ConNexus to Awarenex:
Extending awareness to mobile users

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ABSTRACT

We explored the use of awareness information to facilitate communication by developing a series of prototypes. The ConNexus prototype integrates awareness information, instant messaging, and other communication channels in an interface that runs on a desktop computer. The Awarenex prototype extends that functionality to wireless handheld devices, such as a Palm. A speech interface also enables callers to make use of the awareness information over the telephone. While the prototypes offer similar functionality, the interfaces reflect the different design affordances and use contexts of each platform. We discuss the design implications of providing awareness information on devices with varying interface and network characteristics.

Keywords

awareness, mobile devices, wireless handhelds, instant messaging, computer-mediated communication, CSCW.

AWARENESS ON THE MOVE

For over a decade, the research community has been exploring how to provide awareness information to help distributed collaborators work together more smoothly. Awareness information facilitates contact and communication among distributed workers by representing some of the cues people use in face-to-face situations to determine if a colleague is available for an interaction. This paper presents a progression of design ideas that extends awareness research beyond the desktop to include mobile users.

Context of Awareness Research

Early awareness research included the Media Space (Bly et al. [3]), which provided a live video view of remote collaborators' office activity, and Portholes (Dourish & Bly [5]), which relaxed the bandwidth requirements by using occasional video snapshots instead of live video. More recent work explored using alternatives to literal snapshots, such as the pictorial representations in Piazza (Isaacs et al. [7]), line drawings in Peepholes (Greenberg [6]), and the virtual world in the Forum Contact Space (Jeffrey & McGrath [8]).

Instant Messaging (IM) systems also provide some awareness information, indicating when a "buddy" is on-line and how long they have been idle. The BABBLE project pro-

vides more awareness information about people's activity while in a chat-style conversation (Bradner et al. [4]). Thus, we see a trend in awareness work from rich video images among computer desktops to lower fidelity text information. The pervasiveness and lower network bandwidth requirements of text affords widespread use and is even accessible from mobile, handheld devices.

Making Awareness Mobile

Recent research also highlights the need to account for people's mobility when designing collaborative systems. Bellotti and Bly [1] found that workers' local mobility (e.g., visiting other offices, attending meetings, walking between sites) often means that they are not near their computer desktop. Consequently, all the tools that help manage communication, coordination, and awareness on the computer desktop are ineffective whenever the user is mobile. The proliferation of wireless devices that have some connection to a computer network (e.g., cell phones, wireless handhelds, two-way pagers) presents the opportunity of extending the benefits of awareness information to mobile users.

The 'live addressbook' project by Milewski & Smith [10] augments the traditionally static address book with dynamic awareness information. It allows users to manually update their availability and best phone contact (e.g., office, cell phone, home office) as they move about. Recognizing the need to access and update this information while mobile, they also offer a wireless Palm handheld client.

The CLUES work of Marx and Schmandt [9] took advantage of integrating communication resources to help provide users with a simple and effective interface for managing their communication while mobile. Many of the popular commercial IM systems are also exploring IM clients for mobile devices.

In this paper, we report on a progression of prototype designs that provide awareness information to facilitate contacting people. We begin with a research prototype that runs on desktop computers, code named ConNexus. The next iteration research prototype, code named Awarenex, extends the functionality to mobile devices, such as wireless Palm handhelds and Research In Motion (RIM) Blackberry devices, in conjunction with cell phones. A third prototype provides access to awareness information from a

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conventional telephone through a speech interface. We present our design concepts and some lessons learned in providing awareness services on multiple platforms.

PROJECT ConNexus: AWARENESS FOR THE DESKTOP

Many companies confronting the problem of increasingly distributed workforces have turned to commercial IM systems to facilitate remote communication. We believe that the design requirements in the workplace are different than those for on-line socializing, where IM became popular. In designing ConNexus, we integrated communication tools and awareness capabilities into the workplace context.

We drew upon the research of Nardi et al. [11] who studied the use of IM in the workplace and identified some common patterns of use:

• Establishing contact—In the workplace, IM is often used to make initial contact and decide whether now is a good time to have an interaction.

• Communication transitions—Once contact is made, the IM often transitions to another communication channel (e.g., phone, face-to-face, e-mail).

Their study also revealed how concerned workplace users are about being interrupted and interrupting others when initiating contact. One reason users like IM is because they find it to be less disruptive than the phone.

The ConNexus User Interface Design

Based on the Nardi et al. study [11], our own review of IM products, and visits to IM customers, we identified three design goals for a new workplace communication tool:

• Provide awareness cues to help people find opportune times to initiate contact

• Integrate multiple communication tools to facilitate transitions from one to another

• More naturally support the process of starting, maintaining, and ending communication

These features go beyond current commercial IM systems to create a unified interface for managing communication with others. We called our desktop prototype ConNexus, which stands for *Con*tact *Nexus*. The primary components in ConNexus are:

• Contact List—a selected list of colleagues for which awareness information is provided and through which you can easily establish contact with them.

• Contact Toolbar—upon selecting a particular colleague, more detailed activity information and access to communication channels are presented.

• Communication Tools—a tailored set of communication tools appropriate to each person on the Contact List, including IM, e-mail, application sharing, and calendar.

Contact List

The Contact List provides awareness information for a selected set of people. Each entry in the list indicates whether:

• the user is logged in and using ConNexus

• the input devices (keyboard and mouse) have been idle

• the user is engaged in any computer-mediated communication activities (shown by activity indicators)

Figure 1 shows a Contact List for a user named Nicole. Nicole has opted to show an entry for herself, with is at the top of the list. Her entry indicates that she is running ConNexus and active on her computer (black text with no idle time). Since she is not involved in any communication activities, no activity indicators are displayed.

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.

The activity indicator at John's entry shows that he is currently involved in an IM with another user. Bo's entry shows that his computer has been idle for nine minutes. Don's entry in gray text and the accompanying icon shows that he has logged out of ConNexus at the time and date indicated.

Contact Toolbar

Clicking on any user's entry on the Contact List brings up a Contact Toolbar for that user. The Contact Toolbar provides calendar information and access to the communication resources relevant to the selected user.
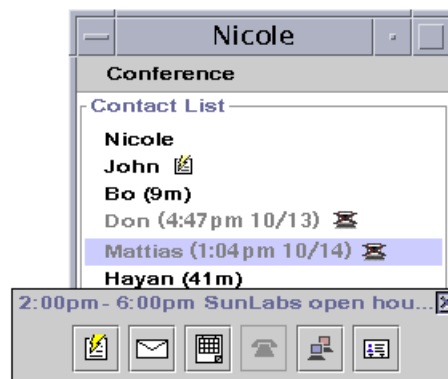

Figure 2. The Contact Toolbar shows a salient appointment and buttons that activate communication resources.

In the Contact Toolbar for Mattias shown in Figure 2, the first line at the top shows one line of information about the most salient appointment for Mattias—either an appointment that is currently occurring, or the next appointment, if any, that is scheduled to occur for the day. The row of buttons presents the relevant communication resources for Mattias. Proceeding from left to right, Nicole can start an IM chat, open an e-mail compose window, browse the full version of his calendar, call on the telephone (not implemented), start a SunForum[TM] desktop conference (which allows application sharing), or access his on-line directory

card (which provides any contact information available from the corporate database, such as room number, mailing address). By integrating the various computer-mediated communication resources into the Contact Toolbar, users can easily choose the appropriate channel to make contact.

Providing More Awareness in IM Text Chat

While the IM chat functionality in ConNexus is similar to commercial IM systems, we revised the features to minimize disruption and increase awareness of remote participants. Choosing to launch an IM chat from the Contact Toolbar (or double-clicking on a Contact List entry, as an accelerator) brings up an IM window. The IM window has a region for displaying the interactive chat, and a text input field below that for typing input to the chat (see Figure 3). Initially, the background of the chat region is a light gray until the person you are directing the IM to joins the chat.
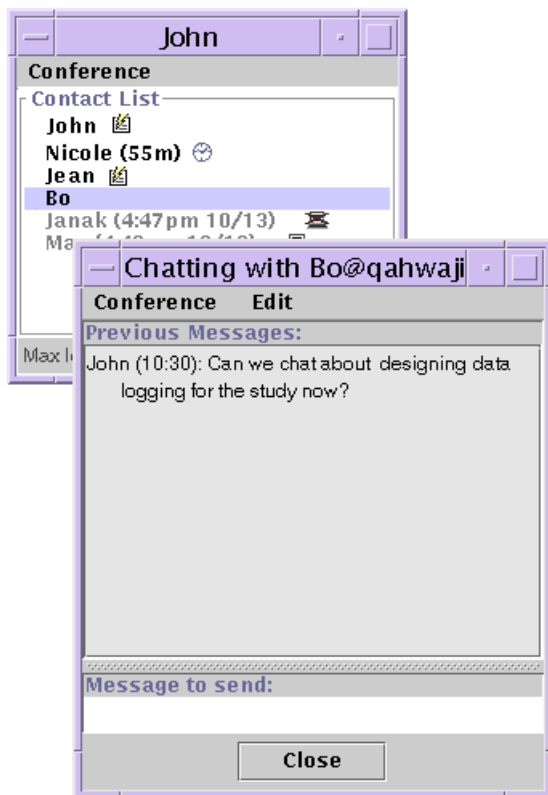

Figure 3. John opens an IM chat window that has a chat region and a text entry field at the bottom. The chat region initially has a gray background until Bo joins the chat.

When a user gets a request to start an IM, a peek icon animates out next to the name of the initiator of the IM, an IM activity indicator appears, and a sound is played. This provides a sense of approach that someone wants to start an IM interaction. If the user wants to join the IM chat, he double-clicks on the entry of the person initiating the message. The recipient can also choose to ignore the IM request. At this point the disruption has been minimized to a peek and icon indicator in the Contact List and a notification sound.

Alternatively, the recipient of an IM request can get a preview of the incoming message to help decide whether to respond to it. 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 the most recent text entered into the message at that point, shown in Figure 4. The Contact Preview allows the recipient of the IM to preview what this message is about, and decide whether to join the IM.
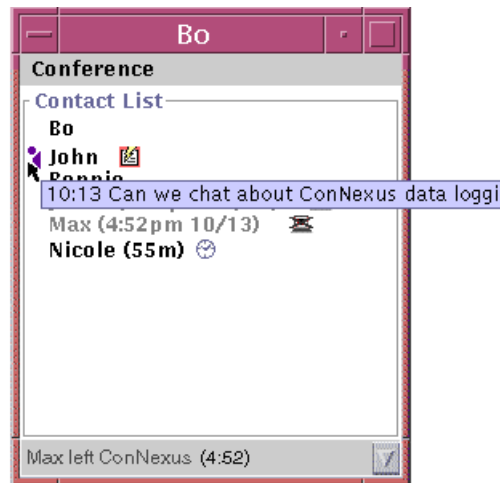

Figure 4. When receiving an IM request, the user can position the mouse over the requester's entry to get a Contact Preview of the incoming message.

When the recipient joins the IM, the chat region background turns white, giving you awareness of when you are mutually engaged in an interaction. As you enter text into the input field at the bottom, it gets inserted into the chat region character-by-character, so that others in the chat see it appear in their IM windows as you are typing. Showing the text input character-by-character lets other users be aware that you are in the process of responding (rather than attending to something else). It can also increase the efficiency of IM chat by allowing participants to anticipate the intent of the text before it is actually completed.
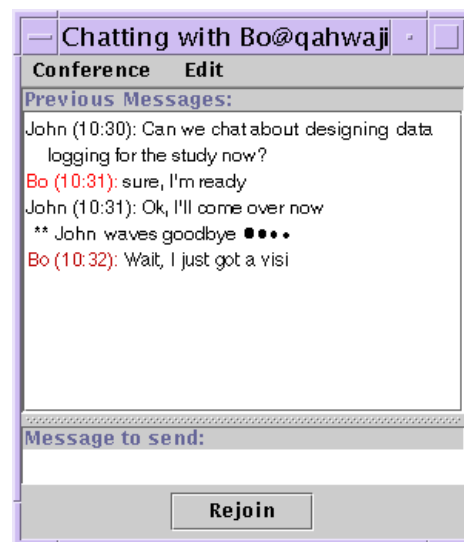

Figure 5. Pressing the "Goodbye" button starts the leave-taking process by printing a message and starting a short countdown, indicated by a series of diminishing dots.

The IM window has a "Goodbye" button at the bottom that allows users to convey their intent to end the chat without abruptly disconnecting the IM. Pressing Goodbye starts the "leave-taking" process by printing a message and starting a countdown, shown by a series of dots of diminishing size, (see Figure 5). This conveys that you would like to take leave of the conversation, but keeps the connection open for any last-minute thoughts before the window disappears.

Preliminary Use Experience with a Working 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. We have been using the prototype in our own group (which is split between California and Massachusetts) for about a year and a half, and have added two other working groups and summer interns adding up to about ten users of the system. We also temporarily deployed ConNexus among a group of three administrative assistants.

From this preliminary use experience, we found that much of the benefit from ConNexus comes from the awareness in the Contact List, without using IM or other communication tools at all. Awareness of when people are at their desk is useful in timing when to place a phone call to them (which is still done manually by dialing the phone since telephony is not integrated into ConNexus). Awareness information is especially useful for users in different time zones. For our group, it helps us notice when people on the West Coast come in to the office, when people leave for and come back from lunch, and when people on the East Coast leave the office. Users also appreciated having calendar information integrated into ConNexus as being much more efficient than using our desktop calendar program to browse someone else's current schedule.

PROJECT AWARENEX: MOBILE AWARENESS

The proliferation of mobile devices and the need to account for mobility in collaborative technology motivated us to extend the awareness functionality in ConNexus to wireless devices. We began by interviewing groups of mobile professionals (real estate agents, technical consultants) to understand their communication needs and how they currently use their mobile devices. Some common themes emerged from these interviews:

• People need access to their information from a variety of locations (e.g., home office, branch office, in transit).
• Mobile devices are commonly used concurrently or in close relationship with each other (e.g., looking up a number on a Palm to place a cell phone call).
• Mobile users demand timely responsiveness and applications that are efficiently designed.

Drawing from previous research and these interviews, we designed the Awarenex (for *Aware*ness *nex*us) prototype. We focused on handhelds (wireless Palms, RIM Blackberry devices) and also integrated telephony into Awarenex. We wanted both to enable mobile users who were away from their desktop computer to maintain awareness of their colleagues, and to be able to maintain awareness of mobile users when they left their desktop. In addition, we built a prototype speech interface so that users calling in over the phone (without any display device) could make use of the awareness and communication features of Awarenex.

Designing for mobile devices, rather than a computer desktop, posed a few major challenges:

• The screen size of mobile devices is severely limited (typically 160 x 160 for handhelds).
• Mobile devices are viewed only intermittently, rather than the somewhat continuous monitoring at a computer.
• Limited bandwidth, network infrastructure, and coverage constrains the amount, reliability, and speed of network connection to the device.

The Awarenex User Interface Design

The Awarenex interface drew heavily from what we learned with the ConNexus interface on the desktop while accounting for the mobility of the users and the constraints of the handheld platforms.

Contact List
The Contact List (shown on a Palm in Figure 6) tries to help you determine whether people are available for contact.
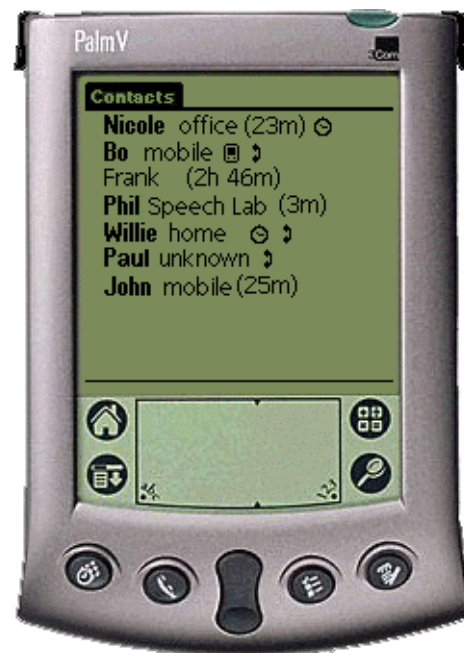

Figure 6. The Contact List (shown on a Palm) shows a selected list of users with the locale and activity indicators for each user's most recent activity.

Each entry in the Contact List includes a name, the locale for where that user is (or was most recently) active, and any communication activity information. Figure 6 shows that Nicole was most recently in her office, but her computer there has been idle for 23 minutes. Furthermore, the clock icon indicates that she currently has an appointment scheduled in her on-line calendar. From her awareness information, it seems unlikely that Nicole is available for contact.

Bo is shown to be mobile, currently using a wireless handheld, and in a call with his mobile phone. Frank has not been logged in to an Awarenex device (name is not in bold) for 2 hours and 46 minutes. Phil's most recent activity was in the Speech Lab 3 minutes ago. Willie is in a call at home,

during a scheduled appointment time. Paul is currently active on the phone but his locale is unknown, since he is using the speech interface over the phone which cannot report a location for him.

Note that all times are presented in a "relative" format (e.g., idle for 23 minutes, logged off for 2 hours and 46 minutes). This format avoids problems we encountered in our earlier experience with ConNexus, which used an "absolute" time stamp (e.g., logged of at 3:18p). Since users spanned across several different time zones, it was often unclear how to interpret in which time zone the time was being reported.

Most users do not log out of their office computers while taking short trips or attending meetings throughout the day, and many users leave themselves logged in indefinitely (until the computer requires rebooting). Thus, we had to handle users becoming active from another locale (e.g., mobile device, home computer) while still being logged on elsewhere. For the Contact List, we present the awareness information from the locale in which the user was most recently active. More detailed awareness information from the other locales is presented in the following screens.

Contact Locator
Clicking on an entry in the Contact List brings up a Contact Locator for that person.

Figure 7. The Contact Locator (shown on a RIM) shows a salient appointment, an e-mail entry, and awareness information on all devices in each locale.

The Contact Locator provides more detailed awareness information and presents the options for contacting that person, as shown on a RIM Blackberry 957 device in Figure 7. The interface on the RIM is driven by selecting an item with the thumbwheel and clicking on it to bring up a context-sensitive menu of actions associated with that item.

The first line in the Contact Locator shows the most salient appointment for the person (either a current or next occurring appointment scheduled in his on-line calender). The next line shows an e-mail address for the user, which can be

selected to bring up an e-mail compose window to him. The rest of the Contact Locator shows the locales that the system knows about, the contact devices within each locale, and the awareness information about each device. The most likely locale to reach the user (i.e., the locale with the most recent activity) is indicated by the locale label in bold.

While we hope the simple algorithm of highlighting the locale with the most recent activity will be helpful, we do not expect it to be foolproof. Rather, we imagine there will be many situations where the human user will have to interpret the complete awareness information from the calendar and all locales to determine the best way to try to contact a user. Thus, we present all the awareness information from all locales to enable the user to make informed choices that the software would not be able to reliably predict.

Within each locale, the communication devices are listed along with their awareness information. In the example in Figure 7, Bo was most recently active in his office and has devices in two other locales (mobile and home) through which he can be contacted. Clicking on an entry for a device will initiate a communication attempt to that person at that device, as described in the next section.

Note that the communication devices fall into two different categories: those that are usually on and used somewhat continuously, and those that are usually inactive and used only intermittently. This differentiation determines what kind of awareness information is useful for each device. Once logged on to a computer, it is used somewhat continuously, and any idle time of the input devices or time since logging out is reported as awareness information.

On the other hand, mobile devices and phones are used only intermittently, and otherwise are inactive. Thus, the awareness information shows when these devices are actively being used (e.g., in the contact list, a phone icon appears when in a call or handheld icon when it is being used). Otherwise, the time since the device was last used is reported.

The Contact Locator also provides access to communication resources that are not specific to a locale. On the RIM interface, these are offered as menu options that are presented when any item is selected. On the Palm interface, these options are displayed in a row of buttons along the bottom edge of the screen. These resources include providing an interface for browsing through the next week of calendar appointments for the person, sending him e-mail, and browsing his on-line directory information.

Initiating Communication
From the Contact Locator, you can initiate an attempt to communicate with a person at a specific device. Clicking on a device that can receive an IM (e.g., computer, handheld) brings up an IM interface. The latencies in some of the wireless networks are such that character-by-character display of the IM text is impractical. In this case, the text is buffered and transmitted when the line of text is completed.

Clicking on a phone entry brings up the interface shown in Figure 8(on a Palm) for placing a phone call. It shows placing a call to the person at the device that you selected. The system makes a guess about what phone to use for you from which to place the call. In this example, you are using

Awarenex on a Palm which is registered in your mobile locale, so the system selects your mobile phone from which to place the call. If you were using the desktop Awarenex client in your office, it would select your office phone.

Figure 8. Selecting to call a user brings up a dialog showing the source and destination phones for the call.

The pop-up menu next to each phone number offers all the phone numbers that Awarenex knows about (as well as an option to enter another phone number) to easily redirect the call if the default option is inappropriate. Once the phone numbers are confirmed by pressing the "Call" button, Awarenex calls your phone, then places the call to the recipient and updates the awareness information to show that both of you are in a call. Note that the IM interface also has a button to initiate a phone call to support the transition from IM to phone that was observed in the research on IM use in the workplace [11].

Selecting to send e-mail brings up a compose window for the user's default e-mail address. People are often known at a single e-mail address (either because they can access their e-mail from a variety of locations, or because they can forward their e-mail to wherever they need to read it). Thus, e-mail tends not to be tied to any locale. If the user has more than one e-mail address, a menu is available in the compose screen to change the address to other known addresses.

Speech Access from a Phone Client

Integrating telephony services within Awarenex suggested the opportunity of making the awareness information available to users calling in over the phone without any mobile device. For example, if you were to call a colleague, Tom, and he does not answer, you could identify herself as an Awarenex user and go through the following dialog:

Awarenex: Tom is not answering the phone. Would you like to leave voice-mail, page him, or check status?
Caller: Check his status.

Awarenex: Tom has an appointment at 1:30 pm to 6:00 pm Eastern Time, 'working at home'. His computer at home is active. What next?
Caller: Call his home
Awarenex: Calling Tom at home.

Awarenex would then transfer the call. Without a display, the speech interface does not provide all the awareness information about a user, but provides the most relevant information to suggest the best alternative for making contact with the person. Integrating awareness into the phone dialer also allows us to experiment with automatically routing phone calls to the user's most recently active locale.

Awarenex Implementation

Awarenex is a centralized system consisting of a set of device-dependent clients and two main server components: the Awarenex server and the telephone Dialer server (see Figure 9). Desktop and handheld clients connect to an Awarenex server which receives activity and communication information from clients and propagates those changes to appropriate clients. The Dialer server consists of a multi-line telephone switch and is responsible for placing calls between Awarenex users and providing a speech interface to the Awarenex service. When a user places a telephone call through Awarenex, the Awarenex server connects to the Dialer server which places the call and tracks the status of both parties (e.g., busy, answer, hang-up). The Dialer server also acts as a client of the Awarenex server, providing a speech interface to users who call into the Dialer server. Two additional server-side components are used to connect with the networks that service the wireless handhelds.
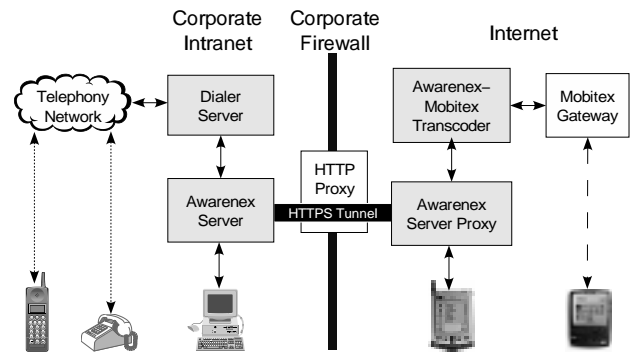

Figure 9. Awarenex server-side components (in gray) communicate with client devices via their associated networks.

All server components and the desktop client are written in the Java^{TM} programming language. The RIM and Palm clients are written in C++. The components communicate using an ASCII message protocol. The protocol and distribution architecture are designed to support scalability through the use of multiple Awarenex servers.

Although the RIM and Palm devices have similar processing and display capabilities, the platforms present different development environments, user interface libraries, as well as data storage and access libraries. Due to this platform variance, we spent considerable time re-creating common platform functions such as the string manipulation functions found in the standard C libraries. Also, different time

formats forced us to create an efficient, platform independent interchange format for time. Although the solutions to the interoperability problems are generally well known and straightforward, we were dismayed at how often they arose between these devices.

Evaluating Usability

In extending our desktop computer interface to mobile devices, we were concerned that we might fall into the trap of treating the mobile devices as simply compact versions of the desktop client. Industry experience with interface design for handhelds has highlighted that those interfaces must account for the more task-focused and urgent context of a mobile user (Bergman [2]). To get some feedback on our design concepts, we conducted a heuristic evaluation with user interface designers in our company that have more experience with designing for mobile devices. We followed this up with a "paper" usability study (using screenshot images on a computer) with experienced Palm users.

Both experiences suggested some design revisions and raised open issues that we want to investigate by observing the prototype with real use experience. We need to simplify the navigation among the Awarenex screens on the mobile client. Currently we have a button labeled "Contacts" that takes users back from the Contact Locator to the Contact List. None of the users could make sense of this button label, and we will instead use more of a Web navigation model with a "Back" operator to navigate back to the list. Several other button label issues also arose in these studies.

An open issue is whether our simple algorithm for suggesting the best locale for contacting people is reliable enough to allow us to streamline the interface. Some felt that if Awarenex knows the user's most recently active locale, presenting awareness information for the other locales unnecessarily clutters the Contact Locator interface.

On the other hand, our concern is that you may often need to exercise judgement based on all the awareness information for the user about how to best contact that person. For example, if a user is in transit between two scheduled appointments, but briefly stops by her office to glance at e-mail, there will be a span of time where the most recent awareness information would indicate that she is in her office. The bigger picture, including the scheduled appointments and mobile devices, would explain that she is probably still mobile. We will be looking forward to real use experience to help us better understand the right UI model.

Another open issue is the organization of the Contact Locator interface, currently grouped in terms of locales. Some devices transcend locales (e.g., using your mobile phone, even when you are in your office). Furthermore, you might be more interested to reach someone using a particular communication channel, regardless of what locale they are in. Thus, some wanted to see the Contact Locator organized by devices rather than locales. Our rationale for grouping devices in the context of locales is that the activity of the other devices in a locale helps determine the best way to contact someone. For example, you might have not used your office phone for over a day, but if your office computer is active, it is probably more promising to try calling your office phone than any of the other phones. This is another area we want to study in real use experience.

REFLECTING ON MAKING AWARENESS MOBILE

Together, ConNexus and Awarenex demonstrate:

- Providing interfaces on multiple platforms for interacting with a centralized resource of dynamically changing awareness information
- Coordinating actions among different devices operating on independent networks
- Integrating telephony with other communication resources and providing awareness of telephony activity
- Augmenting IM chats by offering approach and leave-taking awareness cues when starting and ending chats.

Extending beyond the desktop to include mobile users helped us to appreciate a larger context for which awareness information is useful. It also led us to the concept of locales as a useful way of grouping communication devices, tracking awareness, and suggesting the best way to contact someone.

Integrating the different platforms of computer desktop, wireless handheld, and speech also presented several design challenges. Each device has different interface affordances. The Palm interface is driven by a stylus on a touch screen with graffiti text input. The RIM uses a thumbwheel to make menu selections and a dedicated "Back" button with a miniature keyboard for text input. The menu driven interface on the RIM reveals more about the user operations and options that can be taken on that selection, but typically requires two clicks (one to bring up the menu, and one to select a menu item). On the other hand, interface widgets on the Palm must make evident what will happen when you touch them, which takes some crafting of the interface but requires fewer input actions from the user.

As mentioned earlier, an important difference among the platforms is the user context for each device. The somewhat continuous use of the desktop client often means that you need to alert users to changes of state. The intermittent use of handheld devices makes the user more task-focused and hurried. The temporal nature of speech interfaces makes it more important to streamline the information that is presented over the audio channel.

One interesting aspect of this project is that it is likely that one user will encounter the Awarenex interface on multiple platforms, as she moves from office desktop to handheld device to speech interface. This is slightly different from traditional cross-platform design, where interfaces are created across several different platforms, but users typically stay within a platform (e.g., Macintosh or PC). Since users are likely to experience the interface on multiple platforms, we had to maintain a certain consistency in the interface across all platforms, while also respecting the different use contexts of each platform.

Providing these awareness services across a range of platforms points out the need for better interaction among devices. Much of the current design involves bridging among the various service providers and networks (telephony, cell phone, pager, intranet, wireless network). Having the support for these devices fractured across several

different networks and service providers forced us to create gateways, interfaces, and workarounds to get the information flow and interactions among the devices that we wanted. We expect that technologies such as Bluetooth and Jini^{TM} that promise to enable seamless interaction among devices should make it easier to implement the kind of functionality that we have designed in Awarenex. For example, having a handheld device communicate directly with a cell phone would probably reduce the latency of placing a call that we experience in Awarenex.

FUTURE WORK

At this point we have working prototypes of the Palm and RIM clients as well as the speech interface. We need to complete the design revisions mentioned from our usability study and update the workstation client to conform to the new Awarenex design. The next step is to deploy the system to gain some experience using it. By implementing the Awarenex server from scratch, we were able to address the reliability problems we experienced with ConNexus that should enable an extended deployment that can give us valuable use experience.

Only a longitudinal use study will give us insight into the many research questions that such prototypes raise. Do people feel closer and more coordinated through these awareness features? Are people willing to make the trade-off of broadcasting their activities for the awareness benefits gained? How do people feel about the distractiveness of the system? We hope to address these questions by studying Awarenex in use.

We are especially interested in experiencing the use of the different platform clients and seeing how they interact with each other. For example, one thing we would like to do when having an IM between a computer desktop client and a handheld client is to resize the IM window on the desktop client to reflect how the handheld user is viewing the IM chat, so that they have a shared user experience. We would also like to explore what kind of application sharing might be useful between a desktop and handheld client.

Awarenex strives to give meaningful awareness information to anyone, anywhere, to facilitate making contact among each other. We hope to gain more experience with our working prototypes to refine our design concepts and further our understanding of how we can include mobile users in collaboration systems.

ACKNOWLEDGEMENTS

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