolve. We also look forward to expanding ConNexus to include other devices not anchored to the computer desktop.

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